India Studies in Business and Economics

Ashok Gulati
Ranjana Roy
Shweta Saini *Editors*

Revitalizing Indian Agriculture and Boosting Farmer Incomes

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Foreword

A large section of the Indian population suffers from poverty and malnourishment, and the agricultural sector has received a lot of attentions in this regard. The sector provides livelihood to 47% of the country's workforce (Labour Bureau, GOI (2015–2016)); hence, their economic status is directly affected by the performance of the sector. Indian agriculture is also dominated by small and marginal farmers with about 86% landholding being less than 2 hectares. Income from such small farms is not enough to maintain a healthy life. Moreover, India is home to 1.3 billion people and will soon cross China's population (United Nations Population Projection, 2017 revision). Producing food for such a huge population is a pressing issue for the Indian government given the shrinking average landholding size. Thus, increasing food demands have to be met by implementing interventions to augment farmers' income in an efficient, inclusive, scalable and sustainable manner.

It has been found in many studies worldwide that one per cent growth in agriculture is at least two to three times more powerful in reducing poverty than the same growth in non-agricultural sectors (World Development Report, 2008). A strong agriculture–poverty–nutrition linkage is expected in a developing country like India with serious malnourishment among rural population that depends largely on agriculture for sustenance. It has also been observed that agricultural growth rates in India fluctuate more than the overall GDP growth rates because almost 52% of the country's gross cropped area still relies on the monsoon. Growth rate in farmers' income has remained unsatisfactory.

It is against this backdrop that this book deals with the magnitude, sources and drivers of agriculture growth in the country and selected states using qualitative and quantitative methods. The target states include Bihar, Odisha and Uttar Pradesh, which have a large section of the poor and the malnourished, and Gujarat, Madhya Pradesh and Punjab that are seen as models in terms of agricultural performance. The study establishes a link between agricultural growth, poverty and malnutrition. It also draws lessons from well-performing states that can be used to revamp the agricultural growth of moderate performing states and reduce poverty. Based on econometric analyses and a review of existing policies, the book recommends a set of policies that can help the states in achieving higher agricultural growth and higher incomes for their farmers.

New Delhi, India

Rajat Kathuria
Director and Chief Executive
ICRIER

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Editors

Disclaimer

The presentation of material and details in maps used in this book does not imply the expression of any opinion whatsoever on the part of the Publisher or Author concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its borders. The depiction and use of boundaries, geographic names and related data shown on maps and included in lists, tables, documents, and databases in this book are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the Publisher, Editor(s) or Author(s).

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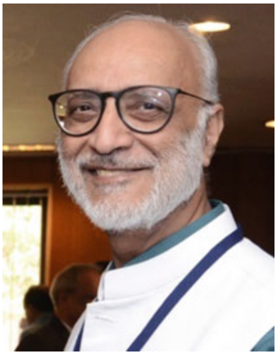

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Abbreviations

A2+FL	Actual Cost + Family Labour
AE	Actual Estimate
AGDP	Agricultural Gross Domestic Product
AGSDP	Agricultural Gross State Domestic Product
AI	Artificial Insemination
AIBP	Accelerated Irrigation Benefit Programme
AMIF	Agricultural Market Infrastructure Fund
APAPLM	Arunachal Pradesh Agriculture Produce and Livestock Marketing Act
APEDA	Agricultural and Processed Food Products Export Development Authority
APL	Above Poverty Line
APLM	Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act
APMC	Agriculture Produce Market Committee
APMR	Agricultural Produce Market Regulation
APS	Average Performing State
ASP	Average Sale Price
AT&C	Aggregate Technical & Commercial
ATIF	Agri-Tech Infrastructure Fund
ATMA	Agricultural Technology Management Agency
BAHFS	Basic Animal Husbandry and Fisheries Statistics
BAU	Business as Usual
BCG	Bacillus Calmette–Guérin
BCM	Billion Cubic Metre
BE	Budget Estimate
BJP	Bharatiya Janata Party
BMGF	Bill and Melinda Gates Foundation
BMI	Body Mass Index
BRBN	Bihar Rajya Beej Nigam

BRGF	Backward Region Grant Fund
CACP	Commission of Agricultural Costs and Prices
CADWM	Command Area Development and Water Management
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority of India
CFFG	Contract Farming Facilitation Group
CGWB	Central Ground Water Board
CHC	Custom Hiring Centre
CIP	Central Issue Price
COMFED	Bihar State Milk Co-operative Federation Ltd
CPI-AL/RL	Consumer Price Index for Agricultural Labourers and Rural Labourers
CSO	Central Statistics Office
CV	Coefficient of Variation
CWC	Central Water Commission
DBT	Direct Benefit Transfer
DCR	Dalwai Committee Report
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DES	Directorate of Economics and Statistics
DFI	Doubling Farmers' Income
DILRMP	Digital India Land Records Modernisation Programme
DIT	Direct Income Transfer
DoAC&FW	Department of Agriculture, Co-operation & Farmers Welfare
DoWR	Department of Water Resources, Odisha
DPT	Diphtheria, Pertussis and Tetanus
DRRP	District Rural Road Plan
e-NAM	National Agriculture Market
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Corporate Statistical Database
FAQ	Fair Average Quality
FCI	Food Corporation of India
FHP	Farm Harvest Price
FL	Family Labour
FPO	Farmers Producers Organisation
FRP	Fair Remunerative Price
FSSAI	Food Safety and Standards Authority of India
FY	Financial Year
GCA	Gross Cropped Area
GCF	Gross Capital Formation
GCMMF	Gujarat Cooperative Milk Marketing Federation
GDP	Gross Domestic Product
GEDCOL	Green Energy Development Corporation of Odisha Ltd
GGRC	Gujarat Green Revolution Company
GHI	Global Hunger Index

GIA	Gross Irrigated Area
GIS	Geographic Information System
GOB	Government of Bihar
GOI	Government of India
GrAM	Gramin Agricultural Markets
GSDP	Gross State Domestic Product
GSDPA	Gross State Domestic Product from Agriculture
GST	Goods and Services Tax
GVA	Gross Value Added
GVO	Gross Value of Output
GVOA/GVOAL	Gross Value of Output from Agriculture & Allied Activities
HCR	Head Count Ratio
HH	Household
HPS	Handpicked Select
HRD	Human Resource Development
HVY	High-Yielding Variety
IC	Insurance Company
ICAR	Indian Council of Agricultural Research
ICRIER	Indian Council for Research on International Economic Relations
I-FMS	Integrated Fertiliser Management System
IHDS	India Human Development Survey
IMD	India Meteorological Department
IMR	Infant Mortality Rate
INR	Indian Rupees
IPC	Irrigation Potential Created
IPU	Irrigation Potential Utilised
IR	Irrigation Ratio
ISMA	Indian Sugar Mills Association
IWMP	Integrated Watershed Management Programme
KALIA	Krushak Assistance for Livelihood and Income Augmentation
KCC	Kisan Credit Card
KLPD	Kilo Litre Per Day
KVK	Krishi Vigyan Kendra
KWh	kilowatt hour
LMT	Lakh Metric Tonne
LPA	Long Period Average
LTIF	Long-Term Irrigation Fund
LUS	Land Use Statistics
MD	Managing Director
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIS	Micro Irrigation System
MMT	Million Metric Tonnes
MNAIS	Modified National Agricultural Insurance Scheme
MOA	Ministry of Agriculture

MoA&FW	Ministry of Agriculture and Farmers' Welfare
MoFPI	Ministry of Food Processing Industries
MoSPI	Ministry of Statistics and Programme Implementation
MP	Madhya Pradesh
MPSCSC	Madhya Pradesh State Civil Supplies Corporation Ltd
MPWLC	Madhya Pradesh Warehousing and Logistics Corporation
MSP	Minimum Support Price
MT	Metric Tonne
MW	Megawatt
MWP	Mid-western Plains
MWSP	Mid-western South Plains
NABARD	National Bank for Agricultural and Rural Development
NABCONS	NABARD Consultancy Services
NAFED	National Agricultural Co-operative Marketing Federation of India
NAFIS	NABARD All India Rural Financial Inclusion Survey
NAM	National Agricultural Market
NAS	National Accounts Statistics
NCCD	National Centre for Cold-chain Development
NDA	National Democratic Alliance
NDDB	National Dairy Development Board
NEP	North Eastern Plains
NFHS	National Family Health Survey
NFSA	National Food Security Act
NFSM	National Food Security Mission
NGO	Non-Government Organisation
NHB	National Horticulture Board
NHM	National Horticulture Mission
NI	Non-institutional
NIDM	National Institute of Disaster Management
NMAET	National Mission on Agriculture Extension and Technology
NPK	Nitrogen–Phosphorus–Potassium
NRDWP	National Rural Drinking Water Programme
NSA	Net Sown Area
NSS	National Sample Survey
NSSO	National Sample Survey Organisation
OECD	Organisation for Economic Co-operation and Development
OG	Operation Green
OMC	Oil Marketing Companies
OMFED	Odisha State Cooperative Milk Producers' Federation Limited
OREDA	Odisha Renewable Energy Development Agency
OSEB	Orissa State Electricity Board
PCDF	Pradeshik Cooperative Dairy Federation
PCGSDP	Per Capita Gross State Domestic Product

PCGSDPA	Per Capita Gross State Domestic Product In Agriculture And Allied Activities
PDPS	Price Deficiency Payment Scheme
PDS	Public Distribution System
PFA	Power for All
PFMS	Public Financial Management System
PIB	Press Information Bureau
PIL	Public Interest Litigation
PKVY	Paramparagat Krishi Vikas Yojana
PM	Prime Minister/Pradhan Mantri
PM-AASHA	Pradhan Mantri Annadata Aay Sanrakshan Abhiyan
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMJDY	Pradhan Mantri Jan Dhan Yojana
PM-KISAN	Pradhan Mantri Kisan Samman Nidhi
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
POS	Point of Sale
PPP	Public–Private Partnerships
PPSS	Private Procurement Stockist Scheme
PRAM	Primary Rural Agricultural Market
PSS	Price Support Scheme
PSU	Public Sector Unit
R&D	Research and Development
RBI	Reserve Bank of India
RD	Road Density
RE	Revised Estimate
RIDF	Rural Infrastructure Development Fund
RKVY	Rashtriya Krishi Vikas Yojana
RSOC	Rapid Survey on Children
RTGS	Real-Time Gross Settlement
SAMPADA	Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters
SAP	State Advisory Price
SAS	Situation Assessment Survey
SBA	Strategic Basin Assessment
SC	Supreme Court
SECC	Socio Economic and Caste Census
SFAC	Small Farmers' Agri-Business Consortium
SHG	Self-help Group
SMF	Small and Marginal Farmers
SMS	Short Message Service
SPS	Sanitary and Phytosanitary
SRD	Surface Road Density
SRR	Seed Replacement Ratio
STD	Subscriber Trunk Dialling

SWSDP	South-western Semi-Dry Plain
TE	Triennium Ending
TMT	Thousand Metric Tonnes
TOP	Tomato–Onion–Potato
TOT	Terms of Trade
TY	Threshold Yield
UIP	Ultimate Irrigation Potential
UN	United Nations
UNDP	United Nations Development Programme
UP	Uttar Pradesh
UPA	United Progressive Alliance
UPPCB	Uttar Pradesh Pollution Control Board
USA	United States of America
USD	United States Dollar
VDC	Village Dairy Co-operative
VGF	Viability Gap Funding
VOAA	Value of Output from Agriculture and Allied Activities
W&S	Wages and Salaries
WDI	World Development Indicators
WDR	World Development Report
WH	Wholesale
WHO	World Health Organization
WP	Western Plains
WPI	Wholesale Price Index

Part I
About the Book

Chapter 1
Introduction

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Ashok Gulati and Shweta Saini

1.1 Introduction

Although agriculture accounts for about 17.8 percent of country's Gross Value Added (GVA) (2019–20 current prices), it remains central to the Indian economy as it still engages about 44% of the work force (it was 47% in 2015–16 as per Labour Bureau, GOI). India is also going to be the most populous country in the world by 2027, according to population projections by the UN, and ensuring food security for this large mass of humanity is a daunting task, more so when it also has the largest number of poor and malnourished in the world (as per World Bank's Development indicators). An average Indian household spends about 45% of its expenditure on food (this ratio stands at 60% for the poor in bottom expenditure group) (NSSO 2011). No wonder agriculture remains critical for India as it has implications not only for farmers in terms of their income, but also for consumers, especially with respect to ensuring food security of the poor and the malnourished.

Between 2000–01 and 2018–19, overall GDP in the country increased by 7.2% per annum and agricultural GDP grew only by 3.2% per annum, way below the target rate of 4% per annum. This underlines the urgent need to accelerate growth in the agricultural sector. Most experts agree on this proposition, but the question really is "*how*" to do it. More comprehensively, the question is how the agricultural growth process can be speeded up and made more inclusive, and financially viable. Are there any best practices that can be studied and replicated to bring about faster growth in agriculture? The prior hypothesis is that rapid agricultural growth can alleviate poverty faster, reduce malnutrition and augment farmers' incomes.

To find answers to some of these questions, normally the approach that many studies take is to turn outward and look for global best practices and evaluate them

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to assess the possibility of replicating these domestically. This book uniquely looks inward in the sense that it looks at best practices and experiences within Indian states.

India has been a federation of 29 states and 7 union territories[1] (until 30 October 2019, and as treated in this study) and not all of them are equally agrarian. They vary in terms of their natural resource endowments, share of agriculture in overall state employment, contribution of agriculture to overall state gross domestic product (GDP) and, *inter alia*, in terms of the historical growth rate witnessed in their agriculture sector. This brings us to the starting point of the research based on which this book is written: how can some Indian states grow faster than others? How have some states continued to lag behind while others have grown sharply? Are there lessons that Indian states can learn from each other? By looking within the country to find best practices and solutions to agrarian problems in fellow states, this book offers a unique perspective.

1.2 Rationale of the study

Agriculture in the current Indian context has multiple roles. The four most important roles, *inter alia*, are:

a. Feeding the large and growing Indian population, particularly with the uncertain impact of climate change looming large on the sustainability of the agricultural sector
b. Alleviating the stubborn problems of malnutrition and poverty amongst people most of whom live in rural areas and are dependent on agriculture for their livelihoods
c. Supplying agricultural products that act as inputs for other industries
d. Initiating a multiplier effect in the economy, where a financially empowered farming community will trigger demand-led growth, particularly for manufactured products and services.

Given the centrality of the sector and the importance of the sector's growth in terms of food security and poverty alleviation, this book proposes an evidence-based roadmap for revitalising Indian agriculture while ensuring that the growth process is efficient, inclusive and sustainable, and results in sustained growth of farmers' incomes.

The book does this by undertaking analysis under the following four broad heads.

a. *Linkage between agricultural performance, poverty and malnutrition*: Intuitively, there is expectation of a high and negative correlation between agricultural performance and the twin problems of poverty and malnutrition. What this means is that when the agricultural sector grows, it helps to alleviate poverty and malnutrition. This hypothesis is tested in this book for all major Indian states.

[1] On October 31, 2019, the state of Jammu and Kashmir was bifurcated into the union territories of Jammu and Kashmir and Ladakh, making 9 UTs and 28 states in India.

b. *Analysing the historical growth performance of agricultural sector in selected Indian states*: Upon establishing the need for higher agricultural growth to alleviate poverty and malnutrition, this section explores agricultural performance in six selected states. Three of these states, Punjab, Gujarat and Madhya Pradesh, have performed much better than others—Punjab during the green revolution period and the other two states over the last 10–15 years. The other three states, Uttar Pradesh, Bihar and Odisha, have been somewhat mediocre (average/below average) performers in agriculture. In this study, we analyse the sources of agricultural growth and its drivers to find out the best practices that led to a higher growth rate in the studied states.
c. *Will higher agricultural GDP necessarily result in higher incomes for farmers*: Historical experience states that (i) not all states that witnessed high agricultural GDP growth rates delivered higher farmer income growth rates and (ii) there were states that delivered high farmer income growth rates despite experiencing lower agricultural GDP growth rates. Both cases mandated further research as is done under this head. This analysis has been done across all major Indian states.
d. *Analysing the current agricultural policy environment to (i) evaluate its efficiency and efficacy and (ii) consolidate all analysis to create a roadmap* : Unless the current policy environment is aligned to the requirements of the sector and is able to deliver on set objectives, the agricultural sector can never realise its full potential. In this section, major government programmes and policies have been evaluated, based on various performance parameters.

All analysis is then processed, collated and presented as a roadmap for revitalising Indian agriculture. The roadmap builds on (a) the results of research and analysis presented in this book and (b) on broader macro-issues that, even though not discussed in much depth in the book, are necessary for agricultural growth.

1.3 Identification of Six Indian States

Using historical data on the relative agricultural growth rates in different states, two sets of states were selected—those that had performed exceptionally well and those that had a relatively lacklustre performance. The aim was to identify and distil learnings and best practices in the better performing states and see if they can be replicated in states whose performance was relatively poor.

Based on average historical growth rates (Fig. 1.1), the two set of states were identified as follows:

1. High performing states: Madhya Pradesh, Gujarat and Punjab
2. Low or average performing states: Uttar Pradesh, Bihar and Odisha.

Both Gujarat and Madhya Pradesh have experienced very high rates of agricultural growth, particularly during the last 10–15 years. Despite low current growth rates in Punjab, the state was selected for its exceptional historical performance during the

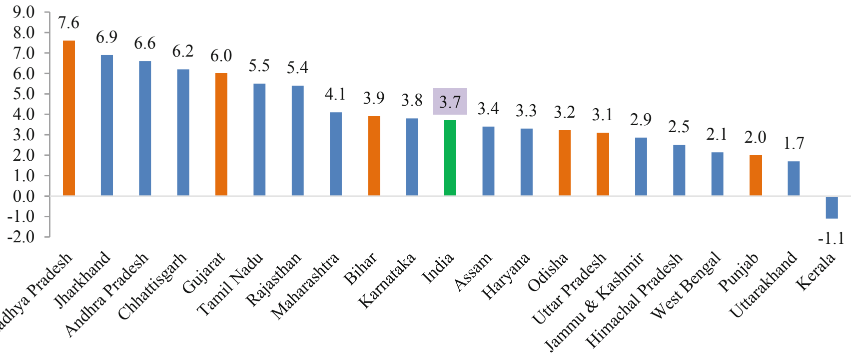

Fig. 1.1 Agricultural GDP growth rates (%) for major Indian states, 2005–06 to 2017–18. *Source* Based on data from MOSPI. Data accessed on 29 February 2019. States highlighted in amber colour are the selected states

post-Green Revolution period since the mid-1960s. Today, the state has a low growth rate but that can be explained by the high base that it has developed over the years.

The study also focuses on—Uttar Pradesh, Bihar and Odisha—because of the importance of agriculture in these states and prevalence of high levels of poverty and malnutrition.

The six selected states are presented on the Indian graph in Fig. 1.2. These six states together account for 41.9% of India's population (Census 2011), 38.6% of India's

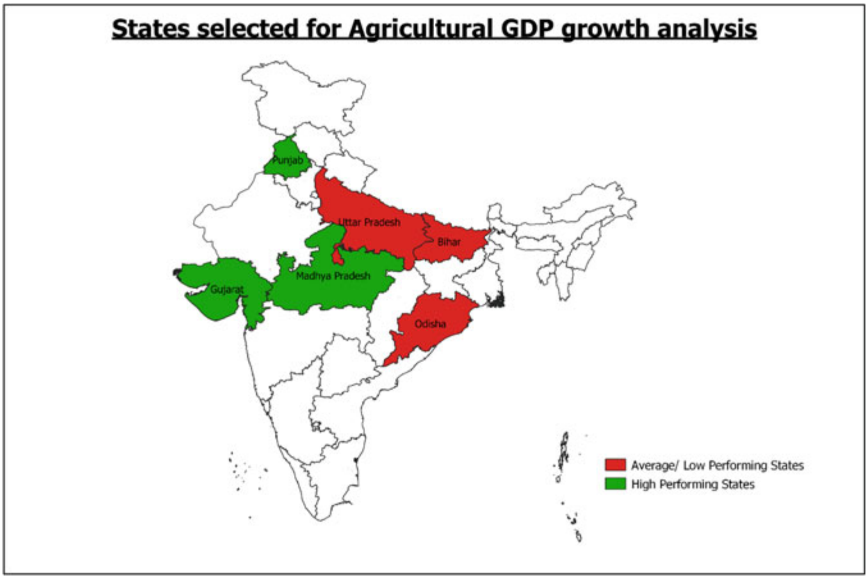

Fig. 1.2 States selected for agricultural GDP growth analysis

gross value added in agriculture (TE 2016–17, Source NAS, MOSPI), 43.05% of India's agricultural workforce (Census 2011) and 53.9% of India's poverty (Planning Commission 2011).

Interestingly, lessons for best practices emerged both ways. In line with our earlier expectations, analysis of the high performing states of Punjab, MP and Gujarat helped us in identifying agricultural best practices. But in addition, the analysis of the three laggard states—UP, Bihar and Odisha—also revealed certain exceptional policies followed by them which had potential for replication in other Indian states.

1.4 Organisation of the Book

The book is organised into 12 chapters, each provides a building block for the concluding chapter that presents a roadmap for revitalising Indian agriculture while ensuring growth in farmers' incomes.

After this introductory chapter, Chap. 2 presents a synthesis of the book.

Chapter 3 explores the linkages between agriculture, poverty and malnutrition at the state level. To test this linkage, a major econometric analysis was done by pooling cross section and time series data across major Indian states.

Next up, the qualitative and quantitative analysis of the agriculture and allied activities sector in each of the six identified states is presented as distinct state chapters in Chaps. 4–9. These chapters relate to the *Performance of Agriculture in Punjab (Chap. 4); Gujarat (Chap. 5); Madhya Pradesh (Chap. 6); Uttar Pradesh (Chap. 7); Bihar (Chap. 8) and Odisha (Chap. 9).*

The analysis at the state level involved (a) identifying the sources of growth within agriculture by sub-groups of commodities such as grains, oilseeds, cotton and sugarcane, fruits and vegetables, livestock, fisheries and by sub-regions; (b) finding the determinants of agricultural growth in each of the states, especially the role of policy, infrastructure, land and water resources, agricultural R&D, institutional changes in agricultural marketing, etc; and (c) to the extent possible, looking at the budgets of selected states with a view to estimate the investment(s) needed, especially in the three states of Uttar Pradesh, Bihar and Odisha, in case they chose to implement some of the best practices as delineated in their respective cases.

A state-wise analysis of farmers' incomes has been undertaken in Chap. 10. It was observed during the research that states that had higher agricultural GDP growth rates did not necessarily deliver faster growth rates in farmers' incomes. In Gujarat and MP (to some extent), despite higher AGDP growth, farmers' incomes failed to rise as fast. Contrarily, farmers' incomes have risen sharply in Odisha, Punjab, UP and Bihar despite a not-so-impressive AGDP performance.

A comparative state-wise analysis of the sources of farmers' incomes and their trends over time was done to identify major challenges that limited growth.

In Chap. 11, the focus is on policies, programmes and schemes as implemented recently by the central government to support Indian agriculture. Major schemes are outlined, analysed for their efficiency and efficacy, and gaps in design and implementation are identified.

The book ends with Chap. 12, which presents a way forward not only to spur Indian agriculture but also to help augment farmers' incomes. The recommendations in this chapter emanate primarily from the analysis presented in preceding chapters but the chapter also contains other recommendations on macro-issues that are likely to help improve the overall eco-system in which agriculture and Indian farmers operate.

References

Census. (2011). *Census of India*. Retrieved May 2019, from Registrar General of India, Ministry of Home Affairs, Government of India.

Labour Bureau. (2016). *Report on fifth annual employment-unemployment survey 2015–16 Volume I*. Ministry of Labour and Employment, Government of India. Chandigarh: Labour Bureau.

NAS MoSPI. (Various Issues). *National account statistics*. New Delhi: Ministry of Statistics and Program Implementation, Government of India.

NSSO. (2014). *Household consumption of various goods and services in India 2011–12: NSS 68th round*. New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Chapter 2
Synthesis Chapter

Ashok Gulati, Shweta Saini, and Ranjana Roy

2.1 Introduction

As stated in Chap. 1, the study presented in this book has four pillars and each pillar builds up sequentially and progressively. It starts by evaluating the relation between per capita agricultural GDP and the twin problems of poverty and malnutrition. After establishing a strong negative relation between the development of agriculture and the twin problems, the book progresses to identify ways to ensure inclusive, efficient and sustainable agricultural growth. It does this through a detailed analysis of state wise agricultural performance to identify best practices for replication in other states. The book then builds on the fact that agricultural GDP growth is not the sole factor driving farmers' incomes; hence, there is a need to look at state wise trends in farmers' income and their composition. In its last section, the book presents an evaluation of the major programmes and schemes run by the government to support farmers. Based on the collective findings of these analyses, a new roadmap for agricultural reform has been outlined in the last section.

The biggest lessons from the analysis presented in this book are:

a. Agricultural growth can alleviate problems of poverty and malnutrition: India's agricultural sector needs to grow consistently at a growth rate of more than 4% per annum at the all India level. It needs to grow at an even higher rate in states with low existing levels of per capita agricultural GDP and that this growth is likely to help reduce the incidence of poverty and malnutrition;

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b. Three factors have historically played pivotal roles in explaining agricultural sector performance in the six studied Indian states: these are access to infrastructure (mainly irrigation and roads), diversification to high value agricultural products like fruits and vegetables, and allied activities like dairy and poultry among others, and price incentives or favourable terms of trade that reflect rising prices for agricultural commodities relative to prices in other industries. The role of inputs like fertilisers also emerged as a contributor to agricultural growth.
c. Even though at the all-India level, the growth rate in farmers' real incomes closely mirrored growth rates in agricultural GDP (for data between 2002–03 and 2015–16), there were variations in the two growth rates at the state-level. For example, in Odisha, farmers' real incomes increased much faster than the rise in the state's agricultural GDP; in Gujarat, despite higher agricultural GDP growth, farmers' incomes grew at a much slower rate. This shows a gap between agricultural GDP growth and growth in farmers' real incomes. With small, and still shrinking, average landholding sizes in India, this gap is expected to widen in the future as farmers will have to diversify their sources of income, reducing their dependence on agriculture to sustain livelihoods.
d. There is a re-think required in the way the Indian government provides support to farmers. Despite a plethora of programmes and schemes launched to alleviate farmer distress, the Indian farmer continues to suffer as many of the flagship programmes fail to deliver on their promises and set objectives. Sometimes, the problem is with the programme design, sometimes its intent; and then there are implementation gaps. All this makes a case for a fresh analysis of the farmer support environment in the country.

We expand these learning and the analysis behind it, *albeit* briefly, below. The details can be found in the respective chapters in the book.

2.2 Inter-linkages Between Agricultural Performance, Poverty and Malnutrition in India

The hypothesis is that with better agricultural performance, which should be reflected in higher per capita GDP from agriculture, both poverty and malnutrition can be alleviated especially among people living in rural areas, a majority of whom rely on agriculture-related activities for their livelihoods. International experience validates this hypothesis. This chapter evaluates and validates this hypothesis for major Indian states.

Methodology Used

In two separate analyses the linkages between (i) poverty and agricultural performance and (ii) between malnutrition (child and adult malnutrition) and agricultural performance have been studied and presented in Chap. 3.

In both cases, agricultural performance has been studied via a proxy variable. The proxy for agricultural performance in case of (i) is per capita gross state domestic product (GSDP) from agriculture and in case of (ii) it is the gross value of output (GVO) per hectare.

As agricultural performance is only one of the many factors that help alleviate poverty and malnutrition, the analysis involves two steps:

1. Identifying other variables that can affect poverty and malnutrition and understanding their linkage using a correlation matrix; and
2. Estimating the relationship among various explanatory variables including the variable that represents agricultural performance by running separate regression models

Ideally, a panel data analysis with a long time series and cross-section data at the household level should be used to test the impact that different variables have on the twin problems, but as data on both poverty and malnutrition are not collected and published regularly and is available only for particular time intervals, panel data fixed effect and random effect models had to be used. The data is pooled for 21 states across two time periods, i.e. 2005–06 and 2015–16 for the analysis on malnutrition and 2004–05 and 2011–12 for the analysis on poverty.

Results

Relation Between Agricultural Performance and Poverty (Rural)

In the statistical analysis of 21 states, a fairly strong negative correlation emerges between poverty (measured as the head count ratio or HCR) and per capita agricultural GDP (−0.6), non-farm employment (−0.68), surface road density (−0.5) and literacy (−0.58) (Table 2.1), indicating that poverty (HCR) declines with rising per capita agricultural GDP, non-farm employment, surface road density and literacy. Due to the problem of multi-collinearity between some explanatory variables, the regression results were skewed. The final results confirmed that historically, a 1% increase in per capita agricultural GDP reduced poverty by 0.73%. The impact of non-farm employment and literacy is even higher, both of which help the work force engaged in agriculture to move out to higher productivity jobs in the non-farm sector. The details can be found in Chap. 3's Table 3.2.

Table 2.1 Correlation between poverty and factors studied for their impact on rural poverty

	Poverty HCR	PCGSDPA	Non-farm Employment	Surfaced road density	Literacy
Poverty HCR	1	−0.60***	−0.68***	−0.50***	−0.58***

Note Poverty
HCR poverty head count ratio; *PCGSDPA* per capita gross state domestic product from agriculture and allied activities; non-farm employment: per cent of workers employed in non-farm activities; surfaced road density: surfaced road length as a percentage of geographical area and literacy- total literacy rates in the state;
*** significant at 1% **

Relation Between Agricultural Performance and Malnutrition

Although interlinked, malnutrition in adults differs from malnutrition in children at least when the intent is to identify ways to alleviate them. This is why the study in this section involved two separate analyses presenting the impact of agricultural performance on both child and adult malnutrition.

The econometric analysis is based on panel data on malnutrition and factors affecting malnutrition collected for two points in time—2005–06 and 2015–16—across 21 major states.

An analysis of correlation estimates for 21 states reveals that malnutrition has been strongly and negatively correlated with the performance of the agricultural sector. Interestingly, the negative relation is much stronger in the case of adult malnutrition than with malnutrition in children (Tables 2.2 and 2.3).

Other important factors significantly influencing malnutrition are literacy, toilet facilities at home, access to health care facilities (vaccination, delivery by health personnel) and child feeding practices (breastfed within an hour of birth).

To understand the relation between variables better, an analysis using the random effects model with BMI as the dependent variable and factors mentioned above as the independent variables was done.

Factors that have a significant influence on adult malnutrition are agricultural performance, literacy and delivery assisted by health personnel (Fig. 2.1a). In other models, sanitation and access to improved water also emerged as important variables.

Table 2.2 Correlation matrix of adult malnutrition and factors affecting adult malnutrition

	BMI	GVOAL/ha	Flit	Mlit	HH_Toilet	Delivery_HP
BMI	1	−0.76***	−0.72***	−0.73***	−0.65***	−0.81***

BMI average proportion of men and women with BMI below average, GVOAL/ha: gross value of output per hectare of GCA; *Flit* female literacy rate; *Mlit* male literacy rate, *HH_toilet* proportion of households with toilets within their houses; *Delivery_HP*: proportion of deliveries of new borns assisted by health personnel
**significant at 5%, ***significant at 1%

Table 2.3 Correlation matrix of child malnutrition and factors impacting child malnutrition

	IMR	Stunted	Wasted	Underweight
IMR	1			
Stunted	0.86***	1		
Wasted	0.21***	0.30	1	
Underweight	0.74	0.87***	0.68***	1
GVOAL/ha	−0.58***	−0.61***	−0.13	−0.56***
Flit	−0.87***	−0.83***	−0.32**	−0.77***
HH_toilet	−0.72***	−0.70***	−0.49***	−0.76***
Bfed_1 hr	−0.67***	−0.67***	−0.11	−0.55***
Delivery_HP	−0.83***	−0.80***	−0.17	−0.68***
Vac	−0.80***	−0.79***	−0.22	−0.67***

Note IMR: infant mortality rate per 1000 live births, stunted: percentage of stunted children in the age group 0–59 months, underweight: percentage of underweight children in the age group 0–59 months; Bfed_1hr—percentage of children born in the last five years who were breastfed in the first hour of birth, vac: percentage of children who received all basic vaccination
**significant at 5%, ***significant at 1%

Similarly, the association between agricultural performance and child malnutrition is estimated using the fixed effects model with IMR as the dependent variable and the random effects model with stunted and underweight as dependent variables (depending on the results of Hausman test).

Agricultural performance holds a strong negative relation with child malnutrition (Fig. 2.1b–d). Access to improved sanitation facilities (toilet facilities and drinking water) has a strong impact on long-term child malnutrition indicators (stunted and underweight children). Other important factors influencing child malnutrition are vaccination (percentage of children in the age group 12–23 months receiving all basic vaccinations: BCG, measles, 3 doses each of DPT and polio vaccines), delivery assisted by health personnel and breastfeeding practices.

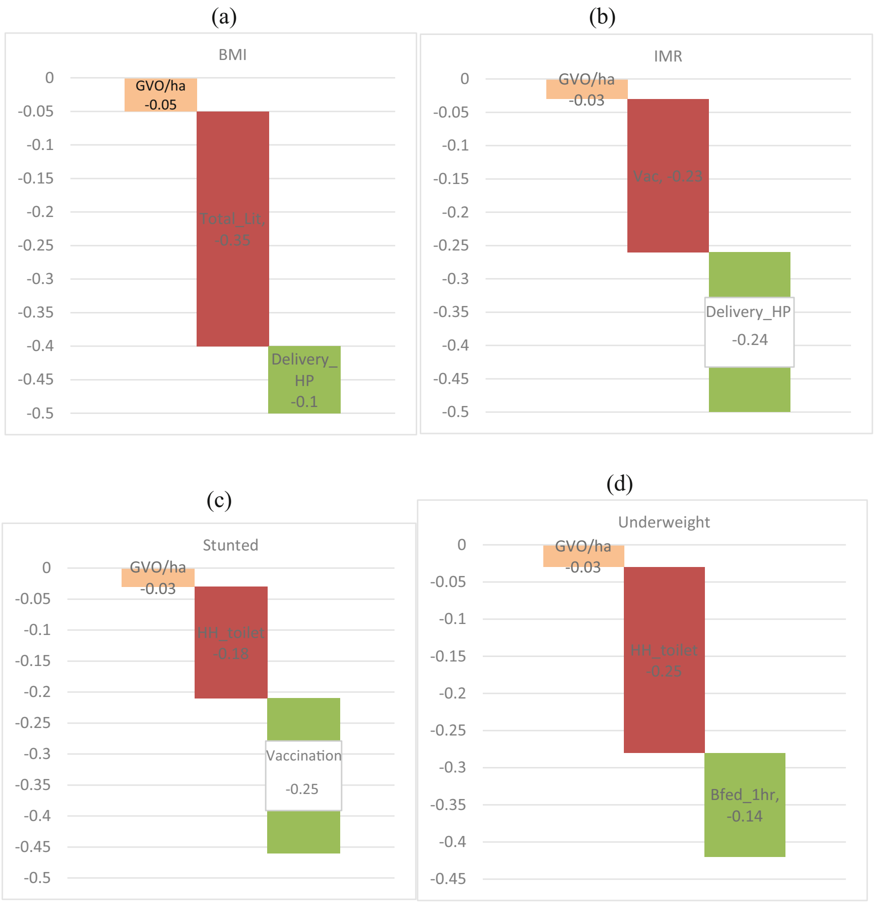


Fig. 2.1 Regression results for linkage between malnutrition and performance of agricultural GDP(GVO/ha). *Source* Based on authors' calculations

Conclusion

To sum up, agricultural performance plays an important role in reducing malnutrition and poverty in India. However, there is a likely lag in this process as it takes time for agricultural growth to manifest in terms of increased agricultural GDP on a per capita basis or per hectare basis and hence, to have an impact on malnourishment and child mortality.

2.3 AGDP Analysis of Six States

The summary presented in this section corresponds to the state Chaps. 4–9. These six chapters contain an exhaustive and thorough analysis of agriculture in six important agrarian states. These six states were identified based on the historical performance of their agricultural sector and are:

1. Punjab, Madhya Pradesh and Gujarat, categorised as high-performance states (HPS), and
2. Odisha, Bihar and Uttar Pradesh categorised as average-performance or laggard states (APS).

The initial objective of the study was two-fold: first, to undertake an analysis of each of the HPS to identify and evaluate their sources and drivers of growth, and second, evaluate the possibility of their replication in each of the APS. However, during the research, it was found that the APS states were not as average-performing or laggard as perceived earlier; in fact, they were found to be frontrunners in certain initiatives and replication of these initiatives could benefit other Indian states including the HPS states. Therefore, from the initially designed one-way learning process, the study evolved into a two-way learning process between the two sets of states.

Each state chapter includes, *inter alia,* the following:

1. A profile of the state's agricultural sector with an outline of its historical performance. This involves, *inter alia*, a study of trends and volatility witnessed in the state's agricultural GDP, the composition of and trends in the state's value of output from agriculture and allied activities, state of its infrastructure and availability and usage patterns of various agricultural inputs.
2. The growth experience of state agriculture has been studied, with focus on identifying
   a. the sources of its historical growth[1] and
   b. the drivers of this growth (estimated using a regression analysis as explained later in the section).

[1]That is done through the following process:

a. The shares (S) of each segment (i = cereals, pulses, oilseeds, fruits, vegetables, etc.) in gross value of output of agriculture and allied (GVOA) are computed using the formula: $s_i = \frac{\mathrm{VO}_i}{\mathrm{GVOA}} \times 100$

3. Based on the above analysis, key lessons have been drawn, based on which, gaps, if any, have been identified, and implementable policy-level recommendations have been made.
4. These recommendations have then been aligned with learning from other state studies.
5. An analysis of state budgets has been presented in the end to evaluate the fiscal implications of the recommendations and the required budgetary adjustments.

This chapter gives a snapshot of the analysis presented in those six chapters individually, and then an analysis of the combined data for all six states.

2.3.1 Agriculture in Indian States

Between 2005–06 and 2017–18, while the Indian economy (measured as gross domestic product or GDP) grew at an average annual growth rate of 7.8%, its agriculture sector (measured as agriculture and allied sector gross domestic product or AGDP) grew at only 3.7% per annum. There are, however, wide regional variations masked under the national average (Fig. 2.2).

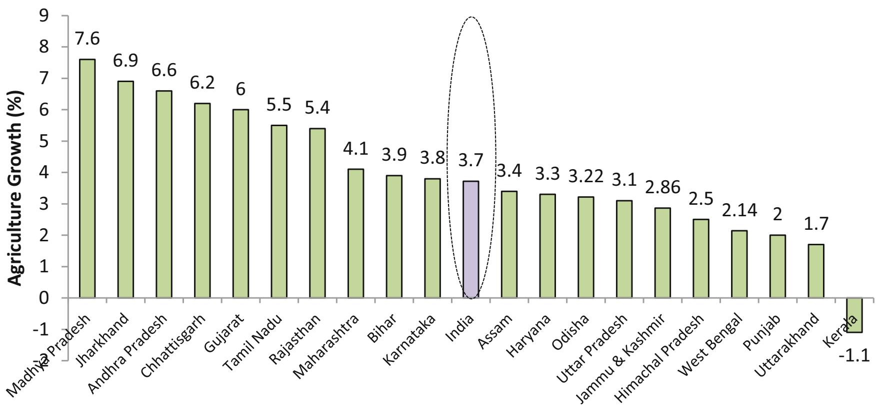


Fig. 2.2 State wise agriculture growth in the period 2005–06 to 2017–18 (2011–12 prices). *Source* Based on data from MOSPI, GOI

b. To determine sources of growth, value of output at current prices for each segment was deflated using the wholesale price index (WPI) 2011–12 = 100. The deflated value of output for a segment i in year t is given by: $D(\mathrm{VO}_i)_t = \frac{[\mathrm{VO}_i]_t}{\mathrm{WPI}} \times 100$

c. The year-on-year growth rate in GVO is then decomposed by taking the absolute year-on-year difference in GVO from each segment as a proportion of the previous years' GVO from agriculture and allied activities. The formula is: $G(i)_t = \frac{D(\mathrm{VO}_i)_t - D(\mathrm{VO}_i)_{t-1}}{D(\mathrm{GVO})_{t-1}} \times 100.$

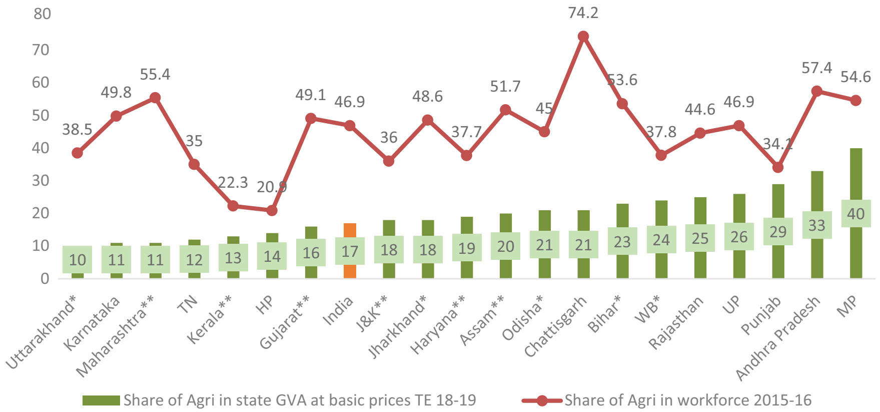


Fig. 2.3 State wise share of agriculture in GVA and share of workforce in agriculture (%). *Source* Based on data from MOSPI & Labour Bureau. *Note* *Data for TE2017–18. ** Data for TE 2016–17

During the period, Madhya Pradesh (7.6%), Jharkhand (6.9%), Andhra Pradesh (6.6%), Chhattisgarh (6.2%) and Gujarat (6%) enjoyed stupendous growth in agriculture. However, it was the low growth rates in states like Uttar Pradesh (3.1%), Odisha (3.2%), Punjab (2%) and Kerala (−1.1%) that pulled down the average national growth rate.

Punjab and Kerala are rich agricultural states, with high value per hectare—Punjab because of high rice and wheat yields as a result of the green revolution and Kerala because of its production basket that comprises mainly high value agricultural products like spices, condiments, etc. A low growth rate in these states may not be as much of an issue as low growth rates in states like UP, Bihar and Odisha will be. This latter set of states is home to a large proportion of India's agricultural workforce (together they account for 29% of the Indian agricultural workforce as per Census 2011). Low agricultural growth rates in these states are likely to affect a larger, more vulnerable section of the country, as can be seen below.

Figure 2.3 reveals that 47% of UP's workforce is employed in agriculture and the sector contributes about 26% to the state's GVA or gross value added. In the case of Bihar and Odisha, these numbers are much worse. In Bihar, about 54% of the state's workforce is employed in agriculture and the sector contributes about 23% to the state's GVA. In the case of Odisha, 45% of state's workforce is employed in agriculture, which contributes 21% to the state's GVA. This highlights how states grapple with low per capita GVA with low labour productivity and problems of underemployment. This picture is also mirrored at the all-India level, where agriculture accounts for 17% of overall GDP while engaging 47% of the country's workforce.[2]

A look at poverty concentrations shows that APS states are among the most economically vulnerable states in the country (Fig. 2.4). Forty per cent of India's poor live in these states—UP (22.2%), Bihar (13.3%) and Odisha (5.1%). The proportion

[2]In 2018–19, these numbers were 14% and 44% respectively (WDI, World Bank, 2019).

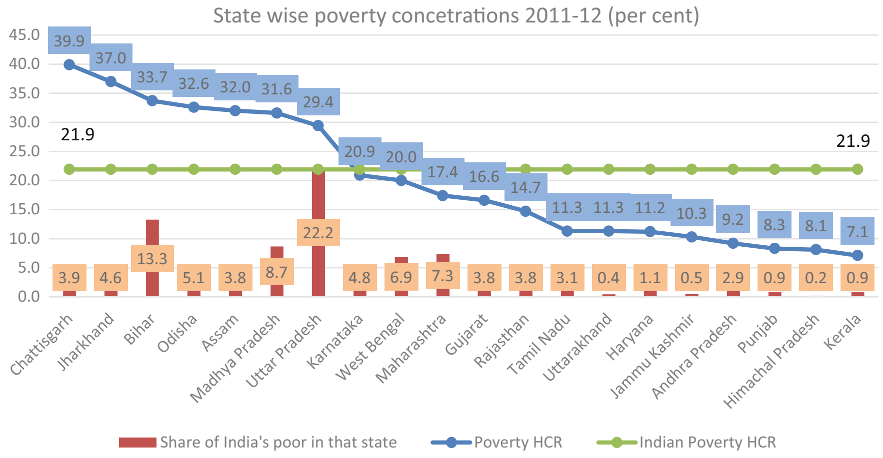


Fig. 2.4 Concentration of poverty in Indian states 2011–12 (%). *Source* Based on data from the Planning Commission, GoI

of the poor is 29.4% of the population in UP, 33.7% in Bihar and 32.6% in Odisha. This is as against the all-India head count ratio (HCR) of 21.9% (2011–12).

In conclusion, the three APS are home to a large poor population, have a greater share of their labour force dependent on agriculture with a relatively low proportion of the state's GDP/GVA coming from agriculture.

In contrast, the HPS are relatively better off with Punjab and Gujarat being among the top performers. Even though Madhya Pradesh is home to about 8.7% of India's poor and has about 32% of its population living below the poverty line, its stupendously high agricultural growth rates in the recent past has helped it secure a place in the HPS. As observed in the last section, there is a lag in the transmission of the benefits of agricultural growth in the country. Hence, even though the poverty estimates look grim for MP in Fig. 2.4 above, which used data for the year 2011, more recent data is likely to show the poverty alleviating impact of this agricultural growth.

2.3.2 *Brief about the Six Focus States*

We start by presenting a summary of the key parameters of the agricultural sector for each of the six states (Table 2.4).

Table 2.4 Overview of the agricultural sector in the six states

	Gujarat	Madhya Pradesh	Punjab	Uttar Pradesh	Bihar	Odisha	India
State Profile							
Population (Census 2011) in millions	60.4 (5%)	72.6 (6%)	27.7 (2.3%)	199.8 (16.5%)	104.1 (8.6%)	42.0 (3.5%)	1210.9 (100%)
Projected Population 2019 based on Census 2011 (Millions)	64.8 (4.8%)	83.8 (6.2%)	29.9 (2.2%)	233.4 (17.2%)	122.3 (9%)	45.9 (3.4%)	1353.9 (100%)
Geographical Area (m ha)	19.6 (6.0%)	30.8 (9.4%)	5.0 (1.5%)	24.1 (7.3%)	9.4 (2.9%)	15.6 (4.7%)	328.7 (100%)
Population Density (population per sq. km) (2019)	330.6	272.0	593.2	968.7	1298.4	294.5	411.9
Gross cropped area (m ha) TE 2014–15	12.6	23.7	7.9	26.0	7.7	5.1 (9.0)[b]	197.9
Gross irrigated area (m ha) in TE 2014–15 (Parenthesis gives Irrigation Ratio)	6 (47.2%)	9.7 (41.1%)	7.7 (98.5%)	20.5 (79.1%)	5.2 (68.3%)	1.5 (29%) 3.4 (38.4%)[b]	94.8 (47.9%)
Cropping intensity in TE 2014–15	122.5	153.9	189.9	156.6	144.6	115.4 166[b]	140.8
Agriculture share in Total GSDP at current prices TE 2018–19 (%)	16.3 (TE2016–17)	40	29	26	23 (TE2017–18)	21	17.6

(continued)

Table 2.4 (continued)

	Gujarat	Madhya Pradesh	Punjab	Uttar Pradesh	Bihar	Odisha	India
Average level of farmer incomes in 2015–16 (NAFIS) (INR/month)	11,899	7919	23,133	6668	7175	7731	8931
Agricultural Workforce in Total Workforce (%) (Census 2011)	49	70	35.6	59.2	74	61.8	55
Normal Rainfall (monsoon months Jun-Sep) in cm	65.8	95.2	49.2	84.6	102.8	115.0	88.8
Rural Poverty (%) (2004–05) [2011–12]	(39.2) [21.5]	(53.6) [35.7]	(22.1) [7.7]	(42.7) [30.4]	(55.7) [34.0]	(60.8) [35.7]	(41.8) [25.7]
Natural disasters: floods [2000 to 2017]				Floods: 2007 most damaging flood in history and 2017	Floods: 9 years	Floods: 15 years	
Droughts [2000 to 2017]				Drought: 2016, 2017	Droughts: 5 years	Droughts: 8 years	
Fertiliser Consumption (kg/ha) in 2014–15	131.8	75.5	218.6	163.4	175.4	55.4[b]	129.0
Power sales per hectare of gross cropped area (KWh/ha) TE 2015–16 (Parenthesis gives agricultural share in total power sales)	1087 (25.6%)	641 (38.2%)	1356 (27%)	442.8 (17.8%)	43 (3.3%)	25 (1.4%)[b]	847 (20.4%)
Road density per 1000 km^2 (2015–16)	913.9	941	2152	1707	2193	1850	1431

(continued)

Table 2.4 (continued)

	Gujarat	Madhya Pradesh	Punjab	Uttar Pradesh	Bihar	Odisha	India
Surfaced road as a share of total road (2015–16)	87.2	83	90.6	85.9	59.8	23.9[a] (2011–12)	70.6

[a]Data point given for a different year (mentioned in parenthesis) than for other states
[b]LUS data for Odisha taken from state DES

2.3.3 Land-use Pattern in the Six States

Land is one of the most important agricultural inputs. As can be seen from Table 2.4, these six states account for about 31.8% of the country's geographic area (of about 329 million ha) and about 43.9% of India's gross cropped area (of 198 million ha). With mounting pressures from urbanisation, industrialisation and climate change, the land available for agricultural activities is likely to shrink in the coming years.

An analysis of the land-use pattern of these six states reveals (Fig. 2.5) the following:

1. Punjab has the largest share of its geographic area being deployed for agricultural purposes (82%) and Odisha has the lowest (28.7%).
2. Fallow lands are a big problem in Odisha and Bihar. The share of fallow lands in total land is the highest in Bihar (10.4%) and Odisha (10%), and the lowest in Gujarat (2.1%) and Punjab (1.4%). Both Odisha and Bihar have a high proportion of fallow land because of the large number of weather-related incidents like floods, droughts and cyclones that the states are subjected to frequently. The problem of fallow lands has also become increasingly pervasive due to highly restrictive tenancy laws.

Forest and forest products are important for Odisha and Madhya Pradesh with 37.5% and 28.3% respectively of their area under forest cover.

Within agriculture, a look at the cropping pattern for the six states reveals some clear trends:

1. Cereals are the most dominant crops. The state of Punjab has the highest share of its gross cropped area (GCA), i.e. 83%, under cereals and Gujarat has the

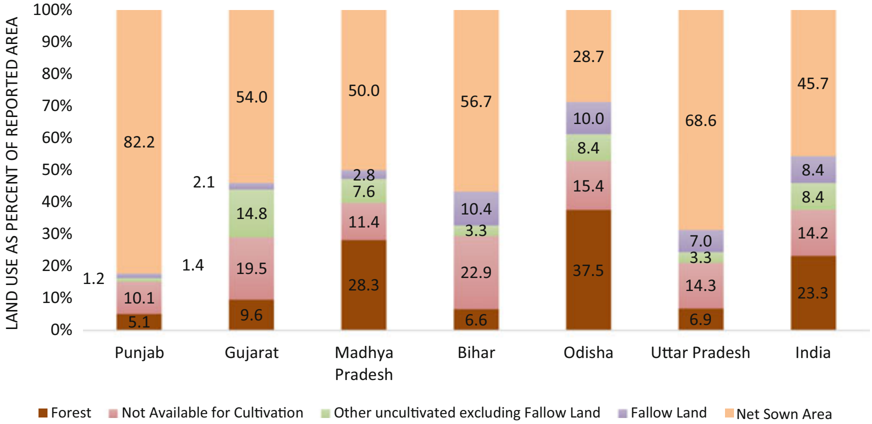


Fig. 2.5 Land use Statistics in Focus States, TE 2014–15. *Source* Directorate of Economics and Statistics, GOI. Data on Odisha state presented here is taken from Land use statistics (LUS), Government of India, which does not match the data reported by the Government of Odisha. However, we are using the GOI *Source* for all states here to make an inter-state comparison

least, i.e. 22%. On an average, only 17% of Punjab's area is left for other crops. Acreage is high under cereals in Odisha and Bihar too.

2. Gujarat has the most diversified acreage among the six states with cereals, oilseeds and cotton accounting for similar shares in the state's GCA.
3. Among the six states, Madhya Pradesh has the largest share of its GCA under pulses and oilseeds.
4. Cotton accounts for the highest share of GCA in Gujarat while sugarcane accounts for the highest share in UP.

Interestingly, the cropping pattern does not reflect the contribution a crop makes to the state's gross value of output from agriculture and allied activities. Based on the share of the value of different agriculture and allied activities calculated as a percentage of the total value of output from agriculture and allied activities (VOAA) (at current prices) (Fig. 2.6), some interesting trends emerge.

1. Barring Odisha and Punjab, livestock emerges as the largest contributor to the state's VOAA among all six states.

   a. The largest contribution from livestock is in the states of Bihar (33.8%) and UP (33%). In Odisha, the largest contribution comes from fruits and vegetables (F&V) and in Punjab, it comes from cereals.
   b. The highest contribution of cereals in a state's VOAA is in Punjab (40.9%) and the lowest is in Gujarat (6.8%).
   c. In Punjab, it may be noted that despite cereal domination, livestock is second most important contributor to VOAA. In fact it is more than that in Gujarat,

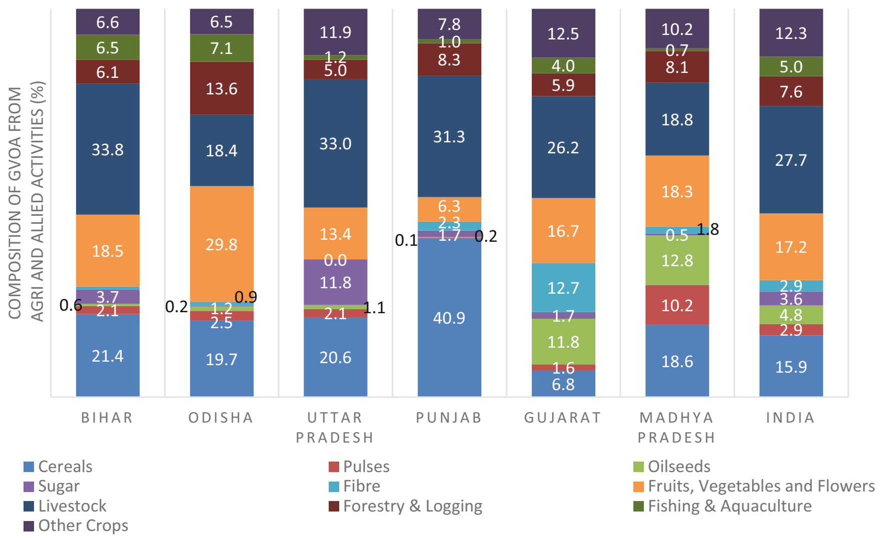


Fig. 2.6 Sector-wise shares in value of output from agriculture and allied activities TE2015–16. *Source* Based on data from CSO, Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

Madhya Pradesh, and even all India average. In fact livestock share in Punjab (31.3%) is pretty close to that of Bihar (33.8%) and Uttar Pradesh (33%).

2. In Bihar, Punjab and UP, two activities, i.e. cereal cultivation and livestock, together contribute more than half the state's VOAA. In the remaining three states, it is three crops/activities:
   a. Odisha and Madhya Pradesh: F&V, cereals and livestock
   b. Gujarat: Livestock, F&V and fibre (cotton)
3. Fishing and aquaculture makes the largest contribution in the states of Bihar (6.5%) and Odisha (7.1%). Even though Bihar is a non-coastal state, it has access to 13 rivers, and hence, has been able to develop inland fishing.
4. F&V emerges as the most important contributor in VOAA in Odisha (29.8%), Bihar (18.5%) and Madhya Pradesh (18.3%) and least important in Punjab (6.3%).
5. Pulses and oilseeds are observed to have the largest contribution in the states of Madhya Pradesh (23%) and Gujarat (13.4%).

As each of the six states have had a different historical growth trajectory (Fig. 2.2), we need to disaggregate the VOAA analysis and observe changes in each sub-segment of agriculture over time to identify the role each has played in agricultural growth to identify the sources of growth for each state.

2.3.4 Method Followed for Finding the Sources of Growth

To calculate the "sources of growth", the current value of output of each segment is deflated by the WPI series at 2011–12 prices. The decomposed year-on-year growth in the GVO from agriculture and allied activities is enumerated by taking the absolute difference in GVO from each segment as a proportion of the previous year's GVO from agriculture and allied activities. The analysis is done for the period between 2000–01 and 2015–16 (Fig. 2.7).

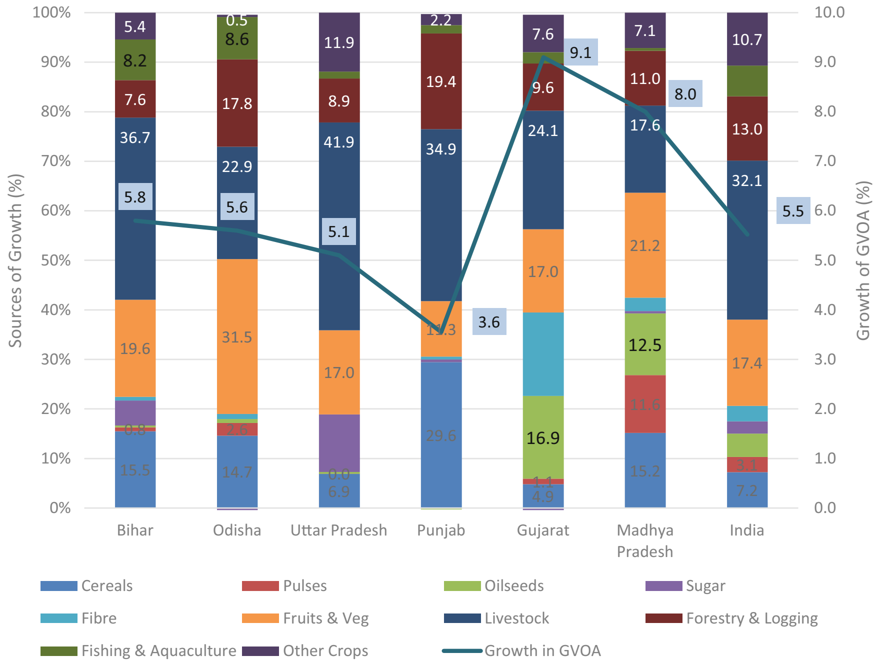


Fig. 2.7 Sources of growth 2000–01 to 2015–16 (share in growth contributed by each sector). *Source* Calculated by authors

2.3.5 Results

The analysis (Fig. 2.7) reveals interesting trends.

1. Among the six states, GVO in agriculture grew the fastest in Gujarat[3] at 9.1% on average per annum in the studied period. About a quarter of this growth came from growth in livestock, followed by the fibre and fruits and vegetables(F&V) sectors that made an equal contribution of about 17% each.
2. Madhya Pradesh with an average annual GVO growth of 8% grew the second fastest. Again, it was F&V and livestock that together explained about 39% of this growth. The contribution of cereals, oilseeds and pulses together was also about 39%.

[3]As per Fig. 2.2 in this Chapter, AGDP growth rate was highest in the case of MP but as per Fig. 2.7, the growth rate in GVO in agriculture is the highest for Gujarat. This difference is due to the difference between the studied periods in each of the figures. While Fig. 2.2 was for the period 2005–06 to 2017–18, Fig. 2.7 is for period 2000–01 to 2015–16. Figure 2.7 is the result of the statistical exercise undertaken during the 4-year research period and Fig. 2.2 is more recent and updated.

3. The lowest growth was observed in Punjab at 3.6%. About 35% of this growth was accounted for by output in the livestock sector and about 30% came from cereals.
4. Oilseeds contributed the largest to the growth in Gujarat (16.9%) and Madhya Pradesh (12.5%).
5. Pulses made a substantial contribution only in the case of MP (11.6%).
6. Sugarcane emerged an important source of growth in UP (11.6%).

Overall, it can be concluded that while Gujarat and Madhya Pradesh experienced a more diversified growth process, growth in other states centred on a few activities.

2.3.6 Drivers of Growth

From our analysis above, we now know the activities/sectors/crops that contributed to agricultural growth in the six states. In this section, we identify factors that explain the growth in these activities/sectors/crops.

The performance in agriculture and allied activities is dependent on a host of factors. These factors can be classified into various categories such as (1) physical inputs used in cultivation (seeds, fertilisers, pesticides) (2) technology (irrigation, mechanisation) (3) availability of physical infrastructure (road, electricity, cold storage, warehouses, etc.) and (4) institutional reform measures such as reform of procurement agencies, extension services and so on. However, it may not be possible to examine the effects of such a large number of variables simultaneously in a model as many of them are very closely related to each other, causing multi-collinearity. In this section, we have taken one representative variable from each of these broad areas to assess its impact on agricultural growth. Many of these explanatory variables show high correlation with each other. For example, there is high correlation between fertiliser consumption and the irrigation ratio. As far as possible, we have used different combinations of explanatory variables that are not expected to suffer from endogeneity.

To determine the drivers of growth, panel data fixed and random effect models (both time and state dummies) have been used. The panel data has been obtained by pooling data across the six states for the period 2000–01 to 2016–17. The Hausman test has been applied to find out which model (fixed or random) is the best fit for our analysis.

The results for the APS and the HPS are presented (Fig. 2.8).

Overall, two factors emerged as the main drivers of agricultural growth in any state: (i) quality infrastructure (mainly irrigation and roads), and (ii) access to markets and marketability of the produce. Additionally, for Odisha, Bihar and Gujarat, a third factor of diversification away from cereals to high value agriculture that includes, fruits, vegetables, pulses, etc., and to allied activities like dairy, poultry, piggery, etc., emerged as relevant.

2.3.7 Econometric Analysis Combining Data on Six States

To estimate the actual relation between these factors and the state's agricultural GDP, we undertook an econometric exercise based on panel data. The period of study was 2000–01 to 2016–17, that is, a period of 17 years. We had pooled data for six states for the period to conduct the regression analysis. The Hausman test was done to confirm the fixed effects model for the equation with agricultural GSDP as the dependent variable, and the irrigation ratio, road density and terms of trade between agriculture and industry as the independent variables. The result of the regression is as follows:[4]

$$\begin{array}{l} \text{Ln\_AGSDP} = \underset{(0.46)}{9.86***} + \underset{(0.05)}{1.121\text{Ln\_IR}***} + \underset{(0.03)}{0.22\text{Ln\_RD}***} + \underset{(0.07)}{0.28\ln\text{\_ToT}**} \end{array}$$

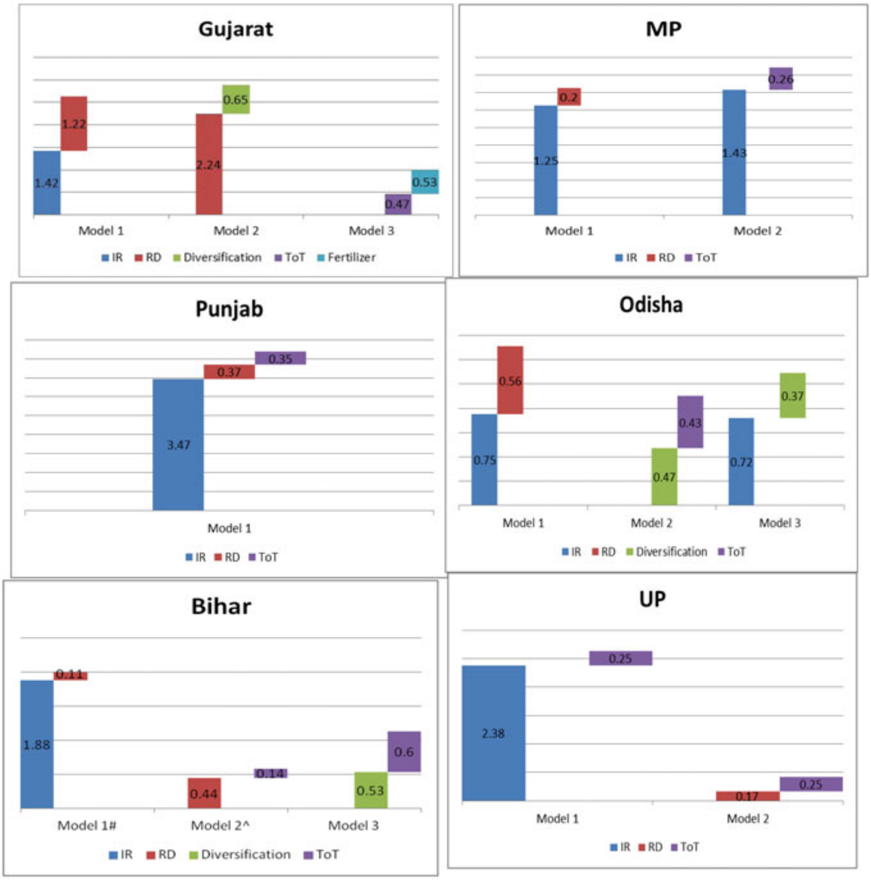
$N = 102$
R square:
Within $= 0.81$
Between $= 0.14$
Overall $= 0.20$

Note Ln_GSDPA = log of GSDP from Agriculture (dependent variable); Ln_IR = log of Irrigation ration; Ln_RD = log of total road density; Ln_ToT = log of Terms of Trade between Agriculture and Industry

The impact of irrigation, roads and ToT are found to be significant in the model with irrigation having the strongest impact on agricultural GDP. The results indicate that a one per cent growth in the irrigation ratio increases agricultural GSDP by 1.12%. Similarly, a one per cent increase in the terms of trade in favour of agriculture leads to a 0.28% increase in agricultural GSDP. So, econometrically, it is recognised that supply of water, road infrastructure and price incentives are necessary for agricultural development.

The quantum of rainfall is pretty low and uncertain in many parts of the country. Hence, providing irrigation facilities is essential for cultivation. With the use of HYV seeds and fertilisers, irrigation facilities become necessary in the production process. Once the produce is ready to be marketed, roads play an important role in agricultural development by providing connectivity to even far off areas, especially for perishable produce that needs to reach the market on time. The third most important factor is price incentives. A higher return on cultivation encourages farmers to invest more, which raises agricultural GDP, which in turn augments farmers' income. A robust marketing infrastructure and procurement facilities guarantee that farmers get remunerative prices for their produce.

[4]Numbers in parentheses are standard errors.



Note: Regression periods: 2000–01 to 2015–16 for Gujarat, MP, Odisha; 2001–02 to 2014–15 for UP, 2001–02 to 2015–16 for Bihar and 1970–71 to 2015–16 for Punjab. Abbreviations: IR: irrigation ratio, RD: Road a Density, ToT: terms of trade for agriculture. Other variables are diversification to high value agriculture and fertiliser consumption. All variables have high R square value of above 75 per cent. Note: Separate model numbers reflect results from separate econometric models. # In Model 1 of Bihar, Road Density is not significant. ^In Model 2 of Bihar, Terms of Trade is not significant

Fig. 2.8 Summary of the econometric results from state studies

2.4 From Agricultural GDP to Farmers' Incomes

Historically, India is a country that is known to have suffered immensely because of floods, droughts, cyclones and other weather vagaries, sometimes all in the same year. To feed its huge population, the country had been a net importer of food at least until the late 1960s. The situation changed gradually after India's green revolution in the late 1960s and 1970s, when high-yielding varieties of wheat and rice seeds were imported and planted in India, resulting in bumper production. Together with support from a robust and revamped agricultural extension system and marketing

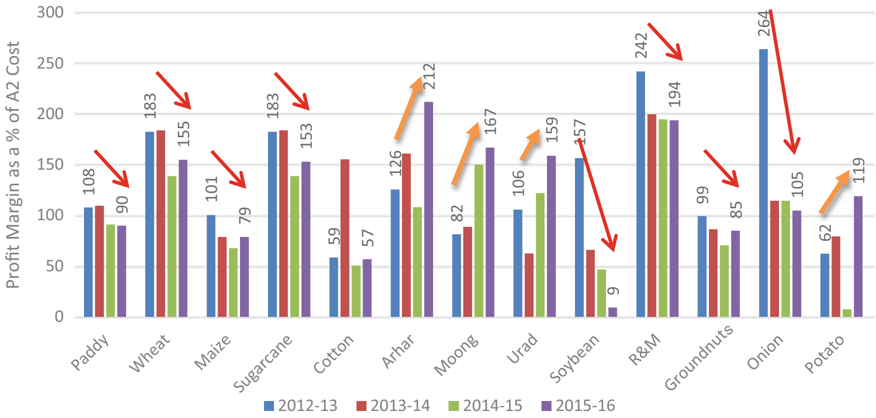


Fig. 2.9 Trends in profitability (over A2 cost) of important crops in India. *Source* Based on data from DES, GOI. Note: trends are estimated as weighted average of major producing states

infrastructure, including government procurement, there was a sustained increase in production over the years that enabled India to become a net exporter of food to the world.

If traditionally an Indian farmer suffered more due to production losses, today he suffers additionally from price risks especially in the years of bumper production. Therefore, the problem of the Indian peasantry is not as much of tonnage today as it is of imperfect and inefficient markets and its related infrastructure.

It may be noted that after 2013–14, the margins of profitability over paid out costs (Cost A2) have been falling on most of major crops in India (Fig. 2.9). And if one works out these margins over full comprehensive cost that includes imputed rent on owned land and imputed interest on owned capital, the margins of profitability become negative for many crops.

Historically, when India suffered immensely due to volatile production, it was right for policies and the policy makers to focus on increasing production. Today, as a result of access to quality inputs and technology, India has been able to produce surpluses in the case of most crops with the notable exception of edible oils. The question before policy makers today is that of the sustainability of these surpluses, which is predicted to suffer on two accounts: (a) the unpredictable impact of climate change and (b) falling margins of profitability that act as a disincentive to farmers to undertake further investment.

While the country's agricultural research and development division is working to resolve the risks associated with climate change, it is the second issue of market and price risk that the policy makers must immediately and urgently focus on.

There is need for increased focus on the value of the produce that is created, which means that the earlier focus on agricultural GDP has to be shifted to a greater focus on a combination of higher tonnage and higher value realisation for that produce.

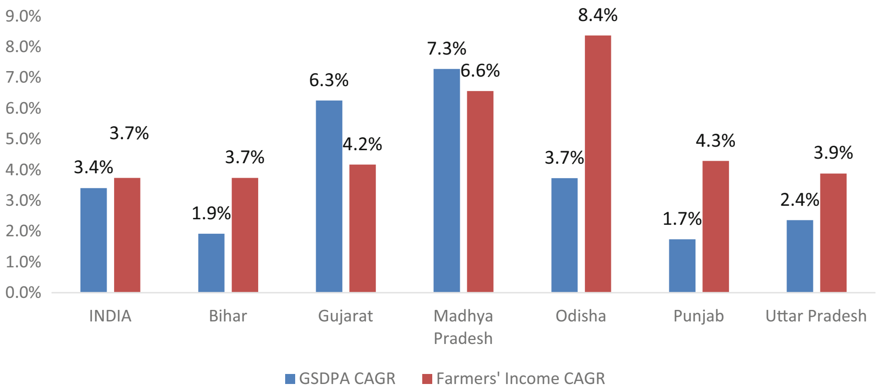


Fig. 2.10 CAGR of GSDPA and Farmers' Income (FY) between 2002–03 and 2015–16. *Source* MOSPI, NSSO and NABARD. Note: Growth rates are estimated as CAGR of terminal values of GDP from agriculture and allied activities and farmers' income for years 2002–03 and 2015–16

Comparing historical growth rates achieved by agricultural GDP and levels of farmer incomes reveals some interesting trends (Fig. 2.10). Between 2002–03 and 2015–16, real incomes of farmers grew at 3.7% per annum and agricultural GDP grew at about 3.4% per annum. It may not be wrong to say that both growth rates followed each other closely in these years. At the state level, however, the two growth rates differed (Fig. 2.10).

In the case of our six states, despite higher AGDP growth, farmers' incomes have failed to rise as fast in Gujarat and MP (to some extent). Contrarily, farmers' incomes have risen sharply in Odisha, Punjab, UP and Bihar despite a not-so-impressive AGDP performance.

But how does a gap arise between two important variables measuring a farmer's eco-system? While this may be explained by outlining accounting procedures,[5] but what may be at the core of the situation would be- the farmer's small and shrinking size of landholding. Due to the small size of his farming landholding, farmers are forced to diversify their income sources by looking beyond agriculture to augment their household incomes. Farmers sometimes work on other's farms in return of wages and sometimes they undertake non-farm businesses to support their families.

An average Indian farm size is 1.08 ha (Agricultural Census 2015–16) and it has been shrinking over the decades (it was 2.3 ha in 1970–71) (Fig. 2.11).

India has about 146 million landholdings and 68.5% of these are marginal holdings, i.e. less than 1 hectare and the average landholding size of this category is much

[5]Some parts of this disconnect between AGDP and farmer income trends may be explained by the way the data for each is segregated and analysed. Certain sources of incomes like wages and salaries that agricultural households made from, for example, working in schools, tuition centres, etc., will be counted as income from services and not towards agriculture; hence, even though an agricultural household earned that income, it does not get reflected in the GDP from agriculture. This and many more data issues raise the need to look at both agricultural GDP and level of farmers' incomes as variables to monitor and target if one wants to alleviate poverty in the country.

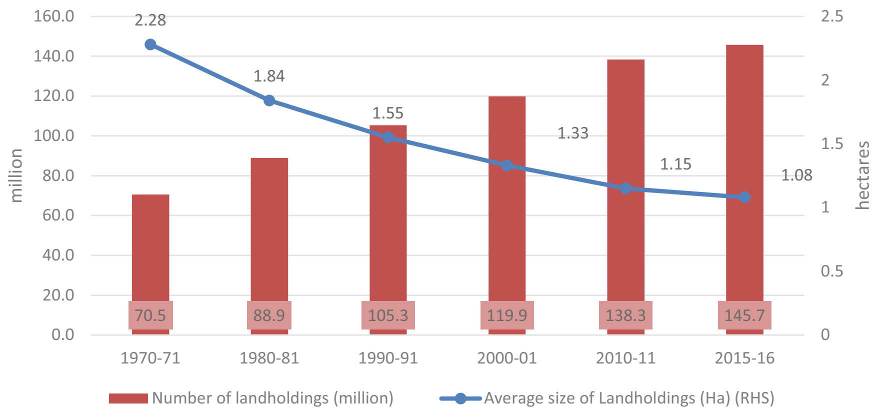


Fig. 2.11 India's operated area under agriculture: size and number of holdings. *Source* Data taken from Agricultural census of various years

smaller at 0.38 ha. In addition, about 17.7% of Indian landholdings are categorised as small, i.e. they are between 1 and 2 ha and have an average size of 1.41 ha. Thus, about 86% of Indian landholdings are less than 2 ha and fall under the category of small and marginal landholdings or farmers (SMF). They together operate on about 47% of the country's 157 million hectares of operated area.[6]

As incomes from such small farms are not enough to sustain families, farmers diversify their sources of income through dairy farming, by working as labourers on others' farms or even outside the farms (non-farm) and operating small businesses like barber shops, among others. As the landholding size falls, one would expect a more diversified income portfolio. These diversified activities may not all be accounted for as part of the country's agricultural GDP. While some may be counted towards manufacturing GDP, others may be added to the services sector's GDP.

What are the sources of farmer incomes? In this section, we will detail the following:

1. The level of farmers' incomes in the country and inequality in incomes between states
2. The structure of farmers' incomes and trends.

2.4.1 Source of Data

Since the year 2000, data on Indian farmers' incomes is available for three years: 2002–03, 2012–13 and 2015–16. The 2002–03 and 2012–13 surveys were conducted

[6]According to the Agricultural Census 2015–16, operated area includes both cultivated and uncultivated areas, provided part of it is put to agricultural production during the reference period. This is different from the net sown area, which refers to the actual acreage under crops in that year and gross cropped area, which includes the double cropped area.

by the NSSO. The 2015–16 survey was conducted by the National Bank for Agriculture and Rural Development (NABARD), and it is called the NABARD All India Financial Inclusion Survey (NAFIS).

2.4.2 *Composition of Incomes*

GoI's National Sample Survey Office (NSSO) profiles an average Indian farmer and identifies the actual sources of income. According to the NSSO's Situation Assessment Survey 2012–13, an average Indian farmer has four major sources of incomes: (i) *income from cultivation* (includes income from the production of field crops and plantation/orchard crops); (ii) *income from livestock* (includes receipts from the sale of milk, egg, live animals, wool, fish, honey, hide, bones, manure etc.); (iii) *wages and salaries* (includes income from working on others' farms and outside farms as well as salaries from working in the construction sector and wages received under MGNREGA) and (iv) *income from non-farm activities* (receipts from the sale of prepared food, refreshment and drinks, earnings from goods and passenger traffic, communication charges receivable from customers (STD/courier, fax, etc.), receipts for educational activity (like tuition fees, examination fees, capitation fees, etc.).

In the 13 years between 2002–03 and 2015–16, these incomes grew at an average CAGR of 11.8% at current prices. With the consumer price index for agricultural labourers (CPI-AL) growing at 8.1%, the CAGR for farmers' real incomes works out to be about 3.7%. Breaking up the farmer incomes into its four components, the sharpest growth in CAGR has been observed in the case of incomes coming from livestock as they are estimated to have increased annually at 17.1% (in nominal terms) in the 13 years.

A summary of an average farm household's nominal and real incomes are presented (Fig. 2.12).

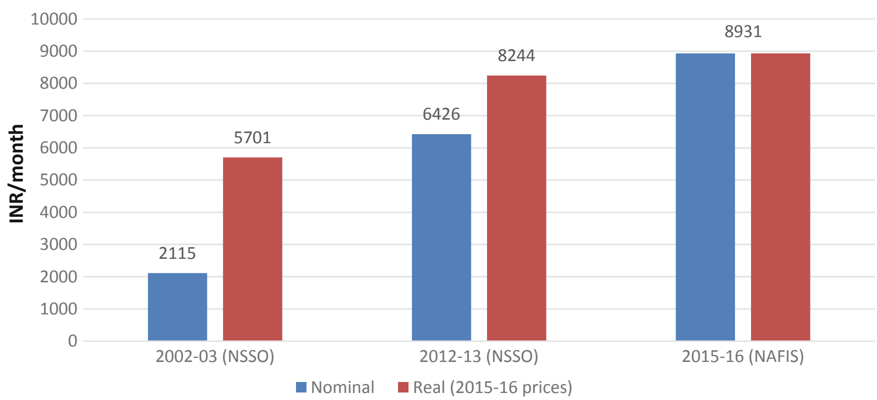


Fig. 2.12 Average farmer income level (INR/month). *Source* Based on data from NSSO and NAFIS

From analysis of data on farmer incomes, some very interesting facts emerge and are presented in the Chapter on Farmers' Incomes. Some of those facts can be found below.

1. The share of income from cultivation and livestock fell between 2002–03 and 2015–16—from 50% (in 2002–03), it first increased to 60% (in 2012–13) and subsequently fell to 43% (in 2015–16).
2. By 2012–13, while the share of income from cultivation rose (from 46% in 2002–03 to 48%), that of income from wages and salaries fell (from 39% to 32%). By 2015–16, while the share of income from cultivation fell to 35% that from wages and salaries increased to 50%.
3. Income from the non-farm sector is the smallest component and has grown the slowest.
4. The share of income from cultivation also increases as landholding size increases. Smaller landholder households earned most of their income from livestock and through wages and salaries.

2.4.3 Farmers' Income in Indian States

There is wide variation in average agricultural household incomes across states (Fig. 2.13). According to NABARD's NAFIS, the highest farmer incomes (monthly basis) were earned by Punjab farmers (Rs. 23,133 per month), followed by Haryana (Rs. 18,496/month), Kerala (Rs. 16,927) and Gujarat (Rs. 11,899). Low incomes were earned by farmers in the eastern Indian states of Odisha (Rs. 7731), Bihar (Rs. 7175), Jharkhand (Rs. 6991) and the southern state of Andhra Pradesh (Rs. 6920); the lowest incomes were earned by UP farmers (Rs. 6668/month).

Figure 2.13 presents the average monthly farmer income levels in different Indian states. The darker the green colour gets, the higher the average level of income. In states with dark red colour, farmers earn very low levels of incomes. As can be seen from the map, these states are Uttar Pradesh, Bihar, Jharkhand, West Bengal, Odisha and Andhra Pradesh and, according to Census 2011, these states are home to close to 40% of Indian farmers.

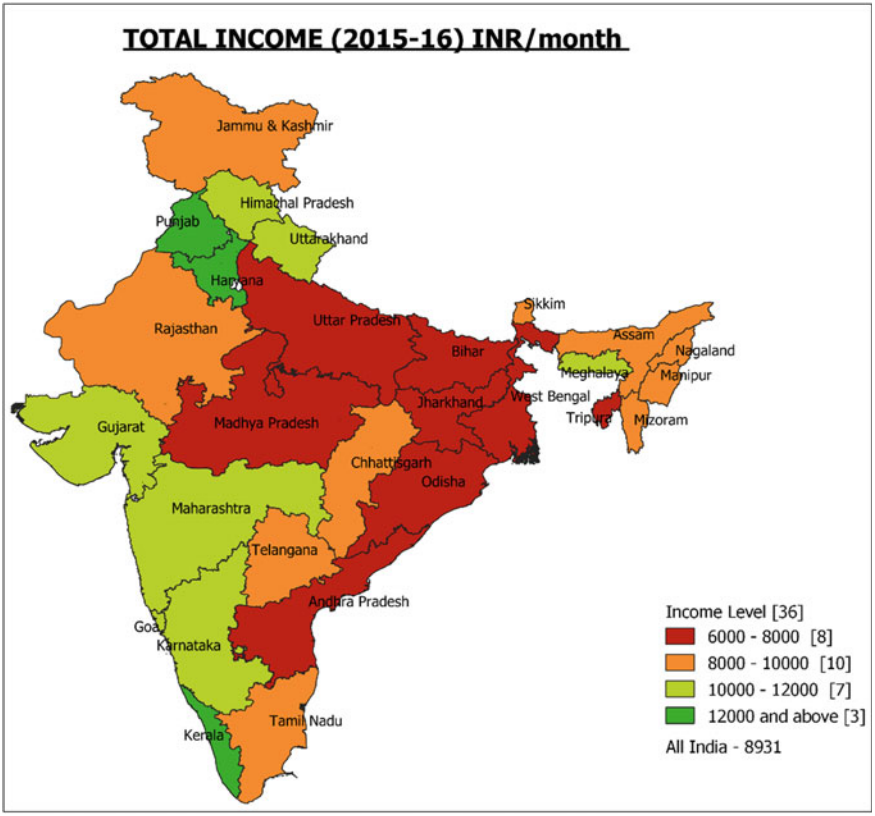


Fig. 2.13 Farmers' average monthly incomes in major Indian states: 2015–16 (INR/month). *Source* Created by authors from NAFIS data

2.4.4 Conclusion

Going forward, the policies and programmes governing Indian farmers need to be aligned to the objective of improving farmers' incomes, where improving price realisation is as important as increasing and diversifying production. To improve farmers' welfare, the focus should also be on creating opportunities for getting greater value from the produce.

2.5 Analysing Policies and Programmes

Ever since PM Modi became India's Prime Minister in May 2014, there have been some interesting developments in Indian agriculture.

1. Cyclicality in prices of most agricultural products –After rising in 2014, the prices of most crops started spiralling downwards. A fall in global prices magnified this downward trend as it adversely affected the price competitiveness of Indian products, leading to a further crash in prices domestically;
2. Five consecutive years of lower than normal rains—In its 118 years of recorded rainfall history, India had never faced five consecutive years when monsoon rains fell short of its long period average. This happened in the five years since 2014–15. Underground water levels in several states fell, their water reservoirs dried, and the agriculture sector suffered a cumulative loss over these five years as 51% of the country's GCA depends on rains for irrigation and monsoon rains are about 75% of the annual rainfall in the country.
3. Promotion of policy-level innovations—These include programmes like the PM-KISAN that makes an unconditional cash transfer into the bank accounts of all landowner farmers. This transfer is a top-up on the existing input and price support that farmers have been getting over the years. Due to the Lok Sabha elections in 2019, several state governments resorted to farm loan waivers.

In this Section, we summarise our analysis of some of the biggest schemes/announcements and evaluate them for their effectiveness in alleviating farmers' problems.

The major schemes and initiatives analysed are the National Food Security Act, 2013, agricultural marketing reforms such as eNAM, APLM, PM Aasha, MSP as cost plus 50%, *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY), *Pradhan Mantri Fasal Bima Yojana* (PMFBY) or crop insurance scheme, *Pradhan Mantri Kisan Samman Nidhi* (PM-KISAN) and farm loan waivers.

An analysis of these schemes (presented in detail in the relevant chapter) reveals that most were inefficiently implemented and marred by design or implementation gaps. In particular, the results were as follows: (a) because of their limited reach, schemes like farm loan waivers and procurement under MSP (PM Aasha) emerge as inefficient solutions; (b) Despite being the right solutions, implementation lags and errors and a siloed approach to reforms have rendered schemes like e-NAM, soil health cards and PMFBY less effective; and (c) unconditional cash transfer to farmers under PM Kisan is a unique opportunity but involves colossal fiscal implications and, in the current situation, when payments under the scheme are in addition to existing input subsidies, the fiscal burden will only snowball, squeezing scarce fiscal resources and adversely affecting public investments in and for agriculture.

What does all this mean? On one side, the Indian Prime Minister promises to double real incomes of farmers by 2022 and, on the other, schemes and programmes designed to deliver on that promise fall short in terms of performance and delivery. If India wants an overall GDP growth rate of about 8%, it cannot do so sustainably without ensuring that its agricultural sector grows at least by 4% per annum. But even a 4% annual growth rate in agricultural GDP cannot double farmers' incomes by 2022. It requires a much higher growth rate, may be 13–15% per annum for the next three years, which is impossible for the agriculture sector. In any case, it seems that doubling farmers' incomes cannot be achieved by 2022, but it may be possible over a somewhat longer period, perhaps between 2025 and 2030. To ensure this, the experience of fast-growing agricultural states like Madhya Pradesh and Gujarat and upcoming states like Odisha, UP and Bihar may be worth studying. A statistical analysis of the growth story of each of these states revealed that most growth in the agricultural sector will come from: (i) diversification to high-value agriculture (tantamount to a movement away from cereals like paddy and wheat), (ii) investment in roads and irrigation and (iii) access to efficient and more remunerative markets to get the best prices for farmers. The central and state governments should focus on these factors. Apart from this, it is imperative that the government acts as a facilitator and enabler of reforms by providing a stable and predictable policy environment for farmers and others in the value-chain to flourish.

Reference

Agriculture Census. (2015–16). All India report on number and area of operational holdings. Retrieved May 2019, from Agricultural census: http://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf.

Census. (2011). *Census of India.* Retrieved May 2019, from Registrar General of India, Ministry of Home Affairs, Government of India.

Land Use Statistics, DES. (2018). New Delhi: Directorate of Economics and Statistics (DES), Department of Agriculture and Cooperation, Government of India.

NABARD. (2018). NABARD All India Rural Financial Inclusion Survey (NAFIS) 2016–17. Mumbai: National Bank for Agriculture and Rural Development.

NSSO. (2014). *Situation assessment survey 2012–13: NSS 70th round* . New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Part II
Linking Agricultural Growth, Poverty and Malnutrition in India

Chapter 3
Linkage Between Agriculture, Poverty and Malnutrition in India

Ashok Gulati and Ranjana Roy

3.1 Introduction

Despite the high economic growth rate over the last 10–15 years, a large section of the population remains undernourished. This has raised questions regarding the quality of India's growth story, especially in terms of its inclusiveness, and its impact on the poor and the malnourished. It has attracted attention in world literature as well as among Indian policymakers. It requires a deeper analysis of agricultural performance and its effects on poverty (especially rural) and malnutrition over a reasonably long period of time. It is precisely this issue that has been attempted in this chapter.

India has come a long way since independence in terms of reduction in poverty and malnutrition. The poverty headcount ratio was as high as 45% in 1993–94; this declined to 22% in 2011–12 following the Tendulkar Methodology for measurement of poverty (Planning Commission 2014). According to UNICEF, nearly half of all deaths among children under five in Asia and Africa are attributable to undernutrition. Recent National Family Health Survey Data (NFHS 4, 2015–16) on India indicates that 38.4% of Indian children (under the age of five years)were stunted[1]

[1]Low height for age/Stunted: is defined as the percentage of children, aged 0–59 months, whose height for age is below 2 standard deviations from the median of the reference population.

Low weight for height/Wasting: measures body mass in relation to body length. Children whose *Z*-score is below minus 2 standard deviations from the median of reference population are considered wasted for their height.

Weight for age/Underweight: is a composite index of height for age and weight for height. Children whose weight for age is below minus two standard deviations from median of the reference population are classified as underweight.

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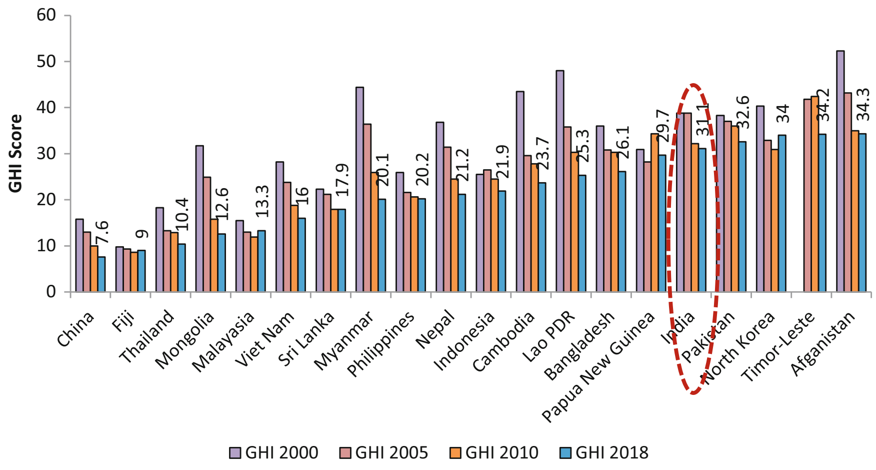

Fig. 3.1 GHI scores: South, East and Southeast Asia. *Source* https://www.globalhungerindex.org/

while 21% were wasted and 35.7% were underweight. The situation seems a little better in comparison to the NFHS-3 (2005–06) results, in which the corresponding figures were 48.0% (stunted), 19.8% (wasted) and 42.5% (underweight). The share of thin women (men) (BMI < 18.5 kg/m^2) in the country declined from 35.5 (34.2)% in 2005–06 to 22.9 (20.2)% in 2015–16. The prevalence of anaemia among adults was almost unchanged in the last decade. In absolute terms, the current level of malnourishment is still high and remains an enigma.

Globally, India performs very lowly on hunger parameters. According to the International Food Policy Research Institute's (IFPRI) Global Hunger Index (GHI),[2] India has a score of 31.1 and has a global rank of 103 out of 119 countries (GHI, 2018). India's performance on this index is much worse than some of its neighbours—Sri Lanka, Nepal and Bangladesh (Fig. 3.1).

Even though Indian hunger statistics have gotten better over the years (the fall in GHI score since the year 2000 in Fig. 3.1), the relatively high level of deprivation (measured through the GHI 2018 score) has ensured that India ranks poorly in the global hunger index.

A country-level average masks individual levels of deprivation. Within India, statistics reveal that rural households are more at risk of malnutrition than urban households. There is also a large inter-state variation in the pattern and trends. In some states, namely Uttar Pradesh, Odisha, Bihar and MP, the infant mortality rate (IMR) remained as high as 50 per 1000 live births, while in Goa and Kerala, IMR was around 10 per 1000 live births.

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[2]GHI is a global comprehensive index that measures, tracks and compares levels of hunger between countries and regions overtime. A zero GHI score implies zero hunger.

Severe malnourishment among the rural population and the high level of dependence on agriculture for livelihood indicate that there is a strong link between agriculture and nutrition in developing countries. This association for India is presented graphically using scatter diagrams in the annexure (Figs. 3.20, 3.21, 3.22, 3.23). The link between agriculture and nutrition is not direct—there are several ways in which agriculture affects nutritional status. The World Bank outlines five pathways through which agriculture can affect the nutritional status of the population: (i) increased food production leading to increased food consumption; (ii) sale of agricultural commodities leading to increased incomes; (iii) empowerment of women playing a significant role in improving household food security and nutritional outcomes; (iv) decline in food shortage reducing real prices of food; and (v) agricultural growth leading to increased national income which in turn induces a reduction in poverty (Report No: 40196-GLB, World Bank 2007). There have been many studies that have examined this linkage in India. A study by Gulati et al. (2012) based on NFHS-3 (2005–06) data shows that agriculture can have a positive effect on nutritional outcomes. Intervention is also required to improve education, health, sanitation infrastructure, care and feeding practices. A study by Vepa et al. (2014) shows that increase in female agricultural wages has a positive impact on child nutritional status. But a household level study by Bhagowaliya (2012), based on the India Human Development Survey (IHDS 2005), finds that income is a better determinant of nutrition in urban areas than in rural areas and they find a weak relationship between agriculture growth and nutritional outcomes.

In this study, we investigate the possible interaction between agriculture and malnutrition to identify factors that have a significant impact on malnutrition and to assess whether success stories can be replicated in underperforming states as well using more recent data.

The chapter is organised as follows:

After this brief Introduction, we spell out the methodological framework for looking at the linkages between agriculture, poverty and malnutrition in Sect. 3.2. Section 3.3 highlights the performance of Indian Agricultural Sector. In sect. 3.4 we look at the current status with respect to poverty and malnutrition in India and how it has changed over time. In sect. 3.5 we test the hypothesis that agricultural performance does affect poverty and malnutrition status. In sect. 3.6 we go beyond agriculture and look at the influence of other socio-economic factors on malnutrition. Finally, in Sect. 3.7 we present some concluding remarks based on our empirical and econometric analysis.

3.2 Methodology

In this chapter, we briefly explore the causes of child malnutrition and emphasise variables such as agricultural performance, women's education, child care and feeding practices, access to health infrastructure and household amenities in influencing nutritional outcomes. These key determinants are selected based on previous studies as well as UNICEF's conceptual framework on causes of malnutrition (UNICEF 2013; Gulati et al 2012; Bhagowaliya 2012; Kadiyala 2014).

Three indicators of child under-nutrition and two indicators of adult malnutrition are used in the analysis. These are (i) infant mortality rate per 1000 live births (ii) percentage of stunted children and (iii) percentage of underweight children (iv) percentage of thin women (BMI < 18.5 kg/m^2) and (v) percentage of thin men (BMI < 18.5 kg/m^2). The data on child under-nutrition is obtained from two National Family Health Survey Data sets relating to the periods 2005–06 and 2015–16 (NFHS-3 2005–06 and NFHS-4 2015–16). Data on adult malnutrition has also been taken from two NFHS data sets pertaining to 2005–06 and 2015–16.[3] These datasets also provide information on literacy, household sanitation, access to health facilities and child care and feeding practices.

Data on the agricultural performance of states have been taken from the Central Statistical Organisation (for gross value of output from agriculture and allied activities) and Directorate of Economics and Statistics (for gross cropped area). The triennial average of the gross value of output at constant (2011–12) prices per hectare of gross cropped area, which is basically gross land productivity, is used to measure agricultural performance across states.

Generally, panel data analysis with long time series and cross-section data at the household level is better suited to test the impact of different relevant variables on malnutrition. But the dearth of data has forced us to contain our analysis within a cross-section of states over two-time points, viz., 2005–06 and 2015–16. Panel data fixed effects and random-effects models are used to analyse the link between malnutrition and various factors affecting malnutrition. We also investigated the relationship between poverty, agricultural performance and other socio-economic variables. The Hausman test has been run to confirm the appropriate model (fixed effects or random-effects) to apply.

3.3 Performance of Indian Agricultural Sector

India has come a long way since independence—from being a food scarce economy to a self-sufficient one with some net export surpluses. But Indian agriculture is still characterised by high volatility. If we have a look at the plan wise agricultural growth rates, agricultural GDP has grown at 2.7% per annum during the 12th plan period (2012–13 to 2016–17), which is lower than the growth in the previous plan period (4.1% in 2007–08 to 2011–12) (Fig. 3.2). Consecutive droughts in 2014–15 and 2015–16 led to the decline in agricultural GDP growth during the12th plan period. The sector is still strongly affected by the vagaries of nature. The coefficient

[3]In the previous NFHS rounds, data on child malnutrition has been collected for children below age three while for the recent rounds, information has been collected for children below age five. Due to comparability issues, we chose not to consider NFHS-1 and NFHS-2. Similarly, in the previous NFHS rounds, information was gathered only for the ever-married women. For comparability, we have based our analysis of adult malnutrition on the latest two datasets of NFHS.

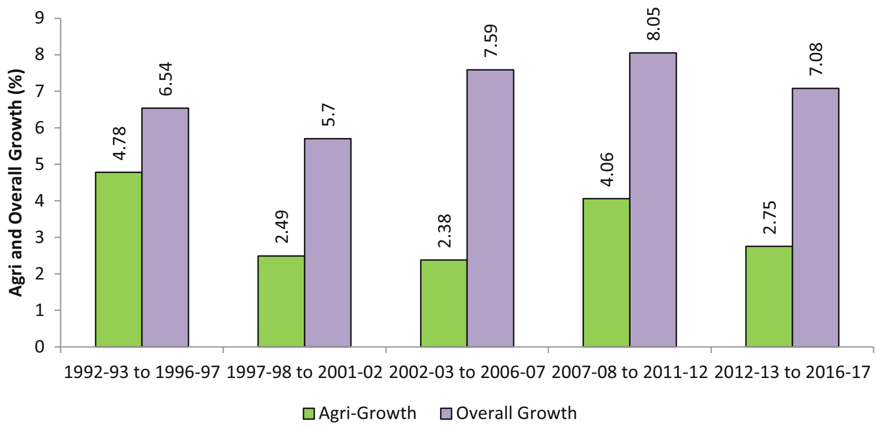

Fig. 3.2 Agriculture and overall GDP growth in India during five-year plans (1992–93 to 2016–17). *Source* Central Statistical Office

of variation of agriculture growth for the period of 1991–92 to 2016–17 and 2000–01 to 2016–17 are 126.3% and 125.8% respectively, which is very high compared to the coefficient of variation of overall GDP growth (24% and 25% respectively) in the same period.

To assess the performance of agriculture over time, one can look at different variables, such as gross value of output from agriculture (GVOA) per ha of net sown area (NSA) or gross state domestic product from agriculture (GSDPA) per agricultural household. The state-wise GVOA per hectare of NSA (GVOA/ha) basically measures net land productivity (Fig. 3.3). States specialising in fruits, vegetables and livestock products (fruits in Himachal Pradesh; fruits, flowers and plantation

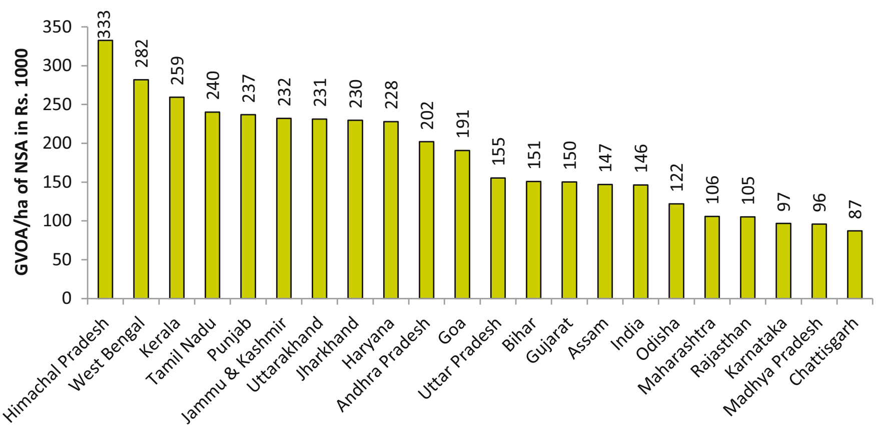

Fig. 3.3 State-wise gross value of output from agriculture and allied activities in Rs. '000/ha of net sown area in TE 2015–16 (in 2011–12 prices). *Source* CSO and DES

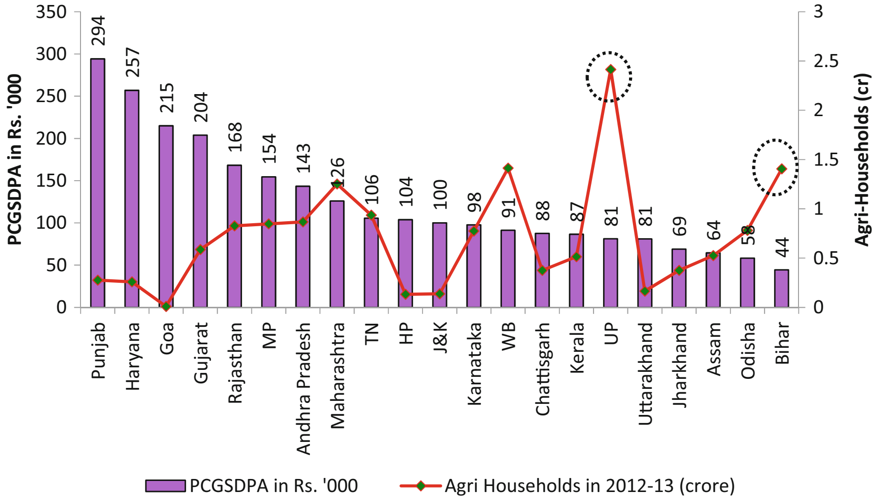

Fig. 3.4 State-wise per capita gross state domestic product (in Rs. '000) from agriculture and allied activities in 2016–17. *Source* CSO and CENSUS

crops in Tamil Nadu; spices and fisheries in Kerala, fisheries and vegetables in West Bengal) perform better in terms of GVO, but their input costs are also very high.

In terms of PCGSDP (GSDP from agriculture per agricultural household) Punjab, Haryana and Gujarat appear to be the wealthiest states. Punjab's PCGSDPA is almost 7 times higher than the poorest state Bihar, indicating wide disparities. Variations in the population growth rate of different states also lead to variation in the per capita GSDPA. States like Bihar and Uttar Pradesh with very high population growth rates fare poorly in terms of this indicator (Fig. 3.4).

Green revolution strategies to augment food grain production were implemented in some parts of the country (Punjab, Haryana and western UP) in the 1960s in a holistic manner and cereal production increased manifold in these areas. The remarkable performance was the result of new farm technology in the form of a combination of high-yielding variety of seeds, fertilisers and pesticides and irrigation infrastructure, which transformed the agrarian structure of these states completely. It resulted in concentrated high growth in the north-western part of India. But eastern states are still dependent on rainfall, making output subject to volatility. The spatial variation in agriculture still exists decades after the implementation of the green revolution; some states show above-average growth rates while others have lagged behind. However, it is important to note that in the initial years of development, very small incentives can boost production substantially (say as in MP, Bihar), but after reaching a high growth trajectory, when their level becomes high, it becomes difficult to boost growth rates further (as in Punjab, Haryana). This is discussed in detail in the state chapters.

Since the green revolution, Indian agriculture specialised in the production of cereals, which have reached a saturation point. Given the limited GCA, the main

Table 3.1 Productivity of important crops

Productivity (MT/ha)	TE 1992–93	TE 2002–03	TE 2016–17
Rice	1.70	2.00	2.40
Wheat	2.33	2.70	3.00
Maize	1.50	1.80	2.60
Cereals	1.60	1.90	2.40
Pulses	0.53	0.57	0.72

Source Directorate of Economics and Statistics

challenge Indian agriculture faces is low productivity (Table 3.1). The yields of input-intensive (water, fertiliser, power) products like rice and wheat are much lower than in China (Economic Survey 2015–16).[4] Even though India is the largest producer and consumer of pulses, its productivity is lower than those of other major world producers of pulses.[5] Hence, there is scope to increase productivity further.

However, in the last few years, it has become apparent that raising production without a harmonised market structure is likely to be counter-productive. In times of glut, the prices of many commodities fall much below their respective MSPs and drop to levels that make it impossible to even recover the full cost (C2) of production, leading to farmers' agitations in different parts of the country. Although agriculture's share in total GSDP declined to around 17% (in current prices) in 2016–17, the movement of labour out of agriculture has been very slow and, according to the Labour Bureau 2015–16, 47% of the total workforce is still employed in agriculture. The share is as high as 74% in Chhattisgarh, 57% in Andhra Pradesh, 55% in Madhya Pradesh and 54% in Bihar. It is lowest in Punjab (34.1%), Kerala (22.3%) and Himachal Pradesh (20.9%). Even though non-farm employment plays an important role in poverty reduction, especially in urban areas, agriculture still plays a critical role. Studies have shown that agricultural growth often results in faster poverty reduction and improvement in nutritional status as compared to similar growth levels in other sectors (WDR 2008).

3.4 Poverty and Malnutrition Situation in India

Poverty levels in India have been exceptionally high, particularly until 1993–94. Half of the population in rural India was living below the poverty line in 1993–94. However, high economic growth and sustained government efforts and programmes have delivered and helped alleviate poverty in the country. As a result, the poverty

[4] According to FAO data, productivity of paddy (rice) in China is 6.9 MT/ha as against 3.8 MT/ha in India in 2017.

[5] According to FAO data, productivity of pulses in major exporting states are as follows: Canada (2.0 MT/ha), Australia (1.8 MT/ha), USA (1.5 MT/ha) in 2017. For TE 2016–17, India's productivity of pulses was 0.72 MT/ha.

headcount ratio has declined significantly in the past two decades both in rural and urban India (Fig. 3.5). The overall HCR poverty has fallen by a little more than half from 45.3% in 1993–94 to 21.9% by 2011–12.

In terms of malnutrition, India's estimates have been high and sticky for a long time (1998–99 to 2005–06). However, there has been considerable improvement in recent years (NFHS-4, 2015–16). Despite the progress, the existing level of child malnutrition (Fig. 3.6) is still very high in absolute terms; there is also considerable inter-state variation. Any improvement in the country's/household's situation will have its initial impact on mortality rates. The infant mortality rate fell from 68 to 57 deaths per 1000 live births between 1998–99 and 2005–06, then again declined to 41 deaths per 1000 live births by 2015–16. So, the risk of mortality was reduced in the first time period (1998–99 to 2005–06), though there was not much change in

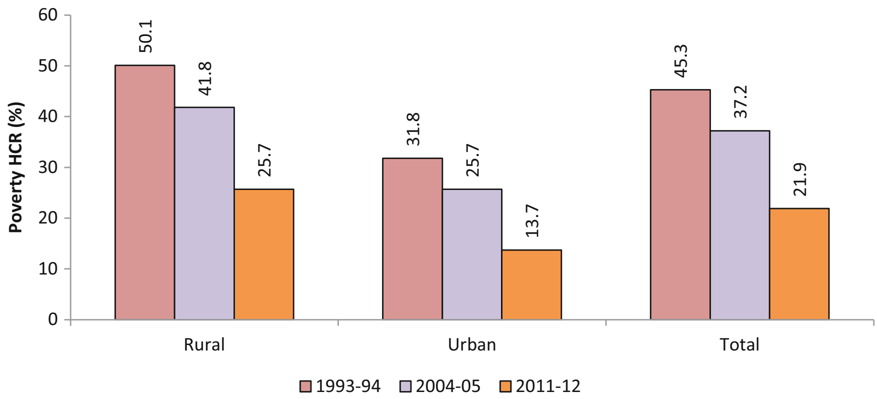

Fig. 3.5 Head count ratio (HCR) of poor (poor as a percentage of population) based on Tendulkar methodology. *Source* Planning Commission, Report of the Expert Group to Review the Methodology for Measurement of Poverty, 2014

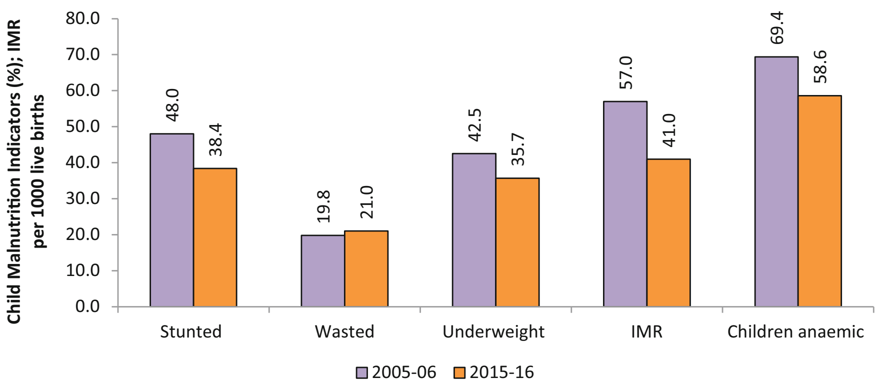

Fig. 3.6 Situation of child malnutrition in India. *Source* NFHS 3 and 4

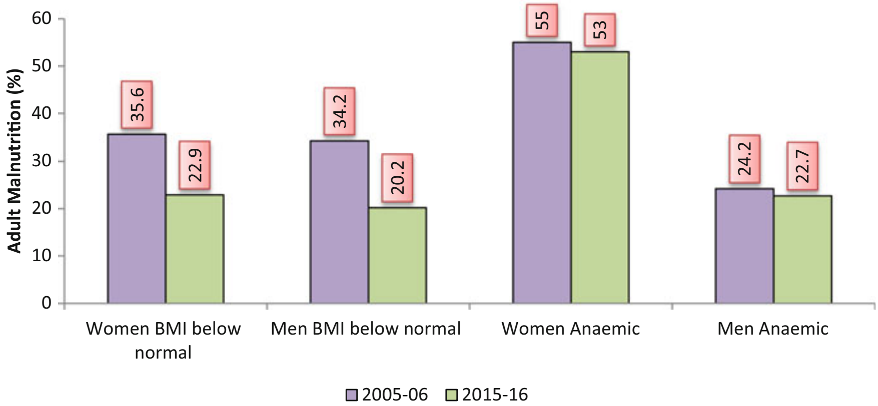

Fig. 3.7 Adult malnutrition in India. *Source* NFHS 3 and 4

terms of a reduction of the risk of malnutrition. But in the next period (2005–06 to 2015–16), the risk of malnutrition fell significantly, although there is still a long way to go. Maybe it is indicative of long lags between the reduction in mortality rates and its effects on malnutrition. There has been a steady decline in the percentage of stunted (48 to 38.4%) and underweight children (42.5 to 35.7%) (Fig. 3.6).However, there was a marginal increase in the share of wasted children (19.8 to 21%), which requires further investigation. The Rapid Survey on Children (RSOC) data estimates the proportion of wasted children for the year 2013–14 at only 15.1%, which is lower than the NFHS figure of 21% in 2015–16. Maybe future NFHSs will reveal a different picture with respect to wasting of children too. Notwithstanding all this, it is somewhat worrisome that more than half (58.4%) of India's children under five years of age suffer from anaemia.

Adult malnutrition is higher among women compared to men aged 15 to 49 years (Fig. 3.7). In 2005–06, 35.6% of women and 34.2% of men were classified as thin with a body mass index less than 18.5 kg/m^2. In 2015–16, the share declined to 23 and 20% for women and men aged 15 to 49 years respectively. This is a significant improvement. But there has not been any commensurate improvement in the micronutrient deficiency among adults. The percentage of women and men suffering from anaemia for the year 2015–16 was 53% and 23%, respectively. The corresponding figures were 55% and 24% respectively in 2005–06. The fact that the rate of anaemic women is more than double that of men is a matter of concern and requires a serious discussion about gender discrimination in Indian diets at the household level. And this should get a special push at the policy level too. Anaemia in women has an adverse effect on children's nutrition levels as well.

There is rural–urban disparity in the indicators of malnutrition. In rural India, the prevalence of stunted and underweight children is 41% and 38%, which is high compared to the urban figures of 31% and 29% respectively. Similarly, 27% of

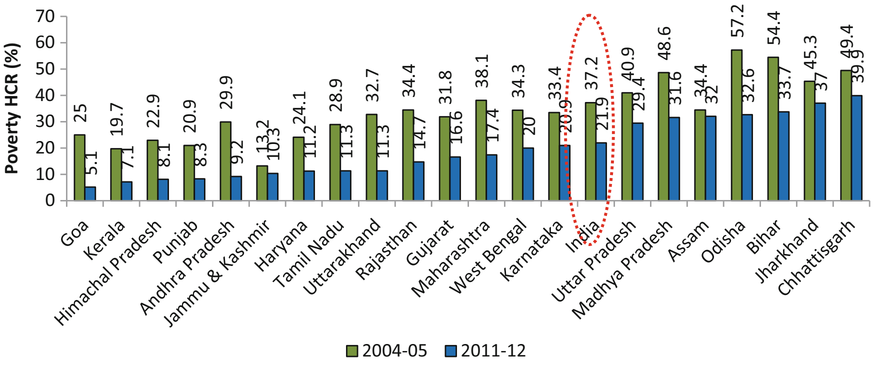

Fig. 3.8 State-wise poverty head count ratio, 2004–05 and 2011–12. *Source* Planning Commission, Report of the Expert Group to Review the Methodology for Measurement of Poverty, 2014

women and 23% of men had below normal BMI in rural India in 2015–16, compared to 15.5% and 15.3% in urban India respectively.

However, as is the case with any national average, this too masks wide inter-state and intra-state variations.

3.4.1 State-Wise Variation in Poverty

State-wise poverty headcount ratios for the year 2011–12 shows that there exists wide spatial variation across states. States like Kerala, Himachal Pradesh and Punjab (that also perform well in agriculture) have a lower number of people below poverty line (BPL) compared to other states. On the other hand, Chhattisgarh, Jharkhand and Bihar perform poorly in terms of poverty (Fig. 3.8).

3.4.2 State-Wise Variation in Child and Adult Malnutrition

State-wise nutrition parameters indicate a huge spatial variation in malnutrition and micronutrient deficiency. The indicators of child under-nutrition are the percentage of stunted, wasted and underweight children under 5 years of age. Each of these indicators represents different aspects of child malnutrition. Stunting is indicative of prolonged under-nutrition while wasting indicates current nutritional status determined by food intake and/or illness. Underweight indicates both acute and chronic malnutrition.

Bihar, Uttar Pradesh and Jharkhand fare poorly in anthropometric indicators. The percentage of undernourished children in these states is more than double when compared to the best performing states of Kerala, Himachal Pradesh, Jammu and Kashmir and Punjab.

The adult nutrition situation is somewhat better across states. But it is still a long journey for states like Jharkhand, Bihar, Madhya Pradesh and Gujarat with 31.5, 30.4, 28.4 and 27.2% of thin women (BMI < 18.5) and 23.1, 25.4, 28.4 and 24.7% of thin men, respectively (BMI < 18.5) in 2015–16.

In 2005–06, half or more than half the population of children below 5 years were stunted in the six states of Uttar Pradesh, Bihar, Chhattisgarh, Gujarat, Madhya Pradesh and Jharkhand. By 2015–16, none of the states was in that category (Fig. 3.9). The highest share of stunted children is now in Bihar (48.3%). Among the states, the fastest decline of stunting (shown as a black line in Fig. 3.9) was observed in Chhattisgarh (a decline of more than 15%), followed by Gujarat (−13.2%), Himachal Pradesh (−12.3%) and West Bengal (−12.1%).

In terms of percentage of children below five years who suffer from wasting (i.e. low weight for height), the situation, nationally and for most states, has worsened. At the all-India level, this percentage has increased from 19.8 to 21%. Interestingly, on all other major indicators of child malnutrition, the situation has improved, except for this indicator where the situation has worsened between 2005–06 and 2015–16 (Fig. 3.10).

Among the 21 states for which the data has been presented above, it shows worsened levels of wasting in children between 2005–06 and 2015–16 in 15 states. Maharashtra shows the worst performance between these years with the incidence of wasting having increased from 16.5 to 25.6% between 2005–06 and 2015–16. This means that at least one in every four children in Maharashtra state has low weight for height, i.e. they suffer from wasting. The states of Madhya Pradesh (−9.2%), Bihar (−6.3%) and Himachal Pradesh (−5.6%) showed the fastest decline in this indicator.

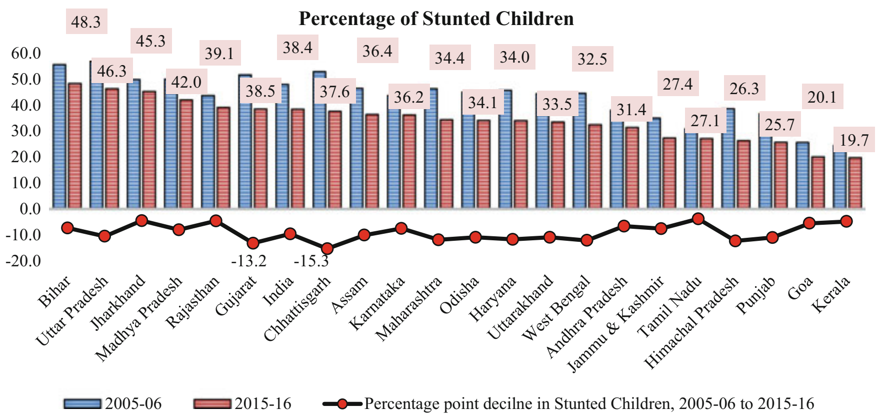

Fig. 3.9 Percentage of stunted children across states, 2005–06 and 2015–16. *Source* Based on data from various rounds of NFHS

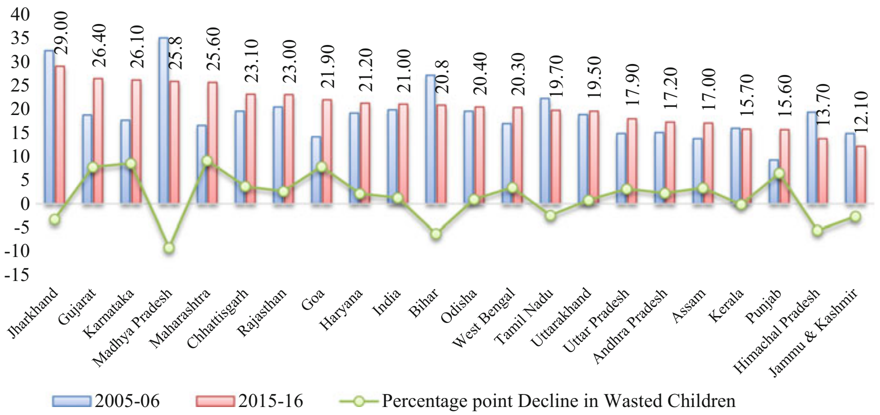

Fig. 3.10 Percentage of wasted children across states, 2005–06 and 2015–16. *Source* NFHS 3 and 4

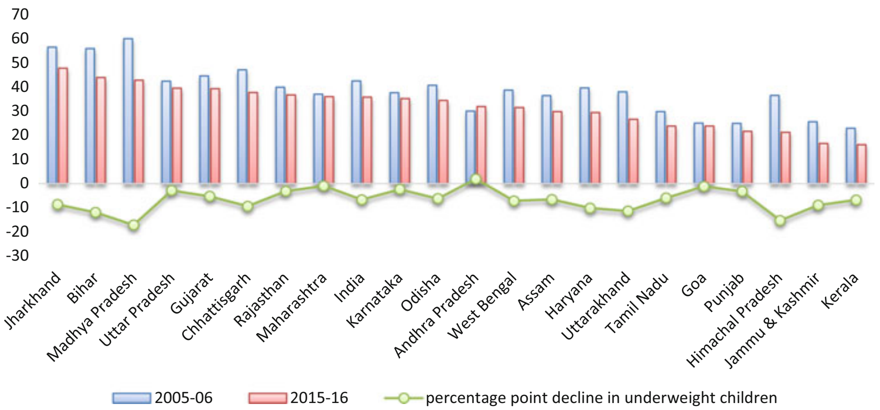

Fig. 3.11 Percentage of underweight children across states, 2005–06 and 2015–16. *Source* NFHS 3 and 4

In terms of the proportion of children who were underweight (Fig. 3.11), the situation has improved in all states. The only exception was Andhra Pradesh where the percentage of children who are underweight increased from 30 to 31.9%.[6]

In terms of nutrition indicators for adults, the situation has improved in all states (Figs 3.12 and 3.13).

State-Wise Performance of the Agricultural Sector and Malnutrition Indicators

[6]Andhra Pradesh data for child malnutrition corresponds to children below age 3.

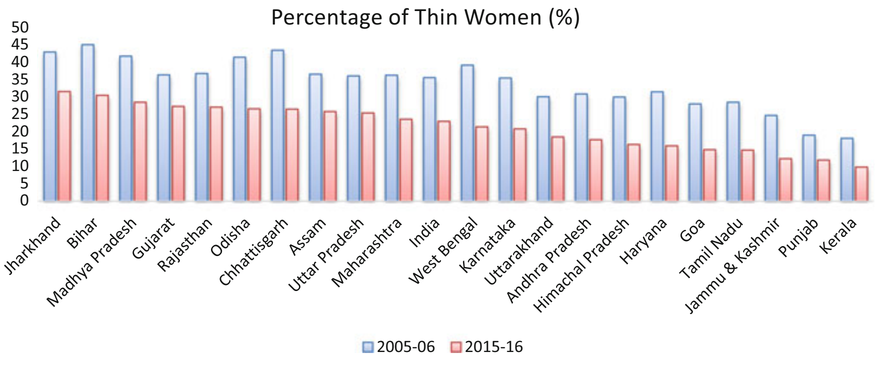

Fig. 3.12 Percentage of thin women across states, 2005–06 and 2015–16

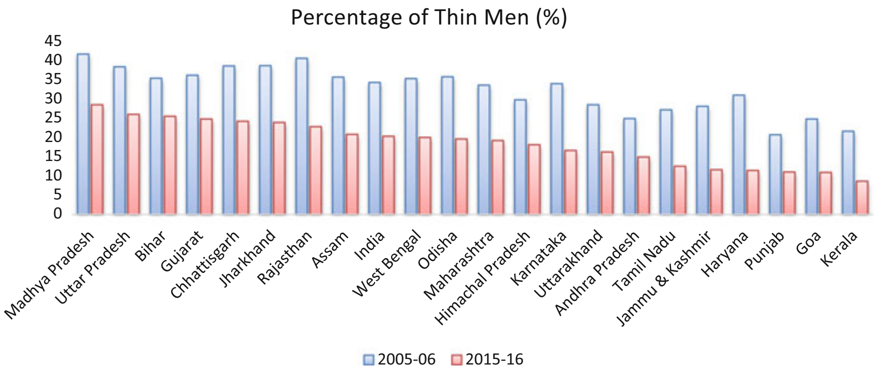

Fig. 3.13 Percentage of thin men across states, 2005–06 and 2015–16. *Source* NFHS, 2005–06 and 2015–16

If we were to map the performance of states on the three indicators of child malnutrition with the agricultural GDP growth rates in states (Fig. 3.14), we find interesting trends. In the figure below, we present the trends for the six focal states.

Three things, inter alia, emerge from the above figure:

1. Among the six states, MP's agricultural GDP grew the fastest and that seems to have translated into significantly improved child malnutrition indicators.
2. Except for Madhya Pradesh and Bihar, all the focal states have experienced an increase in the level of wasting irrespective of their agricultural performance.
3. More generally, agricultural GDP performance appears more closely associated with a state's performance on its "underweight" indicator.[7]

[7]Based on simple correlation between the malnutrition indicators and agricultural GDP growth rates.

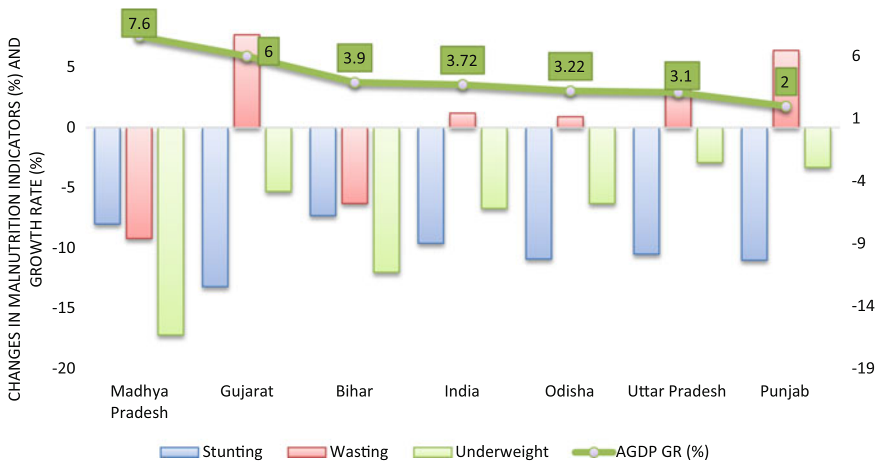

Fig. 3.14 Mapping changes in malnutrition indicators and agricultural GDP growth rates. *Source* Data taken from various rounds of NFHS and MOSPI. *Note* The malnutrition indicator data presented above are calculated as the difference between the actual value of the indicator between 2005–06 and 2015–16. The agricultural GDP growth rate (or AGDP GR) data is calculated as the average agricultural GDP growth in the state between 2005–06 and 2017–18

So, what does this imply? To answer that, one needs to assess if the relation between agricultural performance and performance on various malnutrition indicators is as linear as the figure makes it out to be. To provide depth and robustness to the dynamics of this relation, we undertake an econometric exercise presented in the next section.

3.5 Linkages Between Agriculture, Poverty and Malnutrition

3.5.1 Linkages between Agriculture and Poverty

For a long time, poverty has been concentrated in the rural parts of India. There have been many studies that explain the direct linkage between poverty and agriculture (World Development Report 2008; Godoy 2010). There are many ways agricultural growth can lead to the betterment of a country's population. First, improved agriculture can directly result in increased farm income. Second, the availability of cheaper food will have a positive effect on nutrition. Third, agriculture creates an opportunity for the non-farm sector as well (World Development Report 2008; Godoy 2010). The correlation between poverty and factors that could affect poverty are reported in Table 3.10 in the Annexure . Agricultural performance (PCGSDP), non-farm employment (NFemp), literacy (Lit) and infrastructure (surfaced road density) have a significant negative relation with poverty. The relationship between agriculture and poverty has been investigated through an estimate based on a panel data random-effects model (the Hausman test result confirms random-effects) with poverty being the dependent variable and the factors mentioned above as the explanatory variables with data for 21 major states pooled for two years (2004–05 and 2011–12). There is a strong correlation among the explanatory variables (literacy and infrastructure, non-farm employment and infrastructure, non-farm employment and literacy) and no scope for using instrumental variables. Hence, we have chosen three separate models based on the overall significance of the regression equations. All variables are in the log form; hence coefficients indicate elasticity.

With a structural change in the economy, non-farm employment turned out to be the most important variable influencing poverty, but agricultural income still plays an important role (Table 3.2). Given the declining average holding size in agriculture (1.08 ha in 2015–16), it seems only rational for people engaged in agriculture to look for non-farm incomes supplementing their agricultural incomes. There is ample evidence from NSSO surveys that the smaller the holding size, the more the proportion of income coming from wages and salaries other than from the cultivation of crops. This is taken up in detail in a later chapter on Doubling Farmers' Income. Other important variables that show a strong relationship with poverty are literacy and surfaced road density. Road infrastructure has also been found very powerful in reducing poverty, especially in studies done at IFPRI (Fan et al. 2007).

Table 3.2 Regression results: poverty and factors affecting poverty

Independent variable	Poverty HCR	Poverty HCR	Poverty HCR
PCGSDPA (Standard deviation)	−0.73*** (0.19)	−0.74** (0.25)	−0.89*** (0.23)
Non-farm employment (Standard deviation)	−1.39*** (0.28)		
Literacy (Standard deviation)		−1.97** (-0.70)	
Surfaced road density (Standard deviation)			−0.27** (0.09)
Constant (Standard deviation)	11.57*** (1.09)	14.58*** (2.64)	6.60*** (0.95)
Number of observation	42	42	42
R square within	0.56	0.47	0.47
R square between	0.69	0.53	0.53
R square overall	0.61	0.47	0.48

Source Authors calculation
Note **significant at 5%, ***significant at 1% (Definition and construction of variables are given in detain in Annexure Table 3.9). Numbers in parentheses are standard deviations

3.5.2 Linkages Between Agriculture and Malnutrition

In this section, we have taken one representative variable from each dimension (income, literacy, child care, access to health care and household amenities) to measure the interplay of malnutrition and socio-economic variables. Adult malnutrition is measured by taking a simple average of the share of thin men and women (BMI < 18.5 kg/m^2). Tables 3.3 and 3.4 show that gross value of output per hectare of gross cropped area (measuring the performance of agriculture) has a higher standard deviation than other independent variables indicating a large variation across states. To explain child malnutrition, three important indicators have been considered: IMR per 1000 live births, share of stunted children below the age of 5 years at the state level and underweight children below the age of 5 years at the state level. Detailed description of the variables and their respective sources are presented in Table 3.9 in Annexure. Table 3.4 shows IMR has higher standard deviation, compared to the percentage of underweight and stunted children. This is expected as any positive change in the socio-economic status of the household will have its initial impact on

Table 3.3 Summary statistics: adult malnutrition

Variable	Observations	Mean	Standard deviation	Min.	Max.
BMI	42	26.5	9.3	9.1	41.65
GVOA/ha	42	585.1	265.9	203	1215
Flit	42	66.3	15.12	36.2	97.9
Mlit	42	75.3	16.7	36.2	98.1
HH_Toilet	42	50.5	20.8	15.1	98.1
Delivery_HP	42	68.7	22.9	27.2	100

Source Data taken from various rounds of NFHS and MOSPI

Table 3.4 Summary statistics: child malnutrition

	Observations	Mean	Standard deviation	Min	Max
IMR	42	42.5	16.9	6	72.7
Stunted	42	38	9.5	19.7	56.8
Underweight	42	35.2	10.1	16.1	60
GVOA/ha	42	585.1	265.9	203	1215
Flit	42	65.3	15.1	36.2	97.9
HH_Toilet	42	50.5	20.8	15.1	98.1
Bfed_1 h	42	38.9	17.7	3.7	73.3
Delivery_HP	42	68.9	22.9	27.2	100
Vaccination	42	59.9	16.6	23	89.1

Source Data taken from various rounds of NFHS and MOSPI infant mortality. In the period between 2005–06 and 2015–16, there has been a major decline in infant mortality rates in all states.

Factors affecting child malnutrition also vary across states. Although we have taken the same explanatory variables to explain the dependent variables, the degree and nature of the association are different.

Interpretation of the Regression Results

The present analysis is based on panel data on malnutrition and factors affecting it collected for two points of time, 2005–06 and 2015–16, across 21 major states. The correlation between child and adult malnutrition and the factors that could affect them are presented in the Annexure Tables 3.11 and 3.12. As expected, agricultural performance shows a high and negative correlation with malnutrition. Other important factors significantly influencing malnutrition are literacy, toilet facilities at home, access to health care facilities (vaccination, delivery by health personnel) and child feeding practices (breastfed within an hour of birth).

Many of these explanatory variables show a high correlation with each other. For example, there is a very high correlation between literacy and toilet facilities. Literacy is also highly correlated with child vaccination and child care. This kind of collinearity suggests that the estimation procedure should be based on the instrumental variable approach. However, dearth of data prevents us from using this approach. As far as possible, we have used different combinations of explanatory variables that are not expected to suffer from endogeneity.

Our analysis is based on panel data (both time and state dummies) fixed and random effect models to investigate the interplay of malnutrition and the factors that affect it. The fixed effect model is used while analysing the impact of variables that vary over time. The rationale behind the random effect model is that the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables in the model. The Hausman test has been run to choose between fixed effect model and random effect model. The Hausman test confirms that the fixed effect model is appropriate to examine the relationship between IMR with agriculture, access to health variables. However, the random effect model is preferred for the other three equations. We have chosen four models based on the overall significance of the coefficients of the regressors.

To investigate the association between agricultural performance and adult malnutrition, we estimate a random-effects model with BMI (average of percentage of men and women BMI below normal) as the dependent variable and factors mentioned above as the independent variables. Factors that have a significant influence on adult malnutrition are agricultural performance, literacy and delivery assisted by health personnel (Table 3.5). Sanitation and access to improved water are also important variables. But female literacy is highly correlated with access to toilet and health care and child feeding practices and hence, cannot be measured in the same equation.

Similarly, the association between agricultural performance and child malnutrition is estimated using the fixed effects model with IMR as the dependent variable and random-effects model with stunted and underweight as dependent variables (depending on the results of the Hausman test). Agricultural performance holds a

Table 3.5 Association of BMI with agriculture, access to health and sanitation variables (random effect model)

Dependent variable	BMI
Independent variables	
GVOA/ha Standard deviation Elasticity	−0.05*** (0.008) −0.21
Total_Lit Standard deviation Elasticity	−0.35** (0.13) −0.99
Delivery_HP Standard deviation Elasticity	−0.10*** (0.04) −0.26
Constant Standard deviation	65.9*** (7.58)
Number of Observations	42
R square within[a]	0.95
R square between	0.59
R square overall	0.79

Source Authors calculation
Note **significant at 5%, ***significant at 1% (Definition and construction of variables are given in detain in Annexure Table 3.9). Numbers in parentheses are standard deviations
[a]Within *R*-square measures, how much variation over time is explained and between *R*-square measures, how much variation across cross-section is explained; overall *R* square measures overall variation in the data

strong negative relation with child malnutrition. Access to improved sanitation facilities (toilet facilities and drinking water) has a strong impact on long-term child malnutrition indicators (stunted and underweight children). Other important factors affecting child malnutrition are vaccination (percentage of children in the age group 12–23 months who received all basic vaccinations: BCG, measles, three doses each of DPT and polio vaccines), delivery assisted by health personnel and breastfeeding practices (Tables 3.6, 3.7 and 3.8).

3.6 Performance of Socio-Economic Factors Affecting Malnutrition

In this section, we have followed international literature (UNICEF 2013; Gulati et al. 2012; Bhagowaliya 2012; Kadiyala 2014) as well as results derived from the above analysis to construct a conceptual framework of malnutrition, which is greatly influenced by the agricultural performance of the state/country. Other immediate

Table 3.6 Association of IMR with agriculture, access to health variables (fixed effect model)

Dependent variable	IMR
Independent variables	
GVOA/ha (gross value of agriculture per ha of GCA) Standard deviation Elasticity	−0.03** (0.01) −0.08
Vaccination (children having all basic vaccination) Standard deviation Elasticity	−0.23** (0.11) −0.331
Delivery_HP Standard deviation Elasticity	−0.24 *** (0.08) −0.39
Constant Standard deviation	76.5*** (4.28)
Number of observations	42
R square within	0.89
R square between	0.84
R square overall	0.77

Source Authors calculation
Note **significant at 5%, ***significant at 1%. Numbers in parentheses are standard deviations

Table 3.7 Association of stunting with agriculture, access to housing amenities and health variables (random effect model)

Dependent variable	Stunted
Independent variables	
GVOA/ha Standard deviation Elasticity	−0.03** (0.009) 0.08
HH_toilet Standard deviation Elasticity	−0.18*** (0.04) 0.23
Vaccination Standard deviation Elasticity	−0.25*** (0.05) 0.39
Constant Standard deviation	66.6*** (2.79)
Number of observations	42
R square within	0.73
R square between	0.84
R square overall	0.81

Source Authors calculation
Note **significant at 5%, ***significant at 1%. Number in parentheses are standard deviations

Table 3.8 Association of being underweight with agriculture, access to housing amenities and health variables (random effect model)

Dependent variable	Underweight
Independent variables	
GVOA/ha Standard deviation Elasticity	−0.03** (0.01) −0.08
HH_toilet Standard deviation Elasticity	−0.25*** (0.05) −0.36
Bfed_1hr (% of children who are breastfed within an hour) Standard deviation Elasticity	−0.14** (0.06) −0.15
Constant Standard deviation	56.04*** (3.05)
Number of observations	42
R square within	0.63
R square between	0.71
R square overall	0.69

Source Authors calculation
Note **significant at 5%, ***significant at 1%. Numbers in parentheses are standard deviations

factors influencing child malnutrition are maternal and child care practices, household amenities and access to health facilities. In turn, these are influenced by female literacy, the structure of the economy, the political situation, societal arrangements, etc. Each factor affecting malnutrition is discussed briefly in the section.

3.6.1 Women's Education

Studies have shown that women's education and status in the family plays an important role in a child's nutrition. Literate mothers can make more efficient use of health care institutions (Borooah et al. 2002). Women make important decisions regarding family health, feeding and child care. Lack of knowledge can have an adverse effect on child health. To capture the impact of women's education, we have taken the gross enrolment ratio[8] for girls in I–VIII, gross enrolment ratio for girls in IX–X and gross enrolment ratio for girls XI–XII from the ministry of HRD for the year 2011–12 and female literacy rate for 2011. Each of these indicators of educational status is first

[8]Gross Enrolment Ratio (GER): Total enrolment at a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school-year. It is calculated by dividing the number of pupils (or students) enrolled in a given level of education regardless of age by the population of the age-group that corresponds to the given level of education, and multiplying the result by 100.

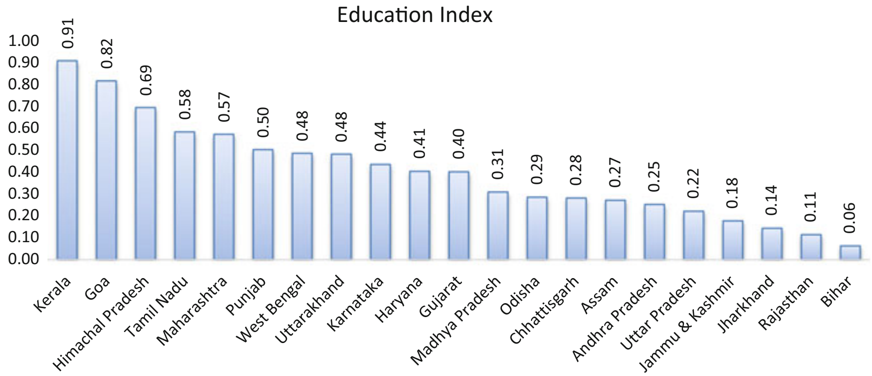

Fig. 3.15 Normalised education index. *Source* Ministry of HRD and NFHS-4

normalised according to the following formula:

$$\text{Normalised Indicator} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

And then a normalised education index is constructed by taking a weighted average of these indices with the one-third weight assigned to knowledge represented by the gross enrolment ratio and two-third assigned to adult literacy (Fig. 3.15).

States like Kerala, Himachal Pradesh, Tamil Nadu and Goa ranked high in the education index and Rajasthan, Bihar and Jharkhand fared badly in the ranking (Fig. 3.15).

3.6.2 Child Care Practices

In the case of malnutrition, an important underlying influence is the care provided to children. There has been increasing awareness of cultural and behavioural practices regarding child rearing that affects child nutrition. Inadequate care for children and women is one of the fundamental causes of malnutrition. Hygienic practices at home and in the handling of food and drinking water reduce the risk of illness. Care practice plays a vital role in the emotional as well as physical upbringing of children. The key care practices that affect child malnutrition include care of pregnant and lactating mothers, breastfeeding practices, feeding young children, care during illness, food preparation and hygiene (UNICEF 2013).[9]

[9]Care of pregnant women and hygiene have been analysed under dimensions of access to health facilities and household amenities (dimensions) respectively in the current study.

Current evidence on feeding practices in India cited from the NFHS survey (2015–16) shows an improvement over NFHS-3 (2005–06) results. Early initiation of breastfeeding is highly recommended because it helps stimulate breast milk production. Breastfeeding within one hour ensures that the infant receives colostrum, which is rich in protective factors (WHO). The first breast milk is highly nutritious and has antibodies that protect infants from diseases. Several studies have shown that early initiation of breastfeeding reduces the risk of neonatal mortality (UNICEF). It also helps in preventing uterine bleeding and hypothermia. Exclusive breastfeeding in the first six months has a positive impact on the child's life. During this period, an infant not exclusively breastfed has a higher risk of death. Hence, optimal breastfeeding (breastfeeding within 1 h + exclusive breastfeeding for the first six months) could reduce child mortality.

Good complementary feeding practice along with breastfeeding has played an important role in the nutritional status of children by reducing stunting significantly. Complementary feeding should be promoted with special focus on the education of the caregiver, fortifying complementary foods, creating awareness of the right age and required complementary food feeding frequency, etc.

According to NFHS 3 (2005–06) data, 23.4% of children under age three were breastfed within one hour of birth. The share doubled by 2015–16. But the share of children in India aged 6–8 months receiving solid, semi-solid food and breast milk declined from 52.6% in 2005–06 to 42.7% in 2015–16.

We have constructed an index of child care practices using four important variables cited from the recent NFHS survey (2015–16) regarding child care: percentage of children under six months exclusively breastfed, percentage of children below three years breastfed within one hour of birth, percentage of children aged 6–8 months who were fed complementary foods and percentage of breastfed children in the age group 6–23 months who had a minimum dietary diversity. A normalised composite index has been constructed for all states. Each of these indicators of "childcare" is first normalised according to the formula:

$$\text{Normalised Indicator} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

The normalised child care index is then estimated as a simple average of the normalised values of the indicators.

The diagram shows the ranking of states based on the normalised childcare index—the higher the rank, the better-off the state is. The state ranking shows that Goa, Tamil Nadu, Kerala and Odisha fare well in child care practice while Punjab, Bihar, Rajasthan and UP are the worst-performing states (Fig. 3.16).

Proper child care practice is dependent on factors like knowledge and beliefs about child rearing, the health and nutritional status of care providers and the role in decision making and economic status of the care givers. Studies have shown that different programmes aimed at nutritional intervention and knowledge building has had a significant impact on child health status.

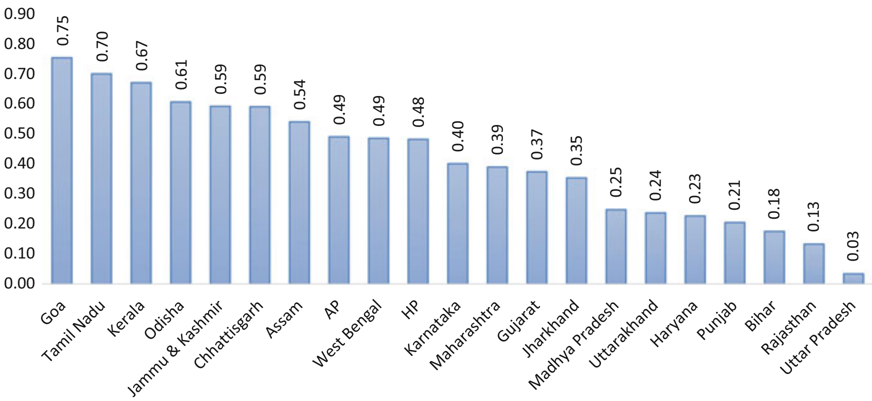

Fig. 3.16 Normalised child care index. *Source* NFHS-4

3.6.3 Household Infrastructure and Amenities

Rapid urbanisation comes with several challenges in terms of proper housing facilities, safe drinking water and sanitation. Access to basic amenities such as safe drinking water, toilet facilities and clean cooking fuel is fundamental to the health of its members. Access to regular piped drinking water on the premise implies women do not have to travel long distances for water every day. Use of unclean fuel exposes women to harmful smoke, which increases the chance of having respiratory diseases. Similarly, access to electricity also reduces day-to-day hardship. Clean fuel and electricity have a direct impact on women's health, and hence, influence child health too. Without proper access to safe drinking water and toilet facilities, the problem of malnutrition cannot be overcome.

There has been an improvement in access to housing amenities over the years. In 2005–06 nearly 88% of the population had access to an improved source of drinking water[10]; the share increased to 90% in 2015–16. However, only 29.2% households (18.4% in rural and 52.1% in urban India) have access to piped water into dwelling/yard/plot. In 2005–06, 29% of households had improved toilet facility; the share increased to 48% in 2015–16. The improvement is impressive, but half the population still did not have access to basic household amenities in 2015–16, which has a serious impact on nutritional status. Lack of improved sanitation facilities increases the probability of getting diarrhoea, which reduces the positive impact of consuming healthy food.

We have created a composite index of household amenities by considering four variables: access to safe drinking water, improved toilet facilities (not shared), electricity as a source of lighting and clean fuel for cooking (LPG use). A normalised

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[10]Include piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater and community reverse osmosis (RO) plants.

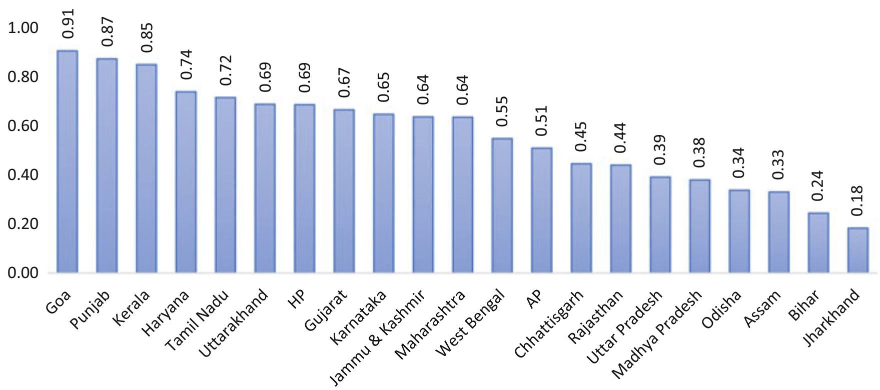

Fig. 3.17 Normalised index for housing amenities. *Source* NFHS-4

composite index has been constructed for all states. Each of these indicators of "housing amenities" is first normalised according to the formula:

$$\text{Normalised Indicator} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

The normalised index for housing amenities has then been estimated as a simple average of the normalised values of the indicators.

The ranking of normalised index for housing amenities shows that Goa, Punjab and Kerala did well while Assam, Bihar and Jharkhand lagged behind (Fig. 3.17).

3.6.4 Access to Healthcare Facilities

Nutrition plays a vital role in ensuring a healthy life for both men and women. However, women's nutrition assumes greater significance due to their complex association with children's nutritional status. There are several linkages between the nutritional status of women and children. Maternal malnutrition (iron deficiency) increases the risk of maternal mortality during childbirth. Malnutrition is both a cause and consequence of disease in adults and children. Maternal care includes supplementation with iron, folic acid or multiple micronutrients during pregnancy. Intake of iodine and iron during pregnancy helps in the development of an infant's nervous system. So, access to healthcare facilities becomes a significant factor affecting malnutrition. Access to healthcare facilities for pregnant and lactating women ensures the birth of children safely and vaccines keep children alive and healthy by protecting them against diseases.

In 2005–06, 12% of pregnant women received full ante-natal care (ANC), 47% of the children were delivered by health personnel and 35% received post-natal (PN)

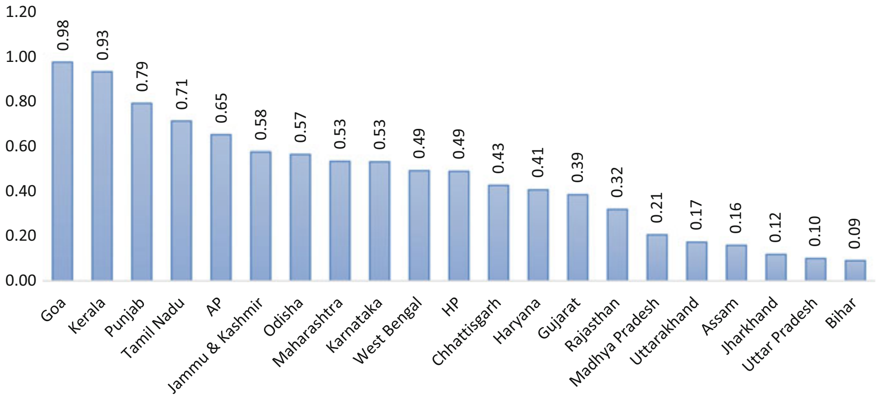

Fig. 3.18 Normalised index for access to healthcare. *Source* NFHS-4

check-ups within two days of birth. In 2015–16, these figures increased to 21%, 81% and 62.4% respectively. The percentage of children (12–23 months) receiving full immunisation increased from 43.5 to 62%.[11]

To construct the index for access to healthcare, we have considered four variables from the recent NFHS-4 data for 2015–16: the percentage of mothers who received full ANC, the percentage of mothers who received full PNC within 48 hours of delivery, percentage of delivery by health personnel and the percentage of children who received all vaccination. A normalised composite index has been constructed for all states. Each of these indicators of "access to healthcare" was first normalised according to the formula:

$$\text{Normalised Indicator} = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$$

The normalised index for access to health care has then been estimated as a simple average of the normalised values of the indicators.

There have not been many changes in the ranking of access to healthcare performance in the last decade. Goa, Kerala, Punjab and Tamil Nadu rank up in the chart and Jharkhand, Uttar Pradesh and Bihar fare poorly (Fig. 3.18).

Finally, we have constructed a composite socio-economic index considering (averaging the values of) all four dimensions: education, child care, housing amenities and access to health care.

According to the ranking based on the normalised socio-economic index, Kerala, Goa and Tamil Nadu score high while Rajasthan, Jharkhand, Uttar Pradesh and Bihar perform badly in terms of basic socio-economic indicators (Fig. 3.19). The rank correlation between socio-economic index and malnutrition index is 0.77, indicating a strong correlation between them.

[11]BCG, measles, and three doses of DPT and polio vaccine.

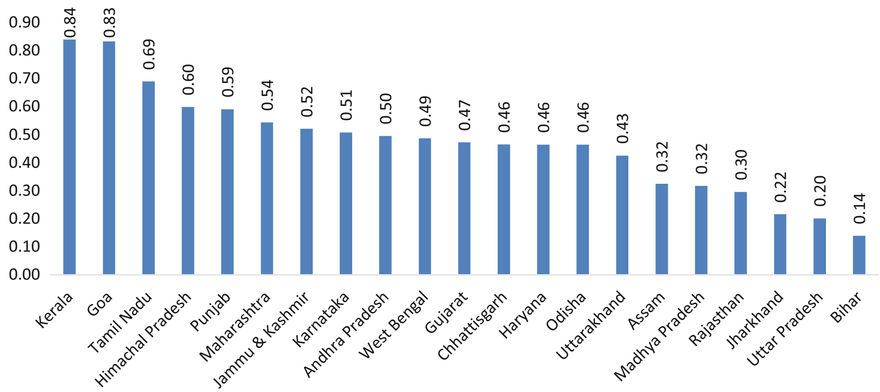

Fig. 3.19 Normalised socio-economic index. *Source* NFHS-4

3.7 Concluding Remarks and Way Forward

Although India's child nutrition rates have shown an improvement since 2005–06, we are still below the rates of progress experienced by other countries. At the current pace, India will achieve what China has achieved today by 2055 (Global Nutrition Report, 2015). Hence, more serious commitment is needed from the government to eradicate malnutrition completely by 2030.

Role of Agriculture in Reducing Malnutrition

Some important results emerge from this study. The performance of the agricultural sector plays an important role in reducing malnutrition in India. A large section of the workforce depends on agriculture and allied activities as a source of livelihood. Food shortages and rising or volatile food prices also affect nutritional status. Hence, an improvement in productivity can solve the problem of food shortage and price stability, making food affordable to the vulnerable sections of the population. Apart from an increase in yield, diversification towards high-value agriculture (fruits, vegetables, fisheries and livestock) will ensure a diversified food basket, which will also ensure better nutrition. This is reflected in the changing consumption pattern of the Indian population, which shows a shift away from basic staple foods (NSSO; 2011–12). States like Kerala, Himachal Pradesh, Jammu and Kashmir and Goa that specialise in high-value agriculture also rank higher in the nutrition ladder. Punjab and Haryana have historically been consistent in terms of a high level of agricultural prosperity, Punjab performs well but Haryana lags behind in terms of nutritional outcome. States like Bihar, Odisha, UP and Rajasthan with low agricultural performance also show high rates of under-nutrition. However, it should be mentioned that since agricultural prosperity affects malnutrition by improving food security and reducing poverty, its impact on malnutrition and poverty will be manifested over the long-term. In recent years, Gujarat and Madhya Pradesh have experienced very high growth rates in agriculture, while Odisha experienced the highest growth in farm income. But this is not yet reflected in the indicators of malnutrition. These states still rank very low in the ranking based on malnutrition. As our research shows above, malnutrition is affected by several factors including access to hygiene and health services, female literacy, etc.; agricultural performance and prosperity is only one parameter, albeit an important one, in this complex equation of solving the problem of malnutrition.

Multidimensional Approach to Reduce Malnutrition

Agricultural performance, therefore, may be a necessary condition, but it is certainly not enough to ensure improved nutrition. The multidimensional nature of malnutrition requires intervention in a holistic manner. The two most important direct nutrition intervention programmes implemented in India are the Integrated Child Development Scheme (ICDS) and the Mid-day Meal Scheme (MDMS). These programmes were launched to address the nutritional needs of children and women. The ICDS scheme is the GOI's flagship programme launched in 1975 by the Ministry of Woman and Child Development and is one of the world's largest programme for early childcare and development. The beneficiaries under the scheme are children in the age group of 0–6 years and pregnant and lactating mothers. The objectives of the two schemes are (1) to improve the nutritional and health status of children in the targeted age group, (2) to lay the foundation for the proper psychological growth of children, (3) to minimise the incidence of mortality, morbidity, malnutrition and school dropouts and (4) to enhance the capacity of mothers to be able to take proper care of children. To achieve these objectives, the scheme offers a combination of six services – supplementary nutrition, pre-school non-formal education, nutrition and health education, immunisation, health check-ups and referral services (the last three health-related services are provided by Ministry of Health and Family Welfare) (icds-wcd.nic.in/icds). According to the CAG Report (22nd Report, 2012–13), the programme is plagued by organisational failures. Poor hygiene and lack of sanitation facilities, lack of medical kits and lack of well-trained staff are among the problems that plague *Anganwadi* centres where children are fed.

The mid-day meal scheme as a tool to promote education and supplement nutrition was adopted in some parts of India (Madras Municipal Corporation) before independence and, over the years, the number of states adopting this programme has increased. It became a centrally sponsored scheme under the name of National Programme of Nutritional Support to Primary Education (NP-NSPE) on August 15, 1995, when it was introduced in 2408 blocks; by 1997–98, the NP-NSPE was introduced in all blocks of the country. Food norms have been revised in recent years (2009) to ensure a balanced and nutritious diet to children of the upper primary group by increasing the quantity of pulses from 25 to 30 gms, vegetables from 65 to 75 gms and decreasing the quantity of oil from 10 to 7.5 gms. This food assistance programme also suffers from organisational failures. Extreme cases of death due to improper food preparation have happened in some pockets of the country (Bihar), luckily not so frequently. But cases of children falling ill from stale food are quite common, which shakes the faith of parents in the scheme, leading them to withdraw their children from school. A proper system of vigilance should be introduced, including participants from various stakeholders, to ensure the quality of food. This scheme is instrumental in reducing hunger and malnutrition among children; hence, the shortcomings need to be corrected.

Nutritional education and health interventions were also initiated through the Nutrition Board and ICDS. But there were gaps in the implementation of these interventions because the workers lacked training. In our study, we have found that each state has specific reason(s) for underperformance in nutritional outcomes. A successful malnutrition reduction strategy is required with a special focus on specific areas relevant to each state.

Some states have declared independent state nutrition missions. Maharashtra was the first to launch a mission in the form of an autonomous, technical and advisory body in 2005. Subsequently, five other states followed in the footsteps of Maharashtra–Madhya Pradesh, Uttar Pradesh, Odisha, Gujarat and Karnataka. But other than Maharashtra and Karnataka, these states could not bring about much improvement in the rates of under-nutrition.

Our study has shown that literacy, child care, sanitation and access to health care facilities have an immediate impact on malnutrition. These findings have important implications for policy interventions. According to the Census data, female literacy improved from 54% in 2001 to 65% in 2011; there is still a lot of scope for improvement. Direct nutritional intervention through special nutrition benefit schemes (ICDS, mid-day meal), can play a critical role in child nutrition. Female literacy also has a positive effect on child care and access to health and sanitation. Hence, improving the female education status will have a multiplier effect on malnutrition, as access to these facilities is not only governed by the income of the household but also by knowledge about nutrient-enriched complementary foods, timing and handling of food, proper hygiene and so on. Liberal scholarship programmes for the girl child should be initiated in states to incentivise female education following the example of *Kanyasree* in West Bengal.

Everyone has a right to basic sanitation facilities (safe drinking water, toilet) and ensuring that very basic right is every government's duty. Only 3% of rural households in Bihar (5% in Odisha and 3% in UP) and 15% of urban households (33% in Odisha and UP) have access to piped water at their residence. The Modi government's new scheme *"Nal se Jal"* to provide piped drinking water to every household by 2024 is a welcome step and is expected to improve the drinking water situation in these states. Only 48% of the households have improved quality of (not shared) toilets. There is lot of scope for improvement. The *Swachh Bharat Abhiyan* is a recent programme aimed at improving sanitation that can play a role in eradicating under-nutrition. The scheme was launched in 2014 and as of now, 28 states and nine UTs have been declared 100% open defecation free. Since October 2, 2014, close to 10.29 crore toilets have been built under the scheme (https://swachhbharatmission.gov.in/sbmcms/index.htm accessed on 17.3.2020). This will certainly have a positive effect on the nutrition outcomes as and when the results of next round (5) of NFHS come.

Micronutrients are important to improve nutritional status and the cost-effective way to do so is through biofortification of crops with essential nutrients such as iron, zinc and vitamin A. United Nations agencies recommend that the adoption of biofortification will not only improve the diet of household effectively but also improve the nutritional status of children. The Indian Council of Agricultural Research (ICAR) should partner with Harvest Plus programme of Consultative Group of International Agricultural Research (CGIAR) to adopt cost-effective, sustainable and innovative approach for nutrient-rich staple food crops.

Diversifying diets away from cereals can help improve nutritional outcomes. But currently, cereals dominate the food basket of most Indian households, resulting in diets that are deficient in protein and micronutrients. Encouraging the consumption of protein and micro-nutrient-rich foods will lead to a marked improvement in nutritional status. This would imply the inclusion of soya, meat, eggs and milk in nutrition intervention programmes. Soybean is one the cheapest source of protein, but soya does not figure in a big way in the Indian diet. A study by Gulati and Verma (2016) has shown that the percentage of households eating non-vegetarian food has increased. Egg is also a cheap source of protein compared to pulses today. Consumption of these nutritious foods can be promoted via distribution in the mid-day meals and Integrated Child Development programmes.

But as emphasised throughout this chapter, based on our econometric analysis, that malnutrition is a multidimensional problem. It requires a synchronised approach to improve basic hygiene facilities (toilets and safe drinking water), health facilities (immunisation, etc.) and female literacy. The latest programmes of the government in this direction are commendable, and one hopes that in due course, they will pay rich dividends, and India can assure its citizens a more healthy and nutritious future.

Annexure

See Figs. 3.20, 3.21, 3.22, 3.23 and Tables 3.9, 3.10, 3.11 and 3.12.

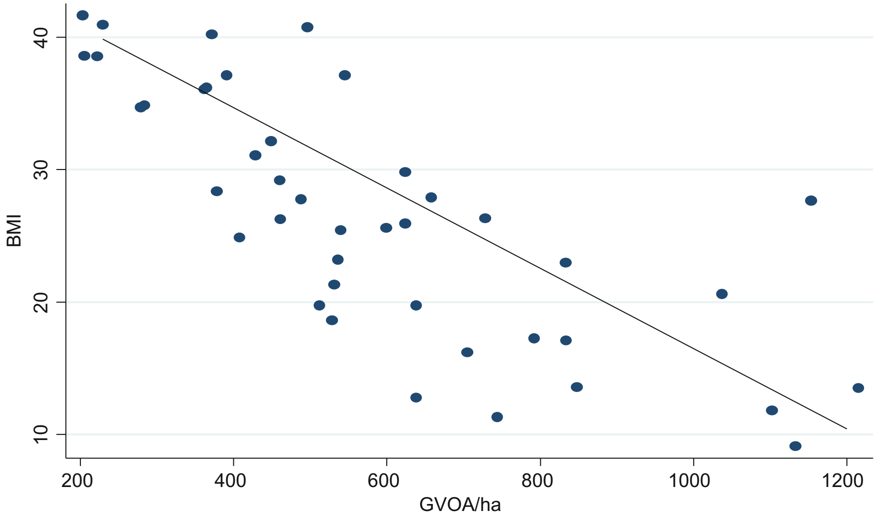

Fig. 3.20 Association between BMI and GVO from agriculture per ha of GCA

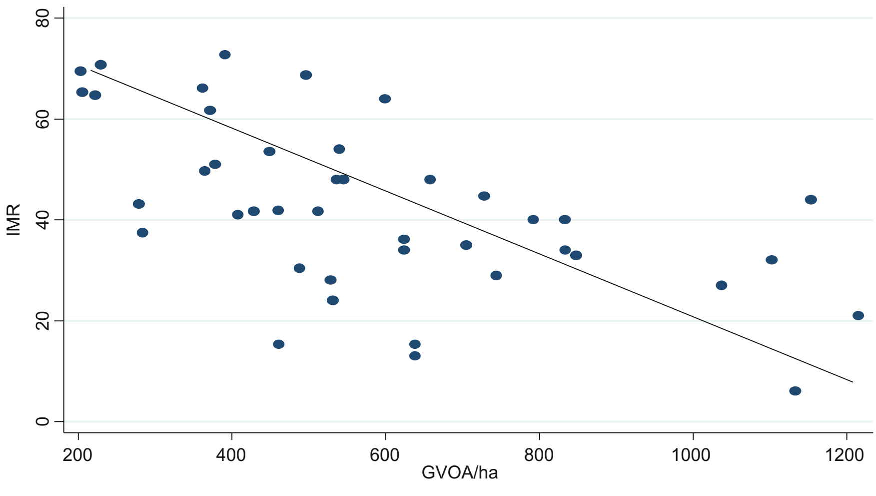

Fig. 3.21 Association between IMR and GVO from agriculture

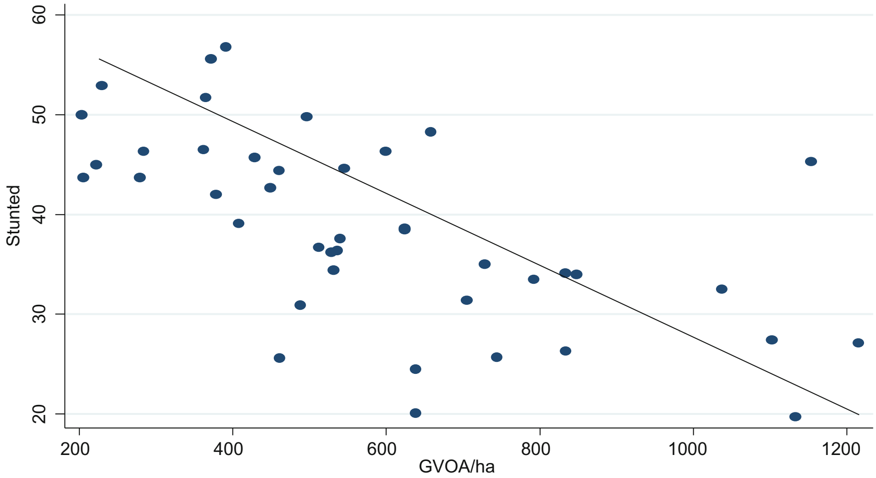

Fig. 3.22 Association between stunted children and GVO from agriculture per ha of GCA

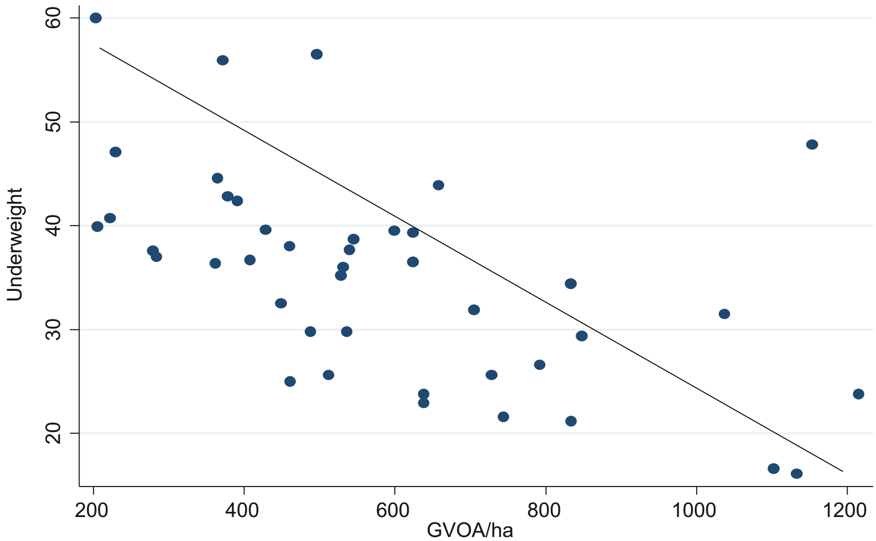

Fig. 3.23 Association between underweight children and GVO from agriculture per ha of GCA

Table 3.9a Variable construction and data source

Variables and Data Source	Definitions	Source
Total poverty (Pov)	Head count ratio following tendulkar methodology (2004–05 and 2011–12)	Planning commission
PCGSDP	Per capita GSDP from agricultural and allied services (TE 2004–05 and TE2011–12)	CSO and CENSUS
Non-farm employment (NFEmp)	Percentage of workforce employed in non-farm activities (2004–05 and 2011–12)	NSSO
Surfaced road density (SRD)	Surfaced road length/geographical area * 1000 (2004–05 and 2011–12)	Ministry of transport, road and highways
Total literacy (Lit)	Total literacy rate of states (2001 and 2011)	Census

Table 3.9b Variable construction and data source

Variables	Construction	Data source	Year
GVOA/ha	Gross value of output per ha of gross cropped area	CSO, MOSPI	TE 2005–06 and TE 2015–16
Literacy	Total literacy rate	NFHS	2005–06 and 2015–16
Stunted	Percentage of stunted children in the age group 0–59 months	NFHS	2005–06 and 2015–16
Underweight	Percentage of underweight children in the age group 0–59 months	NFHS and UNICEF	2005–06 and 2015–16
IMR	Infant mortality rate per 1000 live births	NFHS and MOSPI	2005–06 and 2015–16
Vac	Percentage of children receiving all basic vaccinations	NFHS and UNICEF	2005–06 and 2015–16
Delivery_HP	Percentage of childbirth assisted by health personnel	NFHS and UNICEF	2005–06 and 2015–16
Bfed_1 h	Percentage of children born in the last five years, breastfed within 1 h of birth	NFHS	2005–06 and 2015–16
hh_toilet	Percentage of households having toilet facilities in their house	NFHS	2005–06 and 2015–16

Table 3.10 Correlation matrix of poverty and factors impacting rural poverty

	Poverty HCR	PCGSDPA	Non-farm employment	Surfaced road density	Literacy
Poverty HCR	1				
PCGSDPA	−0.60***	1			
Non-farm employment	−0.68***	0.35**	1		
Surfaced road density	−0.50***	0.30**	0.56***	1	
Literacy	−0.58***	0.50***	0.57***	0.70***	1

Table 3.11 Correlation matrix of adult malnutrition and factors impacting adult malnutrition

	BMI	GVOA/ha	Flit	Mlit	HH_Toilet	Delivery_HP
BMI	1					
GVOA/ha	−0.76***	1				
Flit	−0.72***	0.47**	1			
Mlit	−0.73***	0.55***	0.81***	1		
HH_Toilet	−0.65***	0.35**	0.73***	0.46**	1	
Delivery_HP	−0.81***	0.54***	0.64***	0.69***	0.53***	1

Table 3.12 Correlation matrix ofchild malnutrition and factors impacting child malnutrition

	IMR	Stunted	Wasted	Underweight	GVOA/ha	Flit	HH_toilet	Bfed_1 h	Delivery_HP	Vac
IMR	1									
Stunted	0.86***	1								
Wasted	0.21***	0.30	1							
Underweight	0.74	0.87***	0.68***	1						
GVOA/ha	−0.58***	−0.61***	−0.13	−0.56***	1					
Flit	−0.87***	−0.83***	−0.32**	−0.77***	0.53***	1				
HH_toilet	−0.72***	−0.70***	−0.49***	−0.76***	0.35**	0.80***	1			
Bfed_1 h	−0.67***	−0.67***	−0.11	−0.55***	0.35**	0.72***	0.41**	1		
Delivery_HP	−0.83***	−0.80***	−0.17	−0.68***	0.54***	0.73***	0.53***	0.67***	1	
Vac	−0.80***	−0.79***	−0.22	−0.67***	0.59***	0.73***	0.48**	0.61***	0.70***	1

References

Bhagowalia, P., Kadiyala, S., & Headey, D. (2012). *Agriculture, income and nutrition linkages in India: Insights from a nationally representative survey*. International Food Policy Research Institute.

Borooah, V. K. (2002). *The role of maternal literacy in reducing the risk of child under nutrition in India*. University of Ulster and ICER.

Cervantes-Godoy, D., & Dewbre, J. (2010). *Economic importance of agriculture for poverty reduction*. OECD Food, Agriculture and Fisheries Working Paper No. 23. Paris: Organisation for Economic Co-operation and Development.

Commission, P. (2014). *Report of the expert group to review the methodology for measurement of poverty*. New Delhi: Government of India.

CSO. (Various Issues). *State-wise Gross Domestic Product*. New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Directorate of Economics and Statistics (2015). *Agricultural Statistics at a Glance*. New Delhi: Ministry of Agriculture. Government of India.

Fan, et al. (2007). *Investment, subsidies, and pro-poor growth in rural India*. Discussion Paper No. 00716. New Delhi: IFPRI.

Gillespie, S. and S. Kadiyala (2011. Exploring the Agriculture-Nutrition Disconnect in India. 2020 IFPRI Conference Brief 20: Leveraging Agriculture for Nutrition and Health.

Gulati, A., Kumar, A. G., Shreedhar, G., & Nandakumar, T. (2012). Agriculture and malnutrition in India.*Food and Nutrition Bulletin*, *33*(1), 74–86.

Headey, D. (2014). *An analysis of trends and determinants of child under nutrition in Ethiopia, 2000–2011* . Working Paper No-70. International Food Policy Research Institute (IFPRI).

Jose, S., & Navaneetham, K. (2008). A factsheet on women's malnutrition in India. *Economic and Political Weekly*, 61–67.

MoSPI, (Various Issues). *State wise estimates of Value of Output from Agriculture and Allied Activities*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

NFHS-4 (2005). *National Family Health Survey 2005–06* . International Institute for Population Sciences (IIPS).

NFHS-4 (2017). *National Family Health Survey 2015–16* . International Institute for Population Sciences (IIPS).

Planning Commission. (2014). *Report of the expert group to review the methodology for measurement of poverty*. Government of India, New Delhi.

Radhakrishna, R., & Ravi, C. (2004). Malnutrition in India: Trends and determinants. *Economic and Political Weekly*, 671–676.

Ramji, S. (2009). Impact of infant & young child feeding & caring practices on nutritional status & health. *Indian Journal of Medical Research*, *130*(5), 624–626.

UNICEF. (1990). *Strategy for Improved Nutrition of Children and Women in Developing Countries*. A UNICEF Policy Review. New York: UNICEF.

United Nations Children's Fund. (2013). *Improving child nutrition: The achievable imperative for global progress* (pp. 1–14). New York: UNICEF.

Vepa, S. S., Umashankar, V., Bhavani, R. V., & Parasar, R. (2014). *Agriculture and child undernutrition in India: A state level analysis*. Working Paper 86/2014. Chennai: Madras School of Economics.

World Bank. (2007). *From agriculture to nutrition: Pathways, synergies and outcomes*. No. 40196-GLB. Washington, DC: Agriculture and Rural Development Department. The World Bank.

Part III
Analysis of Six States

Chapter 4
Performance of Agriculture in Punjab

Ashok Gulati, Ranjana Roy, and Siraj Hussain

4.1 Introduction

Punjab had been a star performer in agriculture during the heydays of the green revolution. Its agricultural GDP grew at 5.7% per annum during the period from 1971–72 to 1985–86, which was more than double the growth rate of 2.31% achieved at all-India level in the same period. It was Punjab's spectacular performance, first observed in large wheat surpluses and then in rice, that helped India free itself from food aid under the PL 480 and its associated political strings. Punjab became a symbol of India's grain surpluses, giving India much needed food security. But after 1985–86, the green revolution showed signs of waning and Punjab's agricultural growth slowed to 3% per annum over the period 1985–86 to 2004–05, almost the same as achieved at the all-India level. But the real challenges to Punjab's agriculture emerged when its growth crashed to just 1.6% per annum during 2005–06 to 2016–17, which was less than half the all-India agricultural GDP growth of 3.6% over the same period. Owing to the earlier years of high agricultural growth, Punjab had one of the lowest poverty ratios (7.7% in rural Punjab) as per Tendulkar poverty line in the country in 2011–12, which was almost one-third the level of poverty at the all-India level. Providing food security to the country and reducing its own poverty to the lowest levels within India has been Punjab's most laudable achievements.

But lately, as a result of decelerating agricultural growth, Punjab has lost its pre-eminent position of being the state with the highest per capita income in India, a rank it had held since its inception in 1966 until 2002–03. If current growth trends continue, it will not be a surprise if Punjab slips further down in this hierarchy.

Among the many steps taken by the state, three interventions played the most important roles in the state's impressive performance in agriculture. These are (i)

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provision of irrigation facilities, (ii) all-weather roads to provide rural connectivity and (iii) an assured market for agricultural produce. The state has successfully bought 98.5% of gross cropped area (GCA) under irrigation and the state provided free power to encourage production of cereals. A successful procurement mechanism provided an assured market for farmers' produce. These policy interventions played a critical role in augmenting agricultural GDP and farmers' income. However, the same policies had a severe repercussion on sustainability of the state's agriculture. The availability of free power and an assured market encouraged farmers to produce rice even though Punjab does not have agro-climatic conditions conducive to rice production. As a result, the water table in the state has been depleting fast because of the high-water requirement for paddy cultivation. Currently, 80% of the blocks are overexploited in the state.

This raises some fundamental questions. Where did Punjab go wrong? And how can it get back to a high-growth path of more than 5% per annum in agriculture and an overall GSDP growth rate of more than the national average of 7-8% per annum, say for the next 10-15 years? It is these questions that we try to address in this study on Punjab agriculture, identifying the sources and drivers of growth that could be replicated in the laggard states, and how best to accelerate state's own agricultural growth.

The chapter is organised in six sections. After a brief introduction in Sect. 4.1, an overview of Punjab agriculture is provided in Sect. 4.2. In Sect. 4.3, the composition and sources of agricultural growth in Punjab have been analysed. Section 4.4 presents the econometric analysis to identify the drivers of agricultural growth in Punjab. In Sect. 4.5, we have analysed budgetary allocations to examine how far the state government has been able to correct the historically and overwhelmingly skewed support in favour of crops, particularly grains, and whether higher allocations have been made to the horticulture and livestock sector in recognition of both the changes in the composition of Indian diets as well as the potential these sectors hold in terms of increasing the incomes of agricultural households. Finally, in Sect. 4.6, we present some concluding remarks based on our empirical and econometric analysis and recommend policy prescriptions to sustain high growth in Punjab.

4.2 Overview of Punjab Agriculture

Punjab is situated in the northern part of India bordered by Jammu and Kashmir to the north, Himachal Pradesh to the east, Haryana to the south and Rajasthan to the southwest. Punjab has an area of 50,362 km^2, which is 1.5% of the total geographical area of the country. Punjab's climate is influenced by the Himalayas in the north and the Thar Desert in the south and southwest. The state receives only 61.9 cm (normal) rainfall, of which 75% is received during the monsoon months. The agricultural sector accounts for 85% of the water consumption in the state. Due to increased demand for water and a reduction in canal capacity, the area irrigated by tube wells has been increasing. As a result, ground water is being overexploited for irrigation purposes. The present ground water development[1] in the state is 172% and ground water is overexploited in 80% of the blocks[2] (CGWB 2016).

4.2.1 Agricultural Growth in Punjab

After Punjab was reorganised in 1966, a set of policies was undertaken, which paved the way to the state becoming a dominant agro-based economy. As India was a food scarce economy after independence, the main goal was to achieve self-sufficiency in food grain production. In order to do that, the green revolution strategy was adopted, initially focusing on Punjab, Haryana and Western UP. The adoption of new agricultural technologies consisting of high yielding varieties of seeds (wheat), chemical fertilisers and irrigation facilities helped the Punjab economy achieve a high growth trajectory. The sector grew at 5.70% per annum in the period 1971–72 to 1985–86. The growth rate dropped to 3% in the period of 1986–87 to 2004–05 and further to a level as low as 1.9% in the more recent period of 2005–06 to 2018–19, which is almost half the all-India average of 3.7% (Fig. 4.1).

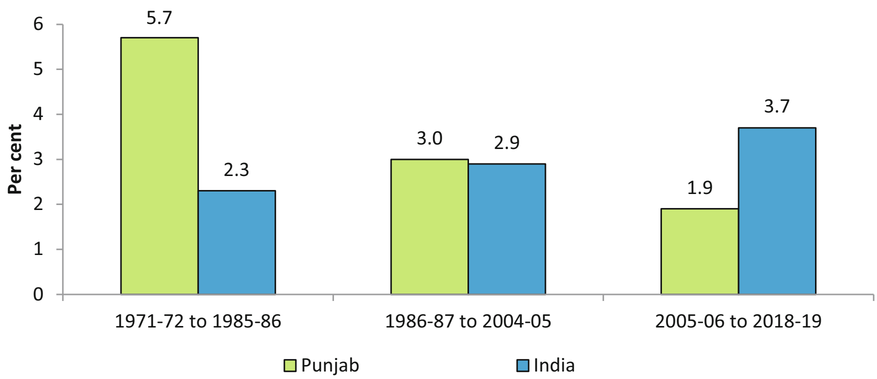


Fig. 4.1 Agriculture growth in Punjab and India. *Source* Government of India, central statistical organization and government of Punjab (www.pbplanning.gov.in)

[1]The stage of development is defined as the ratio of annual ground water draft to net annual ground water availability, expressed in percentage terms.

[2]According to the Central Ground Water Board (North Western Region, Chandigarh 2016), 110 of the total 138 administrative blocks have been overexploited. Of the overexploited blocks, 4 are categorised as critical and 2 as semi-critical; 22 blocks have been categorised as safe.

4.2.2 Agricultural Livelihood in Punjab

The state's population in 2011 was 27.7 million; the estimated population for 2018 is 29.9 million, which is 2.2% of India's population. In Punjab, 39% of the workforce was engaged in agriculture according to Census 2001. This fell to 35.6% in 2011 (34% according to Labour Bureau 2015–16). The contribution of the agricultural sector in the state's GDP declined from 48% in the triennium ending (TE) 1982–83 to 26% (at current prices) in TE 2016–17. Although Punjab established itself as the richest state in the country by improving its agriculture, a structural change is taking place in the economy with the share of agriculture in workforce and its contribution to GDP declining over the years. But the sector is still quite important in the state's economy.

Agriculture is largely dominated by marginal and small farmers in all Indian states. However, the case is different in Punjab, where the sector is largely dominated by semi-medium and medium farmers. In 2015–16, small and marginal farmers (who accounted for 33% of total farmers) with a holding size less than 2 ha operated on 10% of the total area operated while semi-medium and medium farmers (62% of total farmers) operated 68.6% of area. Large farmers (5.28%) accounted for 21.6% of area. The average landholding size has declined marginally from 3.79 ha in 1995–96 to 3.77 ha in 2010–11 and to 3.62 ha in 2015–16 (Table 4.1).

The average monthly income per agricultural household stood at Rs. 23,133 in 2015–16, which is the highest in India. Income grew at 4.3% per annum during 2002–03 to 2015–16, which is higher than the all-India growth rate of 3.7% per annum in the same period. The state has gone through an increase in the share of income coming from cultivation and farming of animals and a decline in the share coming from non-farm business and wages and salaries segment in the period of 2002–03 and 2012–13. However, the trend reversed during 2012–13 to 2015–16. Figure. 4.2 compares the composition of agriculture household income in Punjab with India in 2015–16.

4.2.3 Cropping Pattern in Punjab

The land use pattern in Punjab has remained unchanged over the years with net sown area marginally declining from 83 to 82% between TE 1986–87 and TE 2014–15. Forest area increased marginally from 4.4 to 5.1% in the same period. Net sown area and net irrigated area in TE 2014–15 stood at 4.1 million hectares (ha) and 4.0 million ha, respectively. Gross cropped area and gross irrigated area per 100 persons are 28.4 ha and 27.9 ha, respectively, which are much higher compared to the all-India figures (16.2 ha and 7.5 ha, respectively).

The biggest challenge facing Indian agriculture is the decreasing land holding size. But Punjab has experienced an increase in land holding size over the years. Average land holding size increased from 2.89 ha in 1970–71 to 3.77 ha in 2010–11.

Table 4.1 Operational holding in Punjab, 1995–96 to 2015–16

	1995–96			2010–11			2015–16		
	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)
Marginal	2.95	18.65	0.6	2.55	15.62	0.61	2.36	14.13	0.60
Small	5.78	16.78	1.31	6.78	18.57	1.38	7.33	18.98	1.40
Semi-medium	20.08	29.31	2.6	21.56	30.83	2.64	24.87	33.67	2.67
Medium	42.29	27.98	5.74	43.18	28.35	5.74	43.75	27.93	5.67
Large	28.89	7.28	15.05	25.93	6.62	14.75	21.65	5.28	14.85
All classes	100	100	3.79	100	100	3.77	100	100	3.62

Source Agricultural census

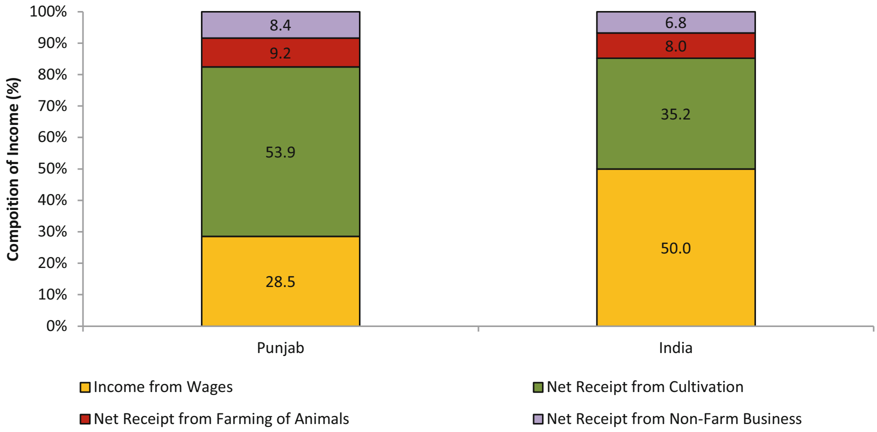


Fig. 4.2 Composition of agricultural household income from different sources in Punjab and India in 2015–16. *Source* NSSO

There has also been a reduction in the workforce engaged in agriculture in the state, which implies rural-urban migration. But some other studies have attributed the rise in average landholding to the rapidly declining water table in the state. They point out that the rapid decline in the water table requires the deepening of existing wells, inflating the cost of production. This has forced small and marginal farmers to sell off their land (Sarkar and Das, 2014).

The major crops grown in Punjab are wheat, rice, maize, cotton, sugarcane and horticultural products. Over the years, Punjab has concentrated on food grain production with the area under food grains as a share of gross cropped area increasing from 76.5% in TE 1986–87 to 82.9% in TE 2015–16, while the share of cotton, sugarcane and oilseeds has declined significantly. In TE 2015–16, the area under cotton, oilseeds and sugarcane was 5.1%, 0.6% and 1.1%, respectively. Within the food grain sector, the state specialises in rice and wheat production; the share of maize declined from 3.9% in TE 1986–87 to 1.6% in TE 2015–16. The total gross cropped area in the state is 7.9 million hectares and, with excellent irrigation infrastructure, 98.5% of the gross area sown is irrigated. Cropping intensity, which is measured by the ratio of gross cropped area to net sown area, was 190 in TE 2014–15.

Within cereals, wheat has traditionally been the dominant crop, but the higher profitability of rice, ensured by free water and an assured market prompted farmers to shift to rice cultivation. As a result, the area under rice kept increasing and stood at around 37% in TE 2015–16. The area under wheat remained stagnant at around 44%.

The area under fruits and vegetables has remained more or less constant over the years. Fruits and vegetables constitute 1.1% (90,000 ha) and 3% (244,000 ha) of the total gross cropped area in 2017–18, respectively.

4.2.4 *Determinants of Agriculture Growth*

Physical infrastructure such as irrigation, power and road play an important role in agricultural growth. Investment in these sectors facilitated the intensive use of inputs. Simultaneously, better use of inputs like fertilisers, high-yielding variety of seeds, farm mechanisation and credit augment farm productivity. The green revolution strategy, adopted to increase food production, consisted of a combination of (a) high yielding varieties of seeds (b) irrigation facilities and (c) the use of chemical fertilisers and pesticides. Agricultural growth was enormous during 1970–1985. It is imperative to discuss the role of these drivers in ensuring high agricultural growth in Punjab.

4.2.4.1 Irrigation Infrastructure

As discussed earlier, normal rainfall is only 62 cm, with the south–west monsoon contributing 79% of the total rainfall. Thus, the quantum of rainfall is quite low and is concentrated in the months of July–September. Hence, providing irrigation facilities was essential for the unconstrained supply of water for cultivation. With the use of HYV seeds, irrigation became a necessary technology to increase production during the early years of the green revolution. The state has successfully brought 99% of gross cropped area under irrigation (Fig. 4.3).

In TE 1986–87, 61% of the net irrigated area was under tube wells and other wells. Over the years, Punjab went through a major shift from canal irrigation to tube well irrigation as demand for water increased. Tube well irrigation ensures steady flow of water, and credit facilities and free electricity made it possible to enhance the use of centrifugal tube wells as the major source of irrigation. In TE 2013–14, around 73% of the net irrigated area was under groundwater irrigation (Fig. 4.3). But unwise use of water is leading to over exploitation of groundwater. The present

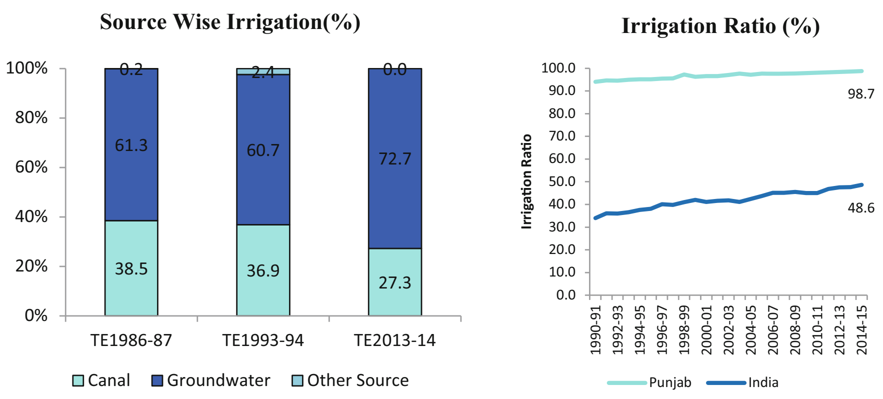
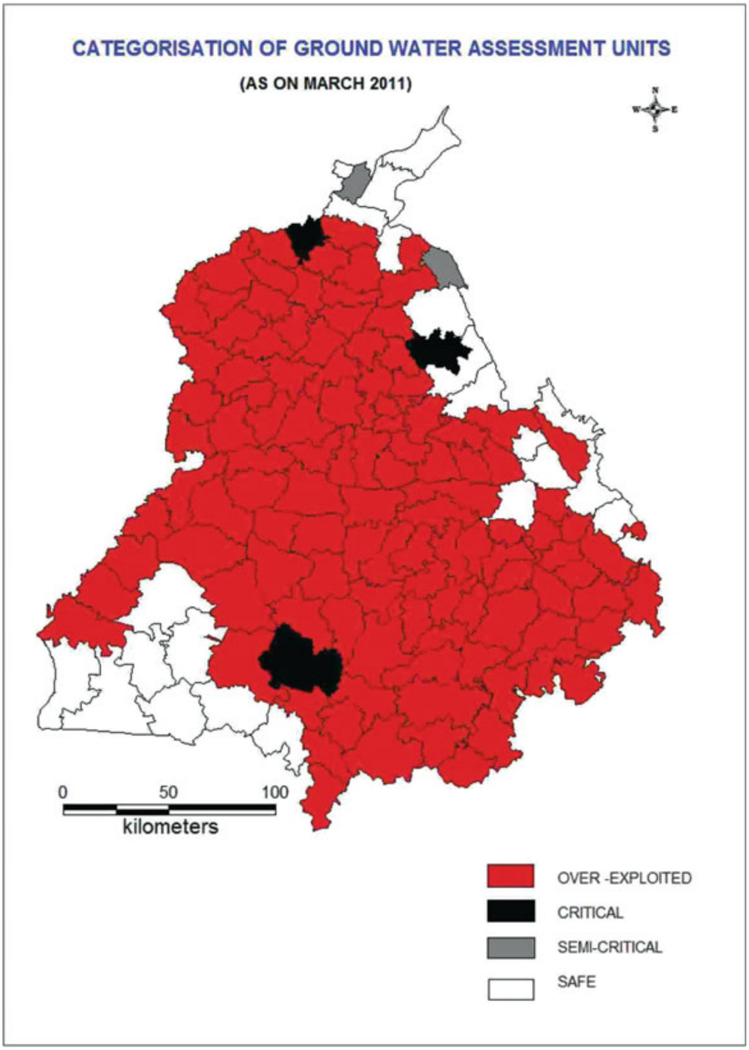


Fig. 4.3 The irrigation situation in Punjab. *Source* Directorate of economics and statistics

groundwater development in the state is 172%[3] and groundwater in 80% of the total geographical area is over utilised. The water table declined by 70 centimetres per year from 2008 to 2012 (http://punenvis.nic.in/accessedon28.4.2017). With one kilogram of rice consuming 3000–5000 L of groundwater, large-scale production and export of rice from Punjab is an unsustainable idea.



With its semi-arid nature, Punjab was more appropriate for the production of wheat and maize. But irrigation policies made water easily accessible to the farmer

[3]Ground water development is a ratio of the annual ground water extraction to the net annual ground water availability.

and free electricity reduced the economic cost of water. At the same time, the food procurement policy of the Government of India for the central pool ensured good returns on wheat and rice production. As a result, Punjab shifted from a traditional wheat-maize cropping pattern to a water intensive wheat-rice cropping pattern. This cropping pattern is not only ecologically unsustainable but is also making cultivation economically unviable. Because of groundwater depletion, centrifugal pumps are being increasingly replaced with submersible pumps, which lead to increased production costs. The consumption of energy for pumping water from deeper underground layers is also increasing, adding to the cost. This alarming situation needs to be addressed with utter seriousness.

The Government of Punjab enacted the Punjab Preservation of Subsoil Water Act in 2009 to check ground water depletion. Under this act, "no farmers shall sow nursery of paddy before 10th day of May of the agricultural year or such other date notified by the state". This legislation has been quite successful saving up to 7–8% of water as compared to May transplanting but as per the Central Ground Water Board's 2016 data, out of 138 blocks in Punjab, 110 continue to be overexploited (80%), thus posing an enormous challenge to sustainable agriculture.

4.2.4.2 Power for Agriculture

Power pricing policies played an important role in augmenting production during the green revolution. The sale of electricity for agriculture as a share of total electricity sales has remained consistently higher than all-India share (Fig. 4.4). There has been a 57% increase in the number of pump sets energised in the state between 2000–01 and 2015–16. The power intensity in the state, measured by power sales per hectare of GCA, was 1356 kwh/ha in TE 2015–16, which was much higher than the national average of 847 kwh/ha.

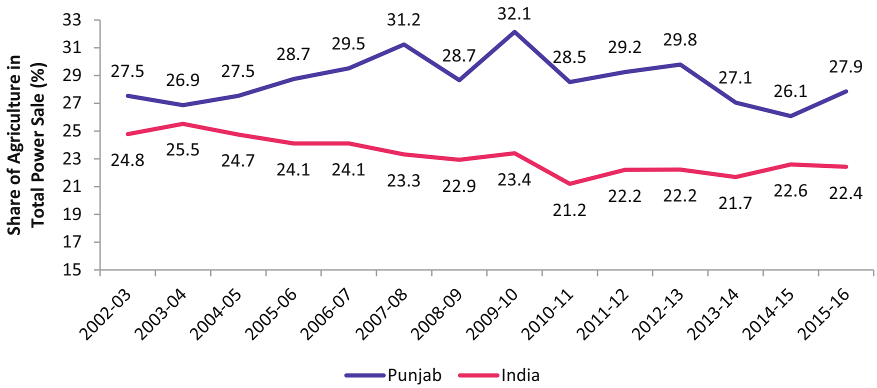


Fig. 4.4 Share of agriculture in total power sale. *Source* Report on the performance of state power utilities, various issues

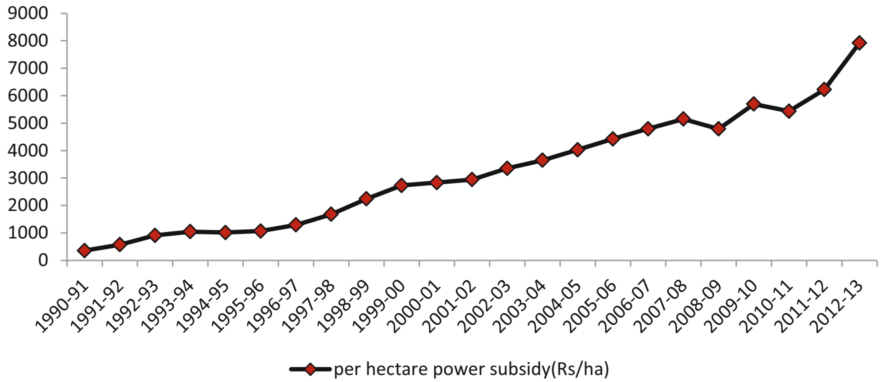


Fig. 4.5 Trends in power subsidy per hectare of GCA in Punjab (Rs./ha). *Source* Gulati and Terway (Upcoming Paper)

This free power has increased the subsidy burden and led to inefficient use of power, resulting in an alarming depletion of groundwater. In the initial years of the green revolution, a part of the electricity cost was recovered from the farmers on a per unit consumption basis. In the second half of the 1970s, the net return from wheat cultivation fell sharply and there emerged a strong movement to reduce input prices. In the late 1970s, the basis of electricity pricing was changed to a flat tariff. From 1984 onwards, there was a reduction in the charges on electricity connections as well. Electricity for the agricultural sector was made free in 1997 and continues to be so till date.

Figure 4.5 shows that the electricity subsidy per hectare has been increasing steadily. Power policy was an important element in the successful implementation of the green revolution. But inefficient and wasteful use of power and water is making farming itself an unsustainable means of livelihood and there is urgent need to restructure the power policy. Punjab has already adopted feeder separation for agricultural use in 10,911 villages out of a total of 12,272 villages. But the inefficiency in the consumption of electricity in Punjab's agriculture still persists and urgent steps need to be taken to curtail this.

4.2.4.3 Fertiliser Consumption

Crop yields can be augmented significantly through optimal utilisation of fertilisers. Wheat and rice are the most nutrient exhaustive crops in Punjab and the monocropping of paddy and wheat in the past four decades has led to a steady decline in macro (NPK) as well as micro (zinc, iron, manganese) nutrients in the soil. The Government of India has encouraged the use of chemical fertilisers by heavily subsidising it. Fertiliser consumption has steadily increased in Punjab and stood at 231 kg/ha of GCA in 2016–17, which is very high compared to all-India fertiliser

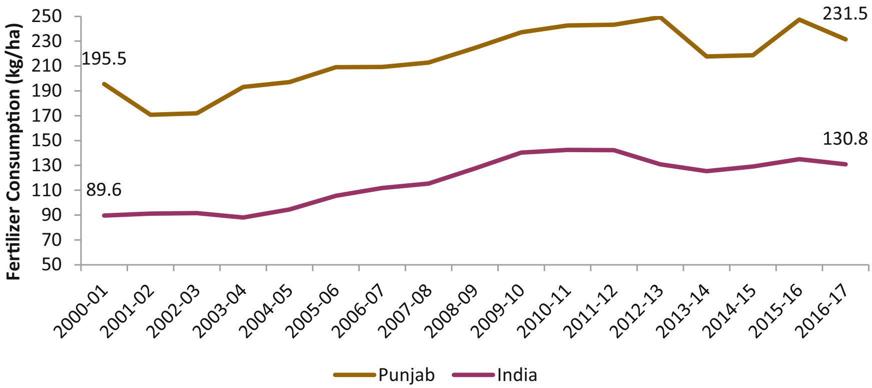


Fig. 4.6 Fertiliser consumption (kg/ha). *Source* Fertiliser association of India

consumption of 130.8 kg per ha of GCA in the same year (Fig. 4.6). It initially contributed to an increase in productivity in Punjab. But now, it has become a vicious cycle of higher use of fertilisers and decreasing soil fertility. There is no doubt that the fertiliser subsidy has helped achieve self-sufficiency in food grain production but it has also led to the inefficient use of fertilisers. The extremely low price of urea has resulted in the imbalanced use of fertilisers, which has affected the fertility of land. The NPK ratio in Punjab is 31.4:8:1 against the generally recommended ratio of 4:2:1 (and a national average of 7:3:1), which has affected crop productivity. In order to improve yield, famers are pumping more nitrogen into the soil, thus degrading the soil. The subsidy burden of the state stood at Rs. 7022 crore in 2012–13.

Studies have shown that (Gulati et al. 2015) this imbalance in the use of fertilisers can be solved by switching to direct cash transfers to farmers on a per hectare basis. Farmers should be incentivised to get soil testing done and to procure soil health cards by linking these to cash transfers. Moreover, the import duty on urea should be reduced to zero and prices should be determined by the interplay of demand and supply.

4.2.4.4 Procurement Policy

The goal of growth with equity involves the dual objectives of ensuring a minimum price to farmers and assured supply of food grains at affordable prices to vulnerable sections of society. The Food Corporation of India (FCI) was set up in 1965 which, along with other state agencies, undertakes procurement of wheat and paddy. Coarse grains are procured by state agencies as per the government's direction but not on a regular basis. The MSP is supposed to make sure that price does not fall below a certain level. Procurement under the price support scheme was adopted to ensure remunerative prices to farmers for their produce, which works as an incentive to increase production. The minimum support prices are recommended by the Commission of Agricultural Cost and Prices (CACP) which, among other items, considers the cost of cultivation and a profit margin for farmers. To facilitate procurement, a large number of purchase centres for wheat and paddy have been set up at various *mandis* and key points.

Punjab contributes considerably to the procurement of rice and wheat and this has played an important role in its agricultural progress. Around 95% of rice and 65% of the wheat produced in the state was procured by government agencies in Punjab in 2016–17 (Fig. 4.7). Thus, there is an assured market for most of the farmers' produce, which works as an incentive for the production of just wheat and paddy. Punjab contributed 30% of the rice and 46% of the wheat in the central pool (2014–15).

Punjab, Haryana and Uttar Pradesh produce a large amount of rice although Punjab is not geographically suitable for rice production. It was made possible by the provision of extensive irrigation facilities and procurement at MSP. Because of an assured market, rice production increased over the years. However, rice is not the staple food in Punjab and rice procured in Punjab is transported to states in the East, North-East and South India. This imposes additional transportation costs. As rice is the most remunerative *kharif* crop owing to the assured MSP, farmers prefer to grow rice over other crops (for example maize). The food procurement policy in Punjab is also responsible for the change in cropping pattern, which has an impact on the environment. The policy that worked as a catalyst for growth in Punjab's agriculture has now become detrimental to the sustainability of its agriculture. Specialising in cereals was great when India was suffering from food shortages; however, the situation today is different. Stocks of cereals in FCI godowns crossed 80 million MT in July, 2012, way above the buffer stock norm. Some of the state specific policies in Punjab have also been distorting the market mechanism. The Punjab government

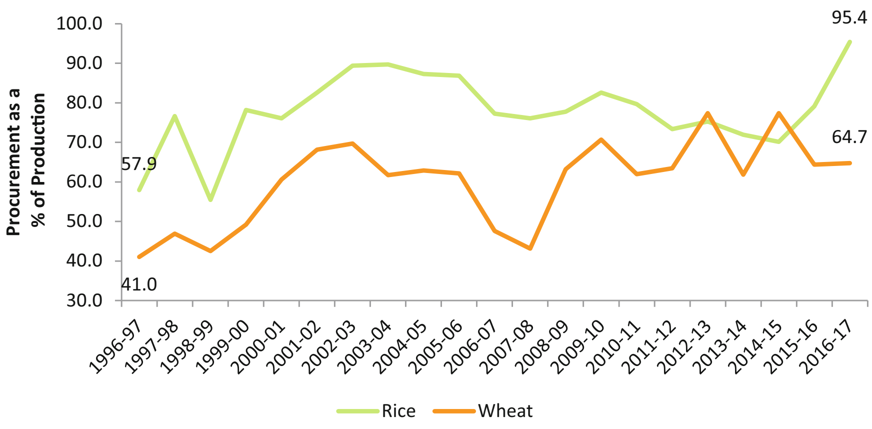


Fig. 4.7 Procurement as a share of production in Punjab. *Source* Department of food and public distribution

Table 4.2 Statutory levies and taxes in major wheat and rice producing states

Wheat				Rice			
State	Rate in 2012–13	Earlier rate	Year	State	Rate in 2012–13	Earlier rate	Year
Punjab	14.5	12.5	2010–11	Punjab	14.5	12.5	2011–12
Haryana	11.5	10.5	2010–11	Andhra Pradesh	13.5	12.50	2011–12
MP	9.20	3.20	2009–10	Odisha	12.00	8.50	2011–12
UP	8.50	7.50	2009–10	Haryana	11.50	10.50	2010–11
Uttarakhand	7.50	6.50	2011–12	Chhattisgarh	9.70	8.70	2010–11
Rajasthan	3.60	4.10	2008–09	UP	9.00	8.00	2008–09

Source cacp.dacnet.nic.in, Price policy for Rabi Crops 2014–15

charges heavy commission/levies/cess on the purchase of wheat and rice, amounting to 14.5%, which is much higher than the 2% in Gujarat and West Bengal (Table 4.2). This makes the food processing industry extremely reluctant to buy their raw material from Punjab. In fact, there have been instances of flour millers from Punjab buying wheat from UP. Revenue from these taxes/levies accrues to state government. In the new GST regime, there is an urgent need to rationalise the structure of taxes and levies so that private sector is not disincentivised from purchasing agricultural commodities in Punjab.

4.2.4.5 Roads

Roads are a basic infrastructure for economic development. Road connectivity is an important indicator of market accessibility. Transport facilities enhance the interaction between different agents, starting at the farm level to the household consumption level. It becomes even more crucial when it comes to perishable agricultural commodities. Often, farmers are forced to sell their products at prices even lower than the cost of cultivation just to avoid the rotting of crops. Advanced road and transport facilities ensure that agricultural commodities reach *mandis* on time and their quality is not compromised. The road infrastructure in Punjab is among the most developed in India. Road density in Punjab has increased from 564 per thousand sq km in 1970–71 to around 2151 per thousand sq km in 2015–16. Further, surfaced roads as a percentage of total roads is 90.6% in Punjab, one of the highest in the country (Fig. 4.8). All villages in the state are linked by roads.

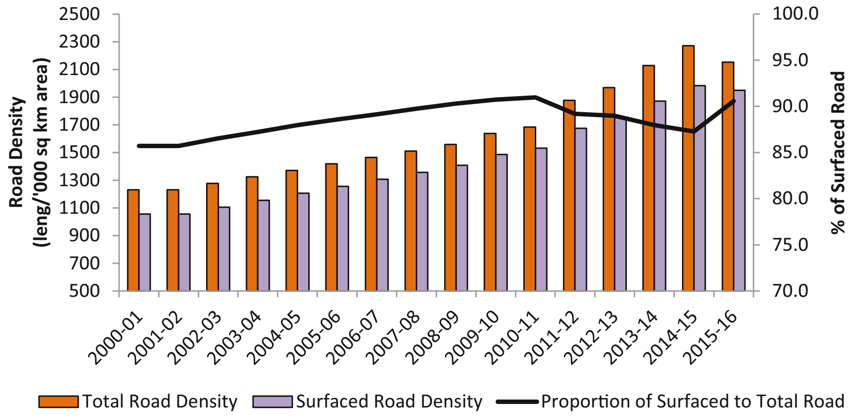


Fig. 4.8 Situation of roads in Punjab. *Source* Ministry of road transport and highways

4.3 Sources and Composition of Agriculture Growth

The share of value of output from different agricultural sub-sectors as a share of the total value of output from agriculture and allied activities (at current prices) has been calculated.

Agriculture and allied activities are divided into eight sub-sectors (1) cereals, (2) pulses, (3) oilseeds (4) sugar (5) fibre (6) fruits and vegetables (7) livestock and (8) other crops. Figure 4.9 highlights the composition of the agrarian economy. In TE 2015–16, cereals (40.9%) constituted the highest share in the GVOA, followed by livestock (31.3%) and fruits and vegetables (6.3%). Between TE 2002–03 to TE 2015–16, the proportion of GVOA accounted for by cereals declined sharply from 47 to 41% while there has been a significant increase in the share of forestry and logging from 0.5 to 8.3% (Fig. 4.9).

To calculate the sources of growth, the current series of value of output of each segment is deflated by the WPI of all commodities at 2011–12 prices. Then year-on-year growth of each segment is calculated by taking the absolute year-on-year difference in GVOA from each segment as a proportion of the previous year's GVOA from agriculture and allied activities. Agriculture and allied activities grew at 3.55% in the period 2000–01 to 2015–16. The contribution of different sectors to the total growth of agriculture and allied activities shows that the highest contribution came from the livestock sector (34.9%) followed by cereals (29.6%) forestry and logging (19.4%), and fruits and vegetables (11.3%) (Fig. 4.10).

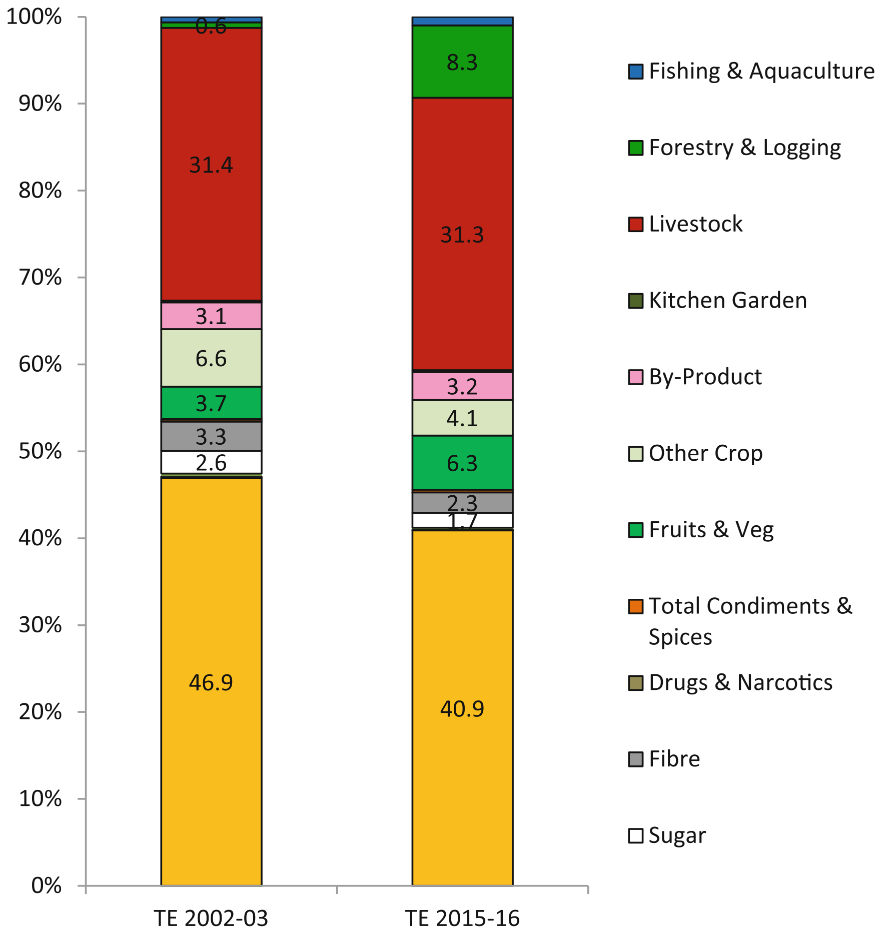


Fig. 4.9 Sector-wise shares in total value of output from agriculture and allied sector (at current prices). *Source* Calculated by authors using CSO data

4.3.1 Food Grains and Non-food Crops

Important crops produced in Punjab include rice, wheat, maize, *bajra*, sugarcane, oilseeds and cotton. However, rice and wheat alone constitute 80% of the total gross cropped area. In tandem with the increase in acreage under wheat and rice cultivation, the production of these crops also increased rapidly. Production of wheat increased from 4.8 million MT in TE 1970–71 to 15.9 million MT in TE 2016–17 (Fig. 4.11). Similarly, the production of rice increased from 0.57 million MT to 11.5 million MT in the same period (Fig. 4.11). The state's share in total rice production in the country increased from 1.40% in TE 1970–71 to 10.8% in TE 2016–17 while the share of wheat declined from 23.2 to 17.2% in the same period. The share of cotton

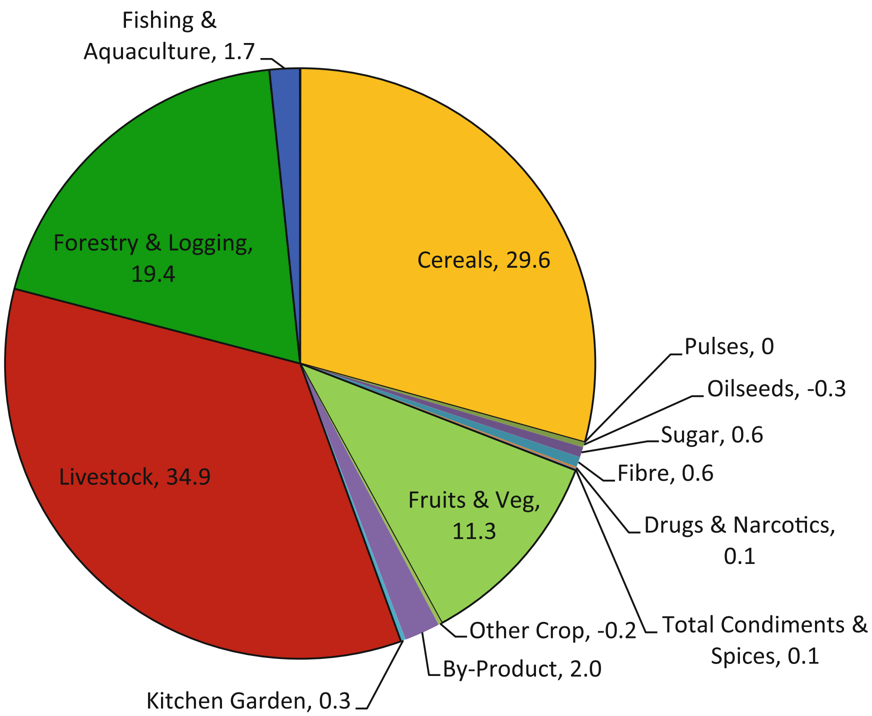


Fig. 4.10 Sources of growth 2000–01 to 2015–16 (Share in growth contributed by each segment). *Source* Calculated by authors using CSO data

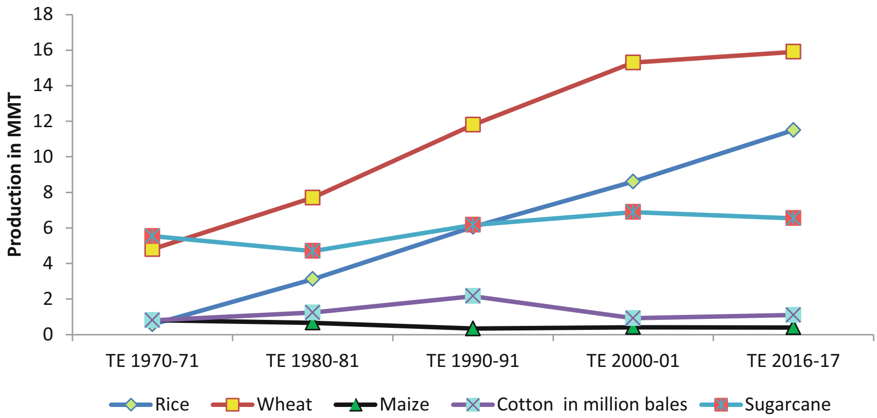


Fig. 4.11 Production of important crops in Punjab. *Source* DES

Table 4.3 Productivity of major crops in Punjab and India

Yield (MT/ha)	Rice		Wheat		Maize		Cotton		Sugarcane	
	Punjab	India	Punjab	India	Punjab	India	Punjab	India	Punjab	India
TE 1970–71	1.5	1.1	2.2	1.2	1.5	1.1	0.327	0.326	38.6	48.4
TE 1980–81	2.8	1.2	2.7	1.5	1.6	1.1	0.331	0.160	54.3	52.1
TE 1990–91	3.2	1.7	3.7	2.2	1.6	1.5	0.503	0.227	61.5	64.0
TE 2000–01	3.3	1.9	4.5	2.7	2.6	1.8	0.317	0.213	62.2	70.2
TE2016–17	4.0	2.4	4.5	3.0	3.7	2.6	0.546	0.486	76.5	70.4

Source DES

also declined from 16.1 to 3.5%. The cropping pattern has shifted to rice with 36% of total gross cropped area under rice production.

Punjab already has achieved very high productivity for all its important crops and the state does not have much scope to improve yield (Table 4.3). Clearly, diversification from the wheat-rice cropping pattern to other crops is important to both increase farm incomes and to conserve soil and water resources.

4.3.2 *Horticulture*

Fruits and vegetables together constitute only 4.23% of the gross cropped area. However, the sector contributed 11.3% to the total growth in agriculture and allied activities between 2000–01 and 2015–16. The gross value of output from fruits and vegetables has increased but the year-on-year growth has been erratic (Fig. 4.12).

Punjab makes a very small contribution to the total production of fruits and vegetable in the country (2% of fruits and 2.7% of vegetables). The production of fruits increased from 0.75 million MT in 2005–06 to 2.0 million MT in 2018–19 (Fig. 4.13). Similarly, the production of vegetables increased from 2.43 million MT to 5.0 million MT in the same period (Fig. 4.13). The increase in production can be attributed to a rise in the yield per hectare for both vegetables and fruits as the area under these crops did not change much over the years. In terms of production in 2016–17, the important vegetable crops produced in Punjab are radish (2nd largest producer), carrot (2nd largest producer), peas (3rd largest producer), potato (6th largest producer), bottle gourd (7th largest producer) and cauliflower (10th largest producer). *Kinnow*, orange, *malta*, lemon and guava are the important fruits grown in Punjab. The state is currently the second largest producer of mandarin, accounting for 25% of the country's production. Moreover, the state is the sixth largest producer of oranges as well as guava.

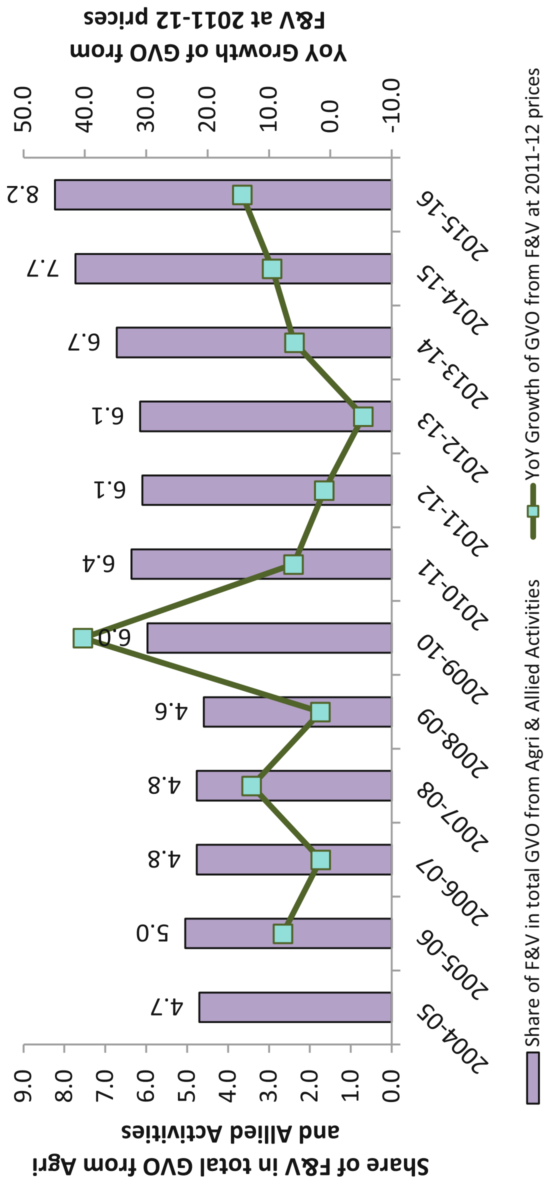


Fig. 4.12 Percentage share of fruits and vegetables in GVOA and year-on-year growth of GVO from fruits and vegetables. *Source* MOSPI

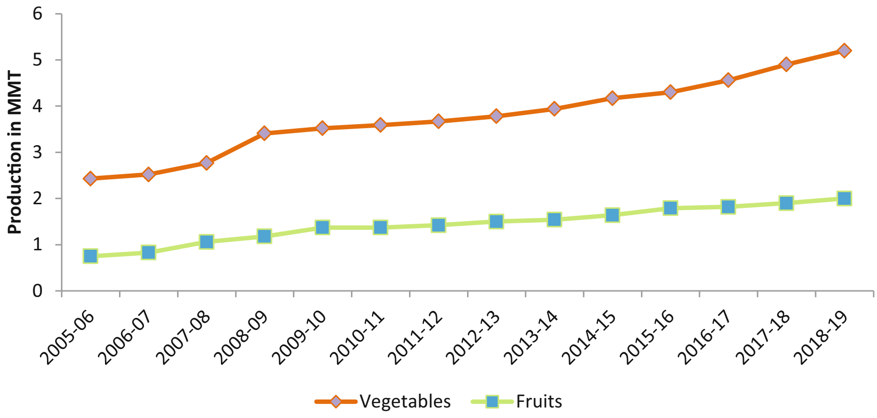


Fig. 4.13 Production of fruits and vegetables in Punjab (million MT). *Source* Different reports of national horticulture board

4.3.3 Livestock

The livestock sector is an important sub-sector in the state as it accounted for 31.3% of the total value of output in TE 2015–16. The composition of livestock products in the total value of output from the sector is as under:

4.3.3.1 Milk

Dairy contributes 82% of the total value of output from the livestock segment (Fig. 4.14). Milk production has increased impressively in the past, making the state India's sixth largest producer after Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat and Andhra Pradesh despite its small geographical area and population. Milk production (Fig. 4.15) grew at 2.2% per annum in the period 2001–02 to 2009–10, but the growth rate has increased in recent years. The state has the highest per capita milk availability of 1037 grams/day (TE 2016–17). Monthly per capita consumption of liquid milk in rural and urban Punjab are 11.9 L and 10.9 L, respectively, which is high compared to the all India average of 4.3 L and 5.4 L, respectively. Given the practice of vegetarianism among the upper caste in the state, milk and dairy products hold a significant share in the food basket of households. Therefore, there exists significant domestic demand.

The Punjab State Co-operative Milk Producers' Federation Limited (Milkfed) was established in 1973 to provide a remunerative milk market and to disseminate technical inputs to milk producers. Milkfed is a three-tier system with the Federation at the top as the apex body at the state level, milk unions at the district level and co-operative societies at the village level. Verka is the brand under which milk and milk products are marketed by the Punjab State Co-operative Milk Producers' Federation.

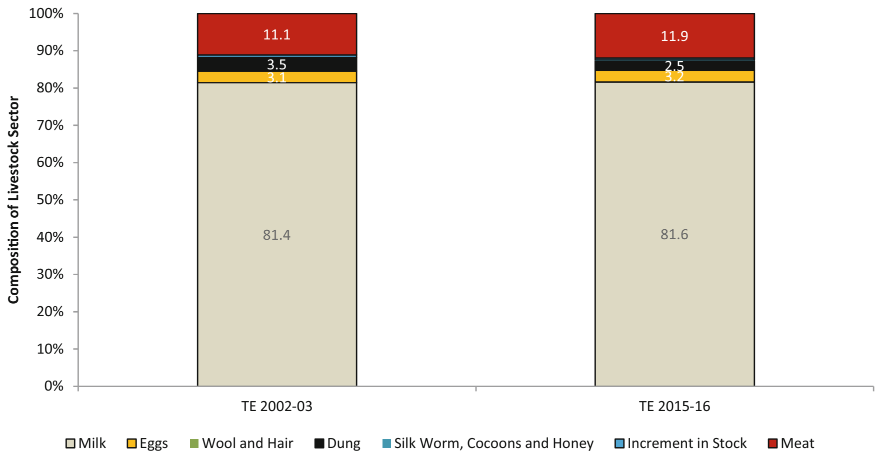


Fig. 4.14 Composition of livestock products (Current Prices). *Source* CSO

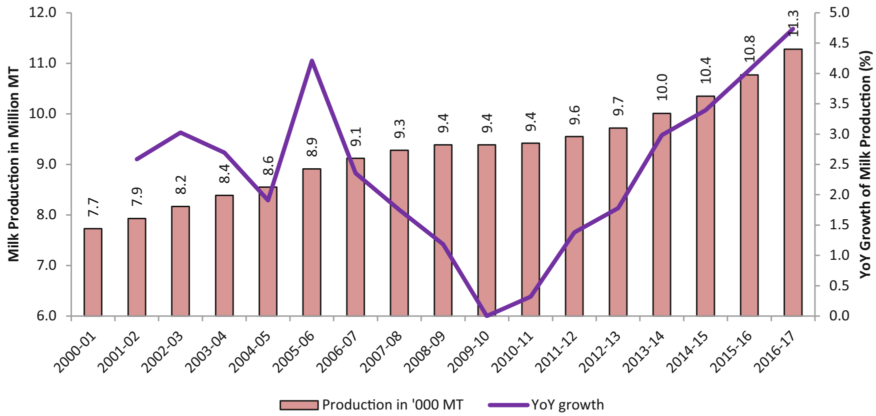


Fig. 4.15 Production and average growth of milk in Punjab for 2000–01 to 2016–17. *Source* NDDB

Non-members are only allowed to sell to Milkfed in the lean season. There is no upper limit on the quantity sold by a member. The Verka brand is available in Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir and even in Northeast India. Ghee is exported to countries in the Middle East, Australia, Japan, New Zealand and Malaysia. In 2016–17, there were 7954 dairy co-operative societies with about 4.05 lacs producer members. Nestle India set up its first manufacturing facility at Moga. Dairy co-operatives procure just about 5% of the total production in Punjab, which is much lower than the 53.7% procured in Gujarat (Fig. 4.16). The rest is marketed through the unorganised sector comprising local vendors. The main problem with the unorganised sector is the presence of many middlemen between producers and

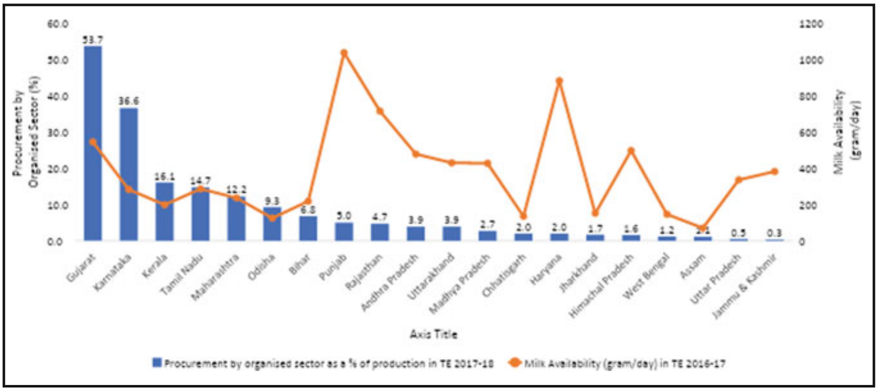


Fig. 4.16 Milk availability and procurement in major producing states. *Source* NDDB

consumers that prevents producers from receiving a remunerative price for their produce (Rajendran et al. 2004, Journal of Food Distribution Research). Punjab should follow the example of Gujarat and increase the participation of the organised sector in the marketing of milk and milk products.

4.3.3.2 Meat and Egg

The share of meat in the gross value of output (GVOA) has been more or less stagnant (3.7% of GVOA) in the past two decades. According to the latest livestock census (2012), the total livestock and poultry population in Punjab are 81.2 lakh and 167.9 lakh, respectively. The estimated meat production in 2016–17 stood at 248.6 thousand MT. The production of eggs in Punjab was 47,825 lakh in 2016–17. The per capita availability of eggs is 166 per annum in Punjab.

Although Punjab accounted for only 3.5% of total meat production in the country in TE 2016–17, the state's share in buffalo meat production is higher and it is the third largest producer of buffalo meat in the country, the top two producers being Uttar Pradesh and Maharashtra. The meat sector of the state is dominated by buffalo meat followed by poultry. The following figures show production of buffalo meat and poultry in Punjab and state's share in all-India production (Figs. 4.17, 4.18).

The buffalo meat sector in India is export-oriented as there is good demand for Indian carabeef due to its quality and price competitiveness. The country exported 1.3 million MT of buffalo meat in 2017–18 for US $4036.9 million (APEDA). The state needs to take the initiative to make cattle free from foot and mouth disease to fetch better prices for non-milching buffaloes.

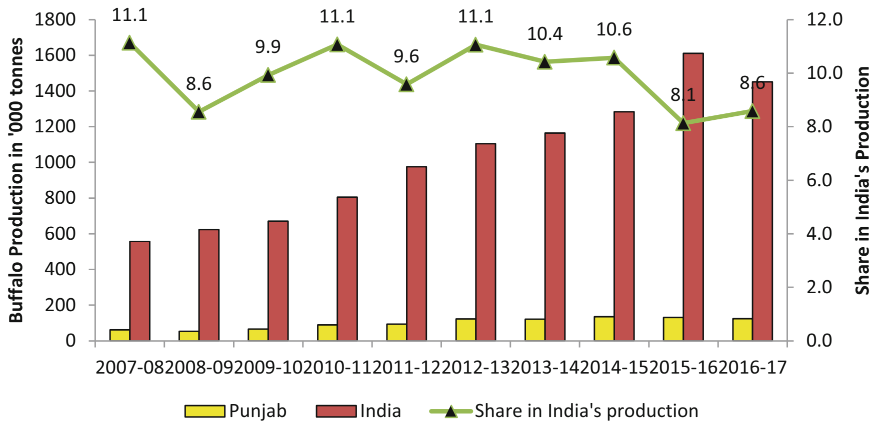


Fig. 4.17 Production of buffalo meat in Punjab and its share in all-India production

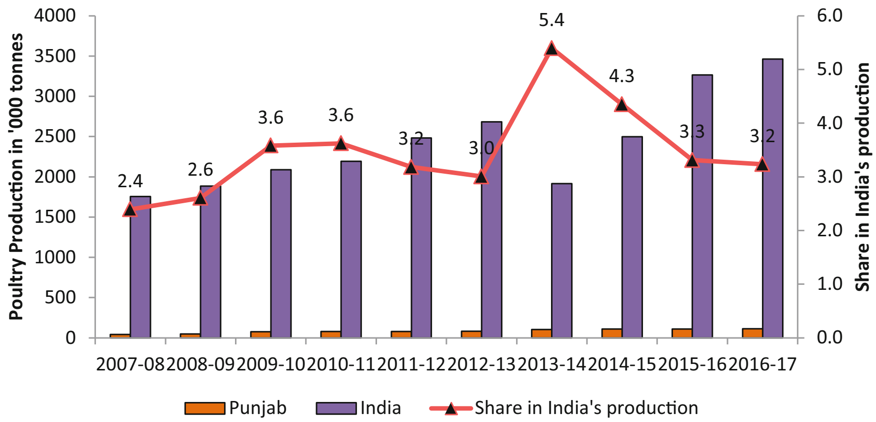


Fig. 4.18 Production of poultry meat in Punjab and its share in all-India production. *Source* Basic animal husbandry and fisheries statistics

The state can also target the domestic market of meat through the promotion of poultry and mutton. Punjab has done well in the poultry sector despite the rising cost of poultry feed. It has been catering to the demand for eggs within the state and in J&K. The Barwala–Derabassi–Lalru cluster in Punjab/Haryana is already the largest poultry cluster in north India but due to cheaper land in UP, a large number of Punjab poultry farmers are setting up units in UP. The Government of Punjab needs to formulate an attractive policy to get investment in the sector as it has the raw material for feed and a large market for eggs and poultry meat within the state and in J&K.

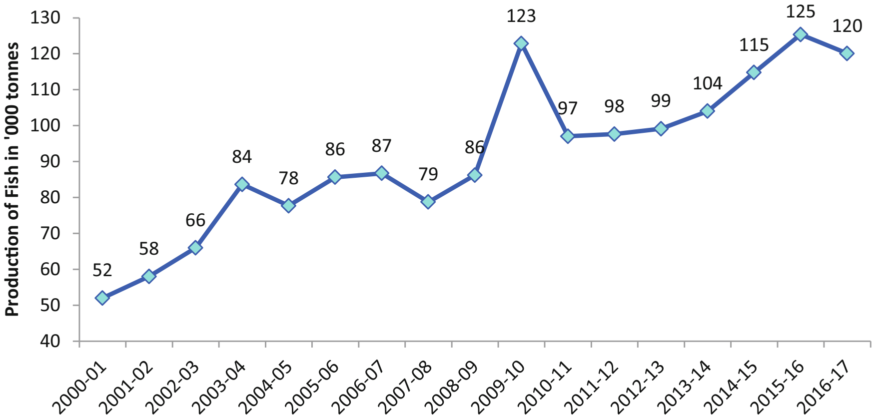


Fig. 4.19 Fish production in Punjab. *Source* Handbook of fisheries statistics

4.3.3.3 Fisheries

Fisheries contribute only 1% of the total value of output from agriculture and allied activities (TE 2015–16). Only inland fish can be produced in Punjab as it does not possess any coastline. There are 868 km of river, 13 notified reservoirs, 11,200 km of canals and 14,510 acres of small reservoirs in the state. In addition, there are 9318 constructed village ponds, covering an area of 32,597 acres. Fish production increased at a rate of 6.3% per annum for the period of 2000–01 to 2016–17 (Fig. 4.19).

Quality seed production should be promoted through the private sector so that fish seed is available at affordable prices. Fish seed production has remained almost stagnant in Punjab while it has increased steadily in the neighbouring state of Haryana (Fig. 4.20).

Tube wells installed at fish farms require electricity. Fish farming can be encouraged in water logged and salinity affected areas by providing assistance for fish ponds. But cold storage and other marketing infrastructure should be improved to increase the marketable surplus and reduce wastage.

4.4 Econometric Analysis for Drivers of Agricultural Growth

The performance of the agricultural sector is influenced by several supply side factors as discussed above, the broad ones being the use of inputs in farming operations, price incentives and infrastructure facilities. It is difficult to analyse the effect of all the variables in a simple framework because these variables would affect agricultural performance through various mechanisms. In this section, we make an attempt to

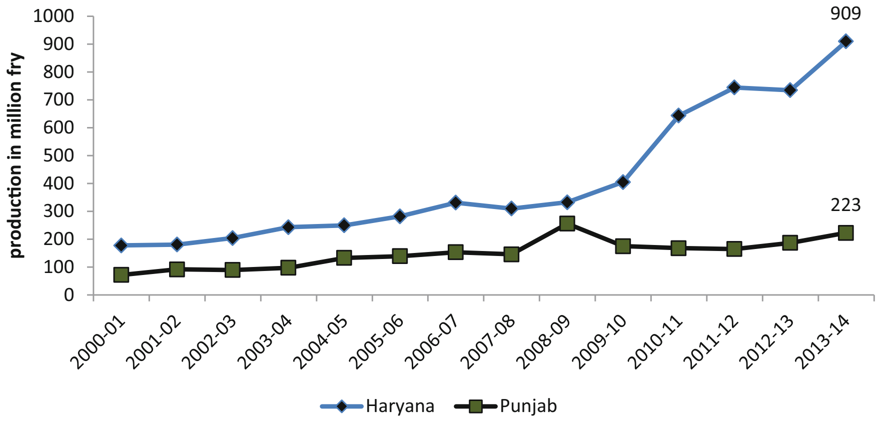


Fig. 4.20 Fish seed production in Punjab and Haryana. *Source* Handbook of fisheries statistics, 2014–15

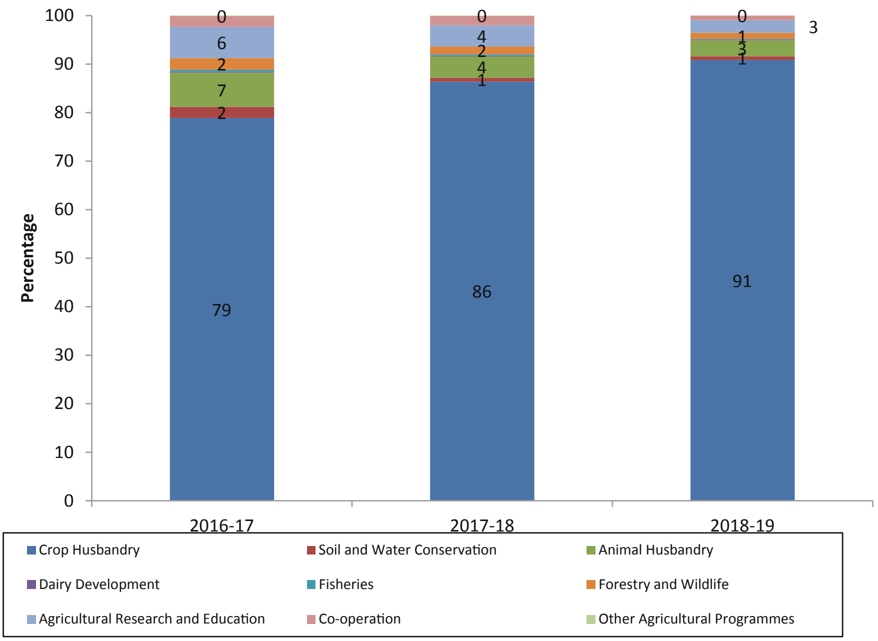


Fig. 4.21 Allocation to broad heads as a share of total allocation to agriculture and allied activities

find out the drivers of agricultural growth in Punjab through an econometric model. For example, fertiliser consumption and irrigation infrastructure are both crucial for agriculture but are highly correlated and hence, cannot be taken in the same equation due to multicollinearity. Table 4.5 in the Annexure gives the correlation

Table 4.4 Variables and definitions used for the model

Variable	Definition
GSDPA	GSDPA is the log of gross domestic product from agriculture and allied activities (2004–05 prices)
IRR	Log of ratio of gross irrigated area (GIA) to gross cropped area (GCA)
TOT	Log of the ratio of GDP deflators for agriculture and industry for Punjab
SRD	Log of surfaced road length per thousand sq. km of area

matrix of the variables. Keeping aside this limitation, it is observed that GSDPA shows a significant and positive correlation with irrigation, terms of trade between agriculture and industry and surfaced road density.

The function is defined:

$$Y_t = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \quad (1)$$

here, X_1 is Irrigation Ratio; X_2 is surfaced road density; and X_3 is terms of trade between agriculture and industry.

In our model, the logarithmic value of GSDPA is the dependent variable and the logarithmic values of variables mentioned above are the independent variables. The equation has been estimated using data from 1970–71 to 2015–16. We have run the model with different variables and have presented only those variables that have a significant effect on agriculture GDP (Table 4.4).

The estimated equation is as follows[4]:

GSDPA= 7.7 +3.47IRR***+ 0.35ToT*** +0.37SRD**

(7.97) (4.43) (4.32)

Adj R-square = 0.97

Note: *** significant at 1per cent level (p-value < 0.01); ** significant at 5per cent level (p-value < 0.05)

The effect of irrigation, road and ToT are found to be significant in the model. Irrigation turned out to be the most significant factor affecting farm income. Since we have used a double-log model, the result indicates that a 1% growth in the irrigation ratio increases agricultural GSDP by 3.5%. It implies that unconstrained supply of water is very important for cultivation and ensuring irrigation has helped the sector flourish. Similarly, a 1% increase in terms of trade in favour of agriculture increased agriculture GSDP by 0.35%. Price policy plays a significant role in driving the sector and remunerative prices persuade the farmers to invest more. Strong marketing infrastructure and procurement facilities ensured that farmers can avail remunerative prices for their produce. Roads, which help access to input and output markets, play

[4]Numbers in the parentheses are *t* values.

a major role in agricultural development. A 1% increase in surfaced road density leads to a 0.37% increase in GSDP from agriculture. What this equation implies is that 97% of agricultural growth during this period can be explained by the increased irrigation ratio, road density and price incentives (ToT). The detailed correlation matrix is given in the annexure Table 4.5.

To test for co-integration, we run the OLS regression in Eq. 1 and then run the ADF test on the residuals to determine stationarity. The series are co-integrated if the residual is stationary. The null hypothesis of non-stationarity is rejected at 1% level of significance. Hence, there is a long-term relationship between GSDPA, irrigation ratio, road density and terms of trade between agriculture and industry.

4.5 Assessment of Budgetary Allocation to Agriculture and Allied Activities

The government has played an important role in promoting agricultural growth in the past. The major commitment of the state government is to put the economy on the path of sustained growth in a manner that the benefits trickle down to the vulnerable sections. We have analysed the budgetary expenditure of the three financial years—FY 2016–17 (Actual), FY 2017–18 (RE) and FY 2018–19 (BE) to evaluate historical trends in budgetary allocations in the broad sectors and assess which area is getting substantial budgetary support. The broad budgetary allocation on agriculture and allied activities is shown in Fig. 4.21. The graph shows that crop husbandry constitutes the largest share of budgetary allocation (91%) with negligible share going to animal husbandry (3%) and research and extension (3%) for FY 2018–19 (BE). It is quite clear that potential of other sub-sectors in terms of augmenting farmers' income has not yet been tapped by increasing budgetary allocation in animal husbandry, dairy development and fisheries.

Crop husbandry comprises of food grains, horticulture and commercial crops. Disaggregated analysis of expenditure on crop husbandry shows allocation of funds on these areas. However it also includes expenditure on support services like extensions, crop insurance and input subsidies that apply to all segments of crop husbandry. The major allocations under crop husbandry are made for power subsidy (75%) in TE 2018-19 (BE) which is not surprising given Punjab's history of free power provided to agriculture (Fig. 4.22).

This section discusses both expenditure in agriculture (cereals, fibre, oilseeds, fruits and vegetables, livestock and fisheries) and expenditure for agriculture (road, irrigation, research and education, extension and training) from the state budget documents. The study finds that there has not been any substantial diversification of fund allocation towards areas with potential to augment income (Fig. 4.23).

Cereals are the largest contributor to the gross value added in agriculture at 40.9% in TE 2015–16; expenditure on cereals, however, is highly disproportionate and accounts for not even 1% of the total budget outlay in TE 2018–19. If power subsidy,

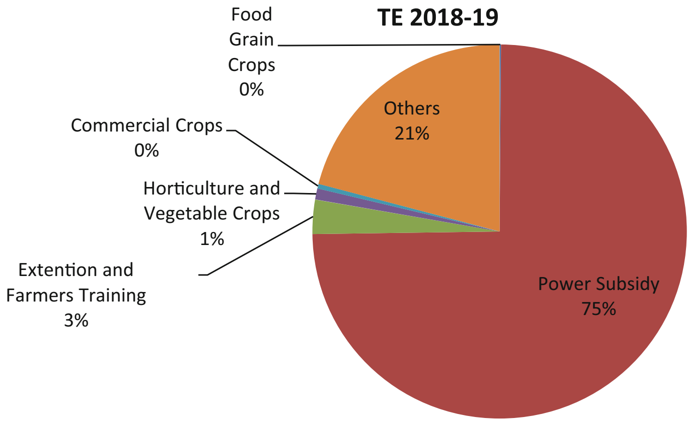
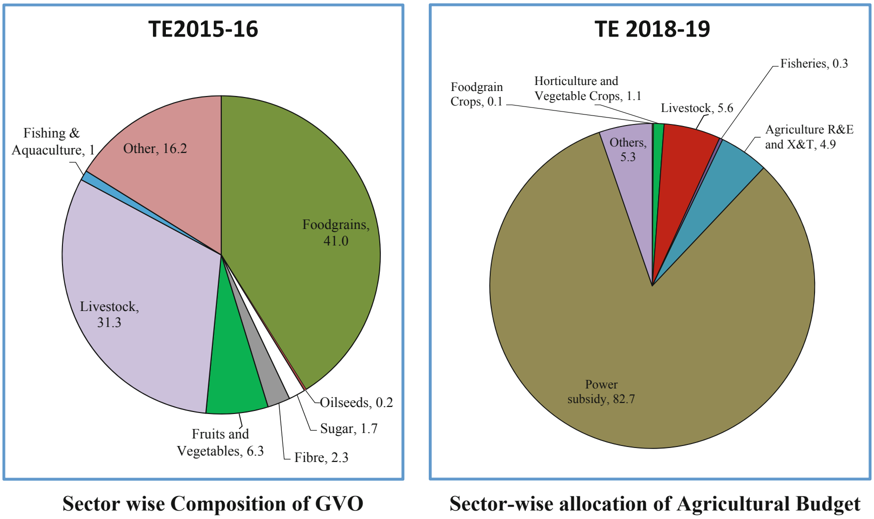


Fig. 4.22 Allocation to broad heads as a share of total allocation to crop husbandry in TE 2018–19



Others in the sector wise budgetary allocation include co-operation, soil and water conservation, manure and fertilizers and seeds.

Fig. 4.23 Alignment of agricultural budget with GVO in agriculture and allied activities

given mainly for cereal crops is included in this analysis, it is found that this figure shoots up to almost 83%. Thus, almost the entire budgetary resource is spent for providing free electricity to farmers in Punjab. Free power leads to unchecked use of water, which leads to the rapid depletion of the groundwater table. To improve power and water use efficiency, power supply should be metered and charged beyond a fixed level of free supply and the subsidy (currently, Rs. 6236 crore in 2012–13) should be transferred to farmer's bank account on a per hectare basis.

The livestock sector, which stands next to food grain in terms of its contribution to GVOA and accounted for 31.3% in TE 2015–16 has received a budgetary allocation of merely 5.6% in TE 2018–19. Of the meagre sum spent on animal husbandry and dairy development, only about Rs. 9 crore are spent on veterinary services and animal health. An important sector like livestock has the potential to augment farmers' income in a substantial way but the financial neglect, which reflects the miniscule attention paid to the sector, is a matter of concern.

Fruits and vegetables contributed 6.3% in the GVOA and accounted for an expenditure of only 1% of the total expenditure incurred on agriculture and allied activities. Punjab contributes little to the total production of fruits and vegetable in the country. But the state is already doing well in the production of fruits and vegetables like mandarin, radish, carrot and peas and it can increase its production further by allocating more funds through schemes dedicated to these crops. More resources need to be spent on schemes like the National Horticulture Mission if the government is serious about diversification of crops from traditional food grains to high value crops.

Expenditure on fisheries is 0.3% as compared to its contribution of 1% in GVOA. But Punjab has the potential to develop fisheries in waterlogged and salinity affected areas by providing assistance for fish ponds, as mentioned above.

Roads are well developed in Punjab and it has one of the highest road densities (2152 per thousand sq km) as well as share of surfaced roads (91%) in the country. Expenditure on PMGSY roads increased from Rs. 221 crore in 2016–17 to Rs. 443 crore in 2017–18 and then decreased to Rs. 141 crore in 2018–19 (BE). However, given the existence of well-developed roads in Punjab, this decrease in expenditure is justified.

The irrigation situation in Punjab is among the best in the country and almost the entire area is irrigated in the state. Expenditure on major and medium irrigation (MMI) in Punjab is still high as the government has set aside about Rs. 2000 crore in FY 2018–19. The alarming groundwater situation in Punjab is well-known and the government must encourage the use of drip irrigation as has been done in other states. The state government has allocated a sum of Rs. 3.35 crore in FY 2018–19 for micro-irrigation in PMKSY. Concerted effort by the government will ensure better utilisation of the scarce groundwater resources available in Punjab.

4.6 Conclusion and Policy Recommendations

The econometric analysis in the previous section highlights the three factors that have been the drivers of agricultural growth in Punjab in the past: (i) expanded irrigation through tube wells (ii) assured remunerative prices for wheat and rice and (iii) expansion of all-weather roads. However, the growth that could be achieved by developing roads, irrigation and markets has already been realised and exhausted. The state has successfully brought 98.5% of the gross cropped area under irrigation, which is commendable. The road infrastructure in Punjab is among the most developed in India. Transport facilities enhance the interaction between different agents, starting at the farm level to the household consumption level. This is particularly critical to facilitate the movement of perishable agricultural commodities. Surfaced road as a percentage of total roads is 91% in Punjab, one of the highest in the country. The share of wheat and rice procurement in total production is also the highest in the country. There is no real scope for further improvement in these areas. Therefore, in order to bring agricultural growth in Punjab back on track and get it growing at more than 5% per annum for another decade or more, we must look to other sub-sectors that could lead to high agricultural growth in the future. The future of Punjab's agricultural prosperity lies in the high-value sectors of agriculture. The combination of the highest irrigation cover, one of the best road infrastructures in the country and increasing holding size places Punjab in a privileged position[5]. What is required now is a correct mix of demand driven policies and incentives. Punjab's most significant problem has been free power, leading to huge depletion of water table as it tilted the cropping pattern towards paddy. The Johl committee report, 1986, had recommended a shift away from the wheat-rice cropping pattern to a wheat-maize one, which still remains valid. Punjab famers have not diversified from rice to other *kharif* crops in the absence of equivalent incentives. We make the following three sets of policy suggestions as the way forward for the agricultural sector in Punjab.

4.6.1 Diversification from Common Rice

Diversification to Maize : Currently, 0.13 million hectares, which is 1.65% of the GCA, is under maize cultivation in Punjab. The area under maize cultivation can be expanded by linking it to the processing industry for food and feed (especially poultry). Maize is used in many ways and these different uses should be explored to generate a market for various maize products.

(i) *Fodder Conservation*: Maize constitutes a primary ingredient for poultry feed in India. It can also be used as feed for dairy animals. Silage preparation is a scientific way of storing green fodder for dairy animals. It helps in supplying fodder for dairy animals on a large-scale during periods of scarcity without any nutrient loss. The criteria for forage to be used as silage include a high level of fermentable sugar, low level of protein and low buffering capacity. Based on these criteria, maize, oat, *bajra*, sorghum, lemon grass, etc., are considered suitable for silage making. In anaerobic conditions (without air), sugar

[5]Unlike other states, average landholding size increased in Punjab from 1970-71 to 2000–01and then declined marginally thereafter.

contained in green fodder is converted into lactic acid with the help of microorganisms, which helps preserve green fodder for a longer period of time. It is a time and labour saving technology compared to the traditional way as fodder cutting, transport and chaffing is done only once, making it economically viable. Although India is ranked first in milk production in the world, the productivity of animals is not satisfactory. Good quality forages make a huge difference in milk productivity (50% increase in productivity). An adult milch animal needs 35 kg of fodder per day and according to the Indian grassland and Fodder Research Institute (2010), the country faces a net deficit of 35.6% in green fodder. As livestock contributes more than 30% of the total value of output in Punjab and the state is the fifth largest producer of milk in the country, the demand for fodder is very high in the state as it is in neighbouring Haryana and Uttar Pradesh. Silage making is a technology that can allow farmers to provide quality roughage throughout the year. In India, hay making was the traditional method of forage preservation. But silage making is a technologically advanced method that is not dependent on weather conditions and a variety of crops can be used. In some pockets of Punjab, silage making has been successfully adopted. The cost of making 1 kg of green fodder is only Rs. 3.12, and it is usually sold at Rs. 5/kg. A mini dairy with 10 cattle and 5 calves will require 150 tonnes of green fodder per year (Dairy Knowledge Portal, NDDB). There are 50 community based silage pits established in Hoshiarpur and Gurdaspur with 100% subsidy from Milkfed. But it needs to be scaled up. Currently, 540,000 ha of area is under fodder cultivation in Punjab (BAHFS 2010). Area under common rice can be replaced with maize and farmers can directly be involved in silage making. The state can emerge as the feed-hub of northern India.

(ii) *Other Uses of Corn*:

a. Cornmeal: Prepared by grinding whole corn, it can be used as a replacement for wheat flour and used in baked food products like pizza, tortilla, corn bread and so on.
b. Corn syrup: It is used as a substitute of sugar in many products like soda, candy, cookies etc. Corn Oil: It is produced by squeezing the germs of the corn and is used as a food ingredient. Ethanol: Ethanol fuel or bio-fuel is made by distilling corn. It is a renewable resource and regular gasoline powered cars are run on gas blended with ethanol.
c. Pharmaceuticals: Preferred carbohydrate sources in antibiotics are corn syrup and corn starch. Over 85 different types of antibiotics are produced using corn.
d. Industrial products: Industrial products made from corn include absorbents for oil and hazardous waste, insecticides, fertiliser, industrial glue etc.
e. Alcoholic Drinks: Corn is the major source of carbohydrate in whiskey production.
f. Toothpaste: Sorbitol, produced from corn, is used in toothpaste. Thus, corn and its by-products have many uses.

The fast growing middle and high-income classes and changes in taste and preferences have led to an expansion in the market for processed foods, which offers new opportunities for the state to explore. In order to tap these opportunities, the state needs to strengthen the value chain infrastructure. Value chain is a vehicle by which new forms of production, technologies and logistics are introduced. The government should facilitate diversification away from rice towards maize and horticulture by creating the infrastructure for value chain development. Maize production can be incentivised by developing maize value chains, connecting farmers to feed producers, processed food industries making cornflakes, popcorn or food marts selling horticulture products like baby corn and sweet corn and producers of corn oil and ethanol. The maize crop faces a marketing problem because it contains more moisture (20–28%) than the optimal level (14%) required for processing. So, farmers are sometimes forced to accept a lower price. The government needs to provide proper infrastructure facilities including maize dryers in *mandis*. Some *mandis* have been provided maize dryers out of RKVY funds but not all *mandis* in maize growing areas are equipped with dryers. These problems need to be addressed on priority.

Promotion of Livestock Sector: Similarly, milk processing needs to be promoted aggressively by the state government. Although Punjab has the highest per capita per day availability of milk (1037 g/day) in the country, currently only 5% of the total milk production of the state is processed by the organised sector. The government should provide incentives to the private sector to improve milk processing in the state and set up several plants to process at least 30–35% of the total production in the coming five years. Moreover, only 30% of the total milk procured by Verka is converted into milk products. This share should be increased as sale of milk products generates more profit than liquid milk. Linking maize farmers with the dairy sector will help increase milk production through the supply of quality feed. But the abundance of liquid milk will put a downward pressure on its price. The government should incentivise the setting up of milk processing units. Following the example of Amul, the dairy sector in Punjab should target the market in the Middle East. Currently, marginal and small farmers are the major players in the dairy sector; hence, the formation of FPOs should be encouraged by the state government. Punjab can also make rearing of cattle more profitable to farmers through its vibrant dairy sector, and by developing meat processing, especially buffaloes, as an export-oriented industry. Farmers who want to sell their buffaloes for slaughter can fetch a better price for their non-milching healthy buffaloes if the state is declared free from foot and mouth disease.

Promotion of Horticulture: The state government needs to realise that growth in income through cereals has reached saturation and there is urgent need for value addition from high value dairy, fruits and vegetables. Only, 3.6% of Punjab's GCA is under fruit and vegetable production, compared to 8.3% at the all-India level. In order to promote the fruit and vegetable sector, protected cultivation should be promoted using drip and sprinkler irrigation. But it has to be backed by proper processing, grading and packaging infrastructure. The government should aim to bring at least 10% of cropped area under F&V in the next five years.

Fisheries: Large parts of Muktsar, Fazilka, Bathinda and Faridkot are waterlogged. A study by GADVASU has found that fresh water carp can successfully be reared in saline water. Hence, it provides a good opportunity to develop fisheries in these districts as it can offer alternative employment opportunities. But quality fish seed production has remained stagnant in Punjab, while it has increased steadily in neighbouring Haryana. The government should take steps to overcome these shortcomings through capital assistance to construct fish seed mills and carp seed farms.

4.6.2 Encouraging Food Processing Industries

The food processing sector should be the focus area in Punjab and farmers should be linked to processing units. The abundance of wheat and milk suggests the development of bakeries, flour mills, pasta manufacturing and other processing units that use wheat as raw material. Punjab's role in feeding the central pool for PDS should gradually come down. It will be taken up by other upcoming states like Madhya Pradesh and Uttar Pradesh. Due to high taxes (14.5%) on wheat, the processing industry has been reluctant to buy wheat from Punjab. In the past, private sector units located in Punjab have preferred to buy wheat from neighbouring Uttar Pradesh, where wheat is cheaper both because the MSP is not paid and because taxes are lower. Under GST reform, it is hoped that these taxes and levies will get rationalised as most raw agricultural commodities fall in the zero tax slab. A reduction in taxes and cesses by 12% will reduce the prices of these basic staples in the open market. The state should take it up as an opportunity to build a vibrant wheat and basmati rice processing industry, creating employment and linking farmers directly to processors. Special focus should be given to improve the value chain infrastructure, from farm to fork, in the state, given the perishable nature of the products that makes farming risky and farmers reluctant to shift from cereals to fruits and vegetables. The expressway linking Khanna to Kandla can minimise the transportation time and the state can exploit the opportunities offered by the Gulf market through speedy transportation of fruits and vegetables to the Middle East using cargo planes. But high taxes on processed food items under the new GST regime will hamper high value agriculture (fruits and vegetables, dairy, etc.) There is an urgent need to reconsider and bring down the rates to the 5% slab.

Contract farming is still not taken up on a large scale in the state. The state needs to operationalise the Contract Farming Act, 2013, to incentivise contract farming by corporate agencies and to promote the food processing industry in the state.

4.6.3 Promote Sustainable Agriculture Especially with Respect to Water Use Efficiency

Shift to DBT with respect to power subsidy: Electricity subsidy is an important component of subsidies that were introduced to increase agricultural growth and farm incomes. Although it has led to assured incomes, the combination of free water, power and procurement has led to rapid ground water depletion. Electricity consumption per hectare has increased over time, whereas agricultural production per unit of electricity consumption has not increased with free power supply; rather, it has been falling over time. This indicates serious inefficiency in the consumption of electricity in Punjab's agricultural sector, and steps need to be taken to curtail this. To improve power and water use efficiency, power supply should be metered and charged beyond a fixed level of free supply and the subsidy (Rs. 6236 crore in 2012–13) should be transferred to farmers' bank accounts. Transferring a fixed amount of cash (calculated using the average land holding) to farmers will provide an incentive to reduce the consumption both of electricity and underground water.

Shift to DBT with respect to Fertiliser Subsidy: Another problem faced by agriculture in Punjab arises from the imbalance in the use of fertilisers. Wheat and rice are the most nutrient exhaustive crops and the mono-cropping of paddy and wheat in the past four decades has led to a steady decline in macro (NPK) as well as micro (zinc, iron, manganese) nutrients. The state has encouraged the use of chemical fertilisers through subsidies and the economic cost was estimated at Rs. 7022 crore in 2012–13. Hence, it has become a vicious circle of higher use of fertilisers and low soil fertility. The fertiliser subsidy has helped achieve self-sufficiency in food grain production but it has led to inefficient fertiliser use. The extremely low price of urea has resulted in the imbalanced use of fertilisers biased towards urea, which has had an impact on the fertility of land. The NPK ratio in Punjab is 31.4:8:1 in 2016. Studies have shown that (Gulati et al. 2015) this imbalance in the use of fertilisers can be corrected by switching to direct cash transfers to farmers on a per hectare basis. Farmers should be incentivised to get the soil tested and get soil health cards by linking these to direct cash transfers. Moreover, import duty on urea should be reduced to zero and prices should be determined by market forces.

Propagating Micro-irrigation Technique: Given the gravity of the problem of water situation, the state government must consider making it mandatory for sugarcane farmers to use drip irrigation facilities. Karnataka has already done so; Maharashtra is considering a similar system. Out of 10 lakh ha area under sugarcane in Maharashtra, about 2.5 lakh ha is already under drip irrigation. Modern drip irrigation systems use computerised sensors that regulate the flow of water depending on temperature, humidity and nutrient levels in the soil. Moreover, water reaches the roots of plants, leading to better plant growth. The automated systems ensure optimum use of water. If the Government of Punjab takes sugar mills on board, it should not be difficult to persuade farmers to install drip irrigation systems over a period of two or three years. There are pilots being conducted in Punjab for drip irrigation in paddy. These need to be closely monitored and encouraged. The manufacturers of drip equipment claim that using drip irrigation leads to savings of 65% in the case of water and 45% in the case of electricity while improving crop productivity by 40% as compared to flow irrigation. Micro-irrigation means more crop per drop.

Sustainable Futuristic Agricultural Development: Another important way to deal with power shortage is to promote solar power for powering irrigation pumps and generating solar power as the "third crop" by enabling farmers to sell surplus power to the state grid. This will help check depleting water tables too. Cold storages based on solar power can be cost effective. A beginning should be made in the case of potato cold storages in Jalandhar.

Overall, the strategy for Punjab agriculture needs to shift from food security concerns of the country to income augmentation of farmers. This can be done by gradually shifting towards high value fruits and vegetables, protected cultivation, and by focusing on the food processing industry to add value to wheat, rice and milk production in the state. The strategy also needs to be demand driven (plate to plough), exploring new and remunerative markets, as in the Gulf countries or even beyond to Europe and CIS countries. We are confident that with this shift in strategy, the state can turn around its agriculture growth back to more than 5% per annum, augment farmers' incomes and use its precious water resources in a more sustainable manner.

Annexure

See Table 4.5.

Table 4.5 Correlation matrix for the period 1970–71 to 2015–16

	GSDPA	Fertiliser consumption	Irrigation ratio	ToT	Total road density	Surfaced road density
GSDPA	1					
Fertiliser consumption	0.93***	1				
Irrigation ratio	0.94***	0.94***	1			
ToT	0.29**	0.06	0.07	1		
Total road density	0.94***	0.87***	0.87***	0.37**	1	
Surfaced road density	0.95***	0.91***	0.91***	0.25*	0.99**	1

*** significant at 1%, ** significant at 5%

References

Basic Animal Husbandry & Fisheries Statistics, 2014. Department of Animal Husbandry, dairying and Fisheries, Ministry of Agriculture.

Economic Survey of Punjab (Various Issues). *Economic Survey of Punjab*. Office of Economic Advisor. Government of Punjab

Government of India (2013-14). *Crop Diversification Program in Haryana, Punjab & Western Uttar Pradesh*. Sustainable Agriculture with Increased Productivity & Profitability. Department of Agriculture & Cooperation. Ministry of Agriculture. Government of India.

Government of Punjab (1970-71 to 2003-04). *State Domestic Product of Punjab Back Series*. Economic Advisor, Government of Punjab.

Ground Water Scenario in India: *Central Ground Water Board*. Ministry of Water Resources, Government of India (January 2016)

Gulati, A and Banerjee, P; 2015. Rationalising Fertiliser Subsidy in India: Key Issues and Policy Options

Gulati, A and Terway, P (Upcoming Paper). *Investment and Subsidies and their Impact on Agricultural Growth and Poverty Reduction*. ICRIER

Gulati, A., Rajkhowa, P., & Sharma, P. (2017). *Making Rapid Strides – Agriculture in Madhya Pradesh: Sources, Drivers, and Policy Lessons*. ICRIER Working Paper No. 339. Indian Council for Research on International Economic Relations: New Delhi

Hoda, A., Rajkhowa, P., & Gulati, A. (2017). *Working Paper 336: Unleashing Bihar's Agriculture Potential: Sources and Drivers of Agriculture Growth*. New Delhi: Indian Council for Research on International Economic Relations.

Hoda, A., Rajkhowa, P., & Gulati, A. (2017). *Working Paper 337: Transforming Agriculture in Odisha: Sources and Drivers of Agriculture Growth*. New Delhi: Indian Council for Research on International Economic Relations.

Horticulture Statistics at a Glance (2015). *Horticulture Statistics at a Glance*. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India.

Livestock Census. (2007). *16th Livestock Census-2007 All India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Randhawa, M. (1977). *Green Revolution in Punjab*. Agricultural History, 51(4), 656-661. Retrieved from http://www.jstor.org/stable/3741754

Sarkar, A., Das, A. (2014). Groundwater irrigation–electricity–crop diversification nexus in Punjab: trends, turning points and policy initiatives. Economic and Political Weekly **49**(52), 64–73.

Singh, K. (2012). Electricity subsidy in Punjab agriculture: Extent and impact. *Indian Journal of Agricultural Economics*, 67(902-2016-66726).

Singh, S., Kaur, M., & Kingra, H. S. (2009). Inadequacies of institutional agricultural credit system in Punjab State. *Agricultural Economics Research Review*, 22(347-2016-16855), 309-318.

Tripathi, A., Mishra, A.K., Verma, G.: Impact of preservation of subsoil water act on groundwater depletion: the case of Punjab. India. Environmental management **58**(1), 48–59 (2016)

Verka. (2013–14). *Verka Annual Report*. The Punjab State Cooperative Milk Producers' Federation Ltd.

Links

http://eands.dacnet.nic.in/
http://morth.nic.in/
http://mospi.nic.in/

http://www.esopb.gov.in/
http://www.faidelhi.org/statistics-reports.htm
http://www.imdpune.gov.in/
http://www.indiastat.com/agriculture
http://www.nddb.org/information/stats
https://gadvasu.in/

Chapter 5
Performance of Agriculture in Gujarat

Ashok Gulati, Ranjana Roy, and Siraj Hussain

5.1 Introduction

There have always been large disparities in India's agricultural performance at the state level because of varying resource endowments and levels of investment in the creation of rural infrastructure. Agriculture states like Punjab and Haryana performed well in the 1960s and 1970s, while Gujarat and Madhya Pradesh have been star performers during the post-2000 period. Other states like Bihar, Odisha and UP have been moderate performers. Gujarat is one of the few states which achieved high growth in this sector; during the period from 2001–02 to 2014–15, Gujarat's agriculture grew at 8.6% per annum. During the same period, the all-India agricultural growth rate was only 3.2% per annum. Gujarat's outstanding performance during this period has been nothing short of an "agrarian miracle", as it surpassed even the growth rate registered by Punjab's agriculture during the heydays of the green revolution. This makes a strong case for looking at the dynamics of change and the factors that drove Gujarat's agriculture to such heights so that this success story can be shared with other states, especially the eastern states of Uttar Pradesh, Bihar and Odisha, which have lot of potential to excel in this sector. However, the state experienced very low growth in agriculture during 2014–15 (0.01%) and 2015–16 (−1.6%), primarily due to droughts.[1]

Among the many steps taken by the state, three interventions played important roles in its impressive performance: (i) irrigation facilities (ii) efficient power supply and (iii) all-weather roads to provide rural connectivity. Groundwater irrigation

[1] Some experts suggest that this drastic fall in agricultural GDP for two successive years had political implications for the ruling party, leading to its poor performance in the agricultural belt of Saurashtra in 2017.

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through assured power was ensured through power feeder separation. Rationing of farm power supply after *Jyoti Gram*[2] brought discipline in the extraction of groundwater. Micro-irrigation in the PPP mode and community-based farm ponds are unique examples of sustainable water use in the state. Investment in all-weather surfaced roads ensured efficient and quick movement of products to the market, minimising waste. Dairy co-operatives have provided a stable base for the growth of the livestock sector so far. Co-operatives procure 53.7% of the milk produced in the state, which is the highest in the country. Complementarities in public policies and private initiatives have made Gujarat's agricultural miracle possible.

Whether Gujarat's agricultural performance will continue to be as strong in the coming decade as it has been since 2001–02 remains an open question. We look at Gujarat's experience more closely, not only to draw lessons for other states but also to sustain its high growth path and guide the state.

This chapter is organised in six sections. After a brief introduction in Sect. 5.1, a detailed overview of Gujarat's agricultural sector is presented in Sect. 5.2. In Sect. 5.3, the composition and sources of agriculture growth in Gujarat have been analysed. Section 5.4 presents the econometric analysis to derive the drivers of agriculture growth in the state. In Sect. 5.5, we have looked at whether the state's agricultural budget is in line with the GVO from agriculture and allied activities. Finally, in Sect. 5.6, we present some concluding remarks based on our empirical and econometric analysis and recommend policy prescriptions to sustain high growth rates in Gujarat.

5.2 Overview of Agriculture in Gujarat

The state, situated in the western part of India, is spread over an area of 196,024 sq. km which is approximately 6.4% of the total geographical area of the country (Census 2011). In Gujarat, rainfall is unevenly distributed spatially. The southern region of the state receives average rainfall ranging from 76 to 152 cm, while the northern region receives average rainfall ranging from 51 to 102 cm. Some parts of Saurashtra receive rainfall of less than 63 cm. Further, the state receives rainfall only during the monsoon season (July–September) (Agricultural Statistics at a Glance, 2014). Uneven rainfall has led to water scarcity in Kutch and some parts of Saurashtra. While Northern Gujarat and Saurashtra are drought-prone, other parts of the state consisting of the lower river basins are prone to floods (Ahmedabad, Surat and Bharuch). Heavy rainfall in the areas of small river basins cause flash floods.

[2]The Jyoti Gram Yojana was launched in 2003. Under the scheme, agricultural feeders were introduced and rural areas received 24 hours power supply. Details can be found in the upcoming sections.

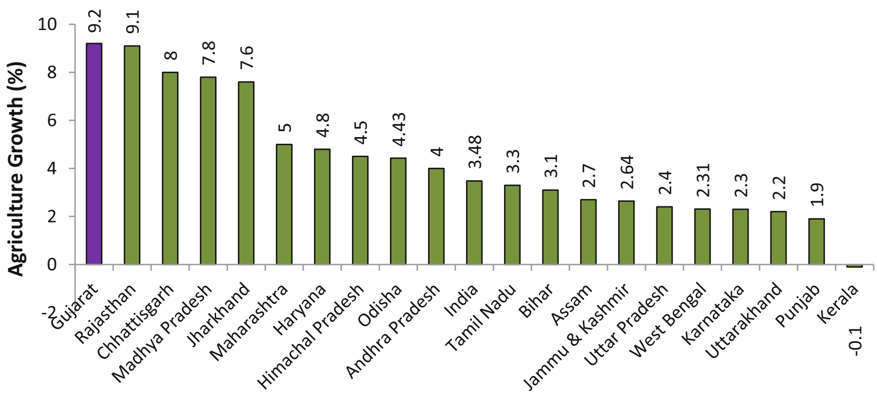


Fig. 5.1 Average annual growth in agricultural GDP, 2001–02 to 2013–14. *Source* National accounts statistics, MOSPI

5.2.1 Agricultural Growth in Gujarat

Gujarat has been praised for its economic performance, which was led by the manufacturing and services sector during the eighties and nineties, especially after the economic reforms. The agricultural sector did not receive much attention during this time; rather, agricultural growth slowed down during this period (Hirway 2000, Bagchi et al. 2005). Specifically, the agricultural growth rate was not low but was accompanied by very high volatility. But the picture changed after 2000, as the sector picked up dramatically with high growth and low volatility.

In recent years too, the sector continued to achieve a high growth rate with comparatively lower volatility. During 2001–02 to 2013–14, Gujarat's agricultural GDP grew at 9.2%, which was the highest among the major states (Fig. 5.1). However, agricultural growth still has a high correlation with rainfall deviation. The correlation coefficient between agricultural growth (%) and rainfall deviation (%)[3] in Gujarat is 0.65, while the correlation coefficient of agriculture growth with rainfall deviation in the Saurashtra region is 0.61 for the period of 2002–03 to 2015–16.

But since 2014–15, agriculture in Gujarat has suffered and the state has lost its position to Madhya Pradesh. Droughts in two consecutive years (2014–15 and 2015–16) led to negative agricultural growth. The situation improved in 2016–17 (9.9% in 2016–17 over 2015–16). But taking the average of the last three years, the sector grew only at 2.8% per annum (Fig. 5.2), which is extremely low compared to Gujarat's earlier experience.

[3]Excess: +20% or more of long period average rainfall, Normal: Between +19% and −19% of long period average rainfall, Deficient: Between −20% and −59% of long period average rainfall.

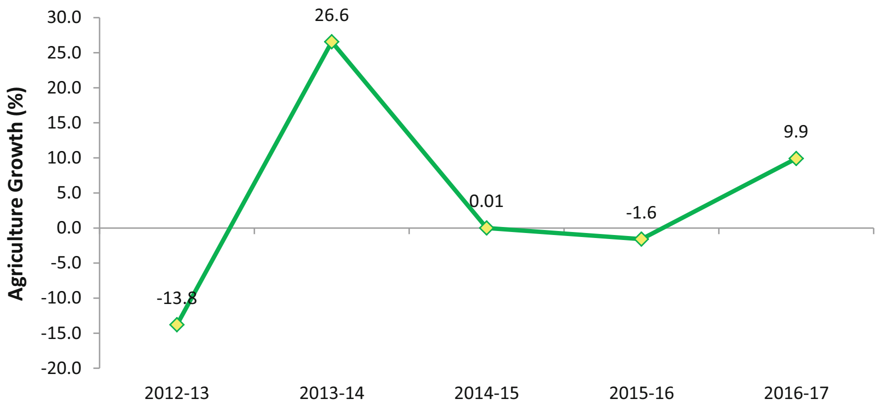


Fig. 5.2 Trends in agricultural growth in the period of 2012–13 to 2016–17. *Source* National accounts statistics, MOSPI

5.2.2 *Agricultural Livelihood in Gujarat*

The state's population in 2011 was 60.4 million, and the estimated population for 2018 is 68.2 million, which is 5% of India's population. Gujarat had 49% of its workforce engaged in agriculture in 2015–16 (Labour Bureau, 2015–16), while the contribution of agriculture in overall GSDP was 16% in TE2016–17 (CSO). The agriculture sector is largely dominated by small and marginal farmers. In 2015–16, small and marginal farmers (with a holding size of less than 2 hectares) accounted for 68% of the total number of farmers in the state, and they operated on 34% of the total state's operated area. The average landholding size declined from 2.62 ha in 1995–96 to 1.88 ha in 2015–16 (Table 5.1).

The average monthly income per agricultural household stood at Rs. 7926 in 2012–13, which is higher than the all-India average Rs. 6426. But the growth rate of income (3.4%) is marginally lower than that achieved at the all-India level (3.5%) (NSSO, 2002–03 and 2012–13). This is somewhat puzzling as Gujarat's agricultural GDP growth during this period was more than the all-India average (almost 5.7% per annum). One possible reason could be that the year 2012–13 was an outlier, when Gujarat experienced extremely low rainfall, more than 30% below normal (in Saurashtra, it is was more 38% below normal), leading to a sharp decline in the profitability of most crops. Since income growth is calculated as CAGR between two points (2002–03 and 2012–13), and not as an annual average of all the years in between, this slow growth in income may be due to this statistical glitch. According to NABARD's All India Rural Financial Inclusion Survey 2015–16 (NAFIS), Gujarat farmers' income was Rs. 11,899 per month. This was the fourth highest among all states (after Punjab, Haryana and Kerala). In the longer period of 2002–03 to 2015–16, the state achieved an average annual farmer income growth rate of 4.2%, which is marginally higher than the all-India average growth of 3.7%.

Table 5.1 State-wise distribution of operational holdings in Gujarat

	1995–96			2010–11			2015–16		
	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)
Marginal	5.68	27.34	0.54	8.94	37.16	0.49	10.75	37.93	0.53
Small	15.67	27.97	1.47	20.96	29.25	1.45	23.43	30.37	1.45
Semi-medium	27.35	25.55	2.80	30.19	22.10	2.77	31.79	21.62	2.76
Medium	37.71	16.73	5.90	29.60	10.49	5.72	28.11	9.32	5.66
Large	13.59	2.40	14.81	10.30	1.00	20.91	5.91	0.75	14.79
All	100.00	100.00	2.62	100.00	100.00	2.03	100.00	100.00	1.88

Source Agricultural Census

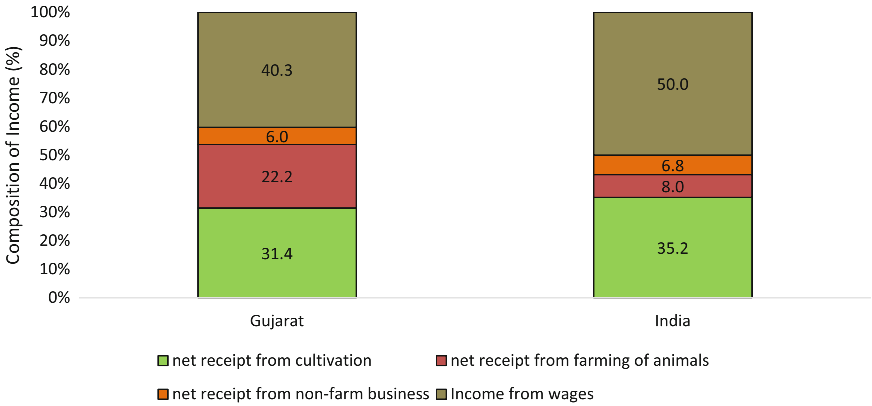


Fig. 5.3 Composition of agricultural household income from different sources in Gujarat and India in 2015–16. *Source* NAFIS, NABARD

In Gujarat, a major share of agricultural household income came from the cultivation and livestock sector (53.6%) followed by income from wages (40.3%) and net receipts from non-farm activities (6.0%). The wages and salaries' segment includes the incomes earned by working on other's farms and small and marginal farmers who work on others' farms or elsewhere for wages. In 2015–16, the contribution of income from livestock declined and the share of "wages and salaries" increased. The following figure shows the composition of agricultural household income from different sources in Gujarat vis-a-vis India in 2015–16 (Fig. 5.3).

5.2.3 Cropping Pattern in Gujarat

In Gujarat, 54% of the land utilisation is accounted for by cultivation. The total gross cropped area in the state is 12.8 million hectares. The major crops grown in Gujarat are cotton, groundnut, castor, wheat, *bajra*, maize, rice and horticultural crops. Over the years, the state has moved away from food grains to the production of cotton. The share of food grains in GCA declined from 43% in TE 1994–95 to 36% in TE 2014–15, while the share of cotton has doubled from 11 to 20.6% in the same period. Within the food grain sector, there has been a shift from *jowar* to the production of wheat. Further, the share of oilseeds declined from 27.1 to 24.9% during the period. Within oilseeds, Gujarat mainly specialises in the production of groundnut and castor with their share in the total area under oilseeds being 56% and 26%, respectively (Fig. 5.4).

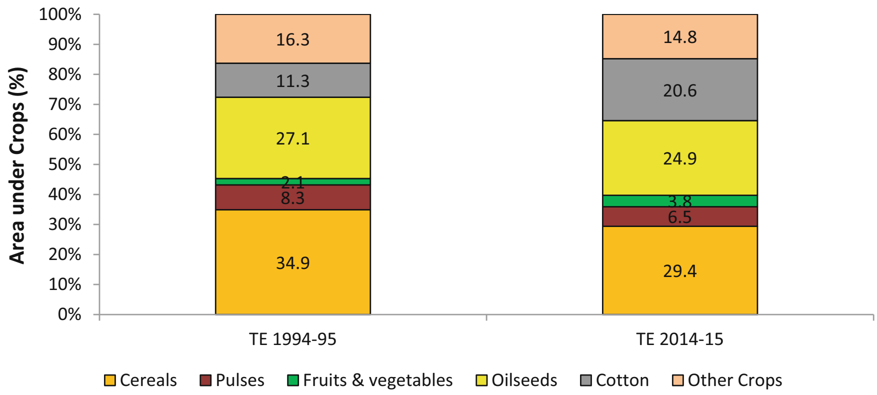


Fig. 5.4 Area under crops as a percentage of total GCA. *Source* Directorate of economics and statistics

5.2.4 Determinants of Agriculture Growth

Physical infrastructures such as irrigation, power and road play a critical role in agricultural growth. There have been several studies that indicate that investment in rural infrastructure has much greater potential to increase agriculture growth than expenditure on input subsidies (Fan et al 2007; Fan and Zhang 2004). In this section, we discuss the development of infrastructure in Gujarat to understand which factors helped in stimulating high productivity and growth in the agriculture sector.

5.2.4.1 Irrigation Infrastructure

Water plays a pivotal role in agriculture, and Gujarat being a drought-prone state with 75% of its area falling in semi-arid and arid zones, irrigation plays a very important role in the state's agricultural development.

The state government's strategic schemes to expand irrigation have resulted in Gujarat increasing its gross irrigated area from 3.3 million hectares in 2000–01 to 6 million hectares in 2014–15. In the beginning of the 1990s, Gujarat's irrigation ratio (share of gross irrigated area as a share of gross cropped area) was 27.5%, below the national average of 34%. But the situation has improved since then and the irrigation ratio for the year 2014–15 stood at 47%, which is close to the national average (49%) (Fig. 5.5).

Source-wise irrigation data reveals that dug wells and tube wells constitute the major share, followed by canals. Disaggregated analysis of source-wise irrigation in Gujarat shows that the area under canal irrigation as a share of net irrigated area has increased from 12.5% in TE 2002–03 to 18.2% in TE 2013–14. Further, the share of tube well declined from 33.5 to 26.5% in the same period.

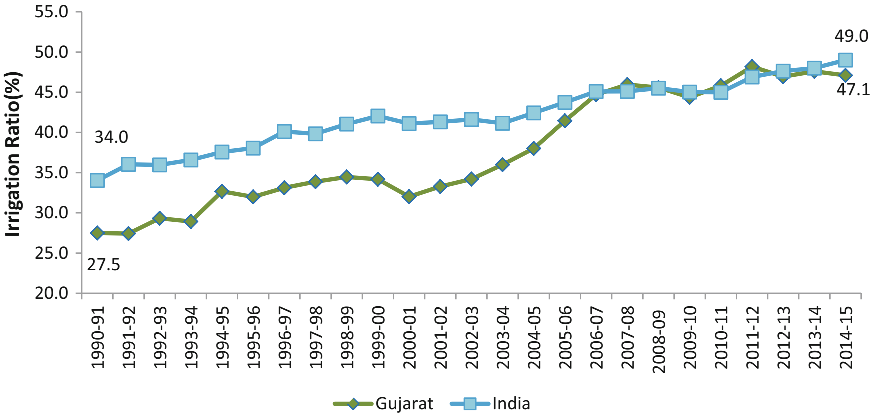


Fig. 5.5 Gross irrigated area as a percentage of gross cropped area. *Source* Directorate of economics and statistics

Increase in rural electrification and flat tariff rates based on horse power of pumps in the 1980s and 1990s accelerated tube well irrigation. This led to groundwater depletion in Gujarat and optimum utilisation of water became an acute issue. Recent development programmes that have improved availability of water for agriculture use in a sustainable manner are the following:

The largest of all the major irrigation projects is the *Sardar Sarovar* Project. The project is expected to provide irrigation facilities to 3112 villages in 15 districts of Gujarat. In terms of acreage, the project covers 1.84 m ha. The dam was inaugurated by the Prime Minister on September 17, 2017 (http://www.sardarsarovardam.org/benefits-of-project.aspx).

Check Dams

When the Saurashtra and Kutch regions suffered groundwater depletion in the 1980s and 1990s, a decentralised movement for groundwater recharge started in these areas. The state government launched the Sardar Patel participatory water conservation project in 2000 for the construction of water harvesting and groundwater recharge structures as a public–private partnership. Check dams, *bori bandhs* and *khet talvadis* are traditional methods of conserving rainwater. Check dams require less operation and maintenance compared to surface irrigation projects. As of 31 March 2016, the number of check dams, *bori bandh*s and *khet talvadis* was 1.68, 1.25 and 2.62 lakh, respectively. These have insulated *kharif* crops in rainfall scarce areas against the early withdrawal of monsoon (Source: Narmada, Water Resources, Water Supply and Kalpsar Department, Govt. of Gujarat). Studies have shown that check dams helped augment groundwater recharge in Saurashtra.

Table 5.2 Status of GW development in different *Talukas* in Gujarat (2004–2013)

	Safe	Semi-critical	Critical	Over-exploited	Stage of ground water development (%)
2004	97 (43%)	69 (31%)	12 (5%)	31 (14%)	76
2009	156 (70%)	20 (9%)	6 (3%)	27 (12%)	75
2013	175 (78%)	9 (4%)	6 (3%)	23 (10%)	68

Source Central Ground Water Development Board

Micro-Irrigation System

Another initiative of the Gujarat government to promote micro-irrigation in the state was the establishment of the Gujarat Green Revolution Company Limited (GGRC) in 2005. Micro-irrigation is an integral part of state government's *Jal Sanchay Abhiyan.* By placing the subsidy with GGRC, the Gujarat government made it easy for farmers to install micro-irrigation systems and avail of the subsidy. Covering the cost of micro-irrigation systems under insurance was also an innovative step. To promote sustainable agriculture, the state implemented a scheme to subsidise 70% of the cost of micro-irrigation systems (MIS) or Rs. 70,000 per hectare (whichever is less). Small and marginal farmers and farmers in dark zones (where groundwater is over-extracted) are eligible for slightly higher subsidy (w.e.f. 1 April 2017). The scheme also prioritises electricity connection for farmers adopting micro-irrigation systems. Since the implementation of the scheme, a total area of 1.1 million hectares was covered under MIS by the end of February 2017. Major crops covered under micro-irrigation are groundnut, cotton, sugarcane, castor, potato, banana and mango. Currently, 8.7% of the gross cropped area (11% of NSA) is covered under MIS of which 4.3% is covered through drip irrigation and 4.4% is under sprinkler irrigation.

Effectiveness of measures undertaken

As a result of the various measures implemented by the Gujarat government, groundwater recharge has increased significantly and there is a remarkable improvement in the groundwater of many *talukas* in the state with an improvement in the overall stage of groundwater development from semi-critical (75%) to safe (68%) for the state (Table 5.2).

While the overall stage of groundwater development in Gujarat at about 68% appears to be comfortable, groundwater development has not been uniform throughout the state. Out of 223 assessment units, 23 units have been categorised as over-exploited, 6 as critical, 9 semi-critical, 175 safe and 10 saline. A large number of the OE/critical and semi-critical units are located in the North Gujarat and Kutch regions of the state. In these areas, intensive groundwater exploitation has resulted in a secular decline in groundwater levels in wells and tube wells. There have been large seasonal drops in the water level in wells and under certain situations, and deterioration in the quality of groundwater, especially in the coastal areas.

Gujarat needs to aggressively promote rainwater harvesting and recharge of groundwater as well as watershed development based on scientific inputs from the National Aquifer Mapping Programme through the convergence of the activities of various agencies in the state implementing water conservation programmes under MGNREGA, NRDWP, IWMP, PMKSY, etc. This involves, inter-alia, levelling land and tapping rainwater in small structures like check dams, percolation ponds, gabions, recharge wells, etc., in hydro-geologically favourable locations. This will increase soil moisture, recharge groundwater and permit a second crop to be raised. With the support of the government, NGOs, community groups and other civil society organisations, the state of Gujarat has already built over 100,000 check dams, which has contributed significantly to Gujarat's impressive agricultural growth.

5.2.4.2 Power for Agriculture

Power is a prerequisite for unconstrained water supply through groundwater irrigation. The Gujarat government has made conscious efforts to ensure power for agriculture and the *Jyoti Gram Yojana* has helped improve rural electrification. The scheme is considered a model found nowhere in the world. The power situation was alarming before the inception of the scheme. Even though most villages were electrified, they did not receive adequate power due to lack of power supply. Until 2003, a common feeder catered to different types of electricity uses: residential, agricultural, industrial and commercial. Power supply to villages was limited to 8–12 hours a day, that too with interruptions. Another problem with the ongoing system was that agricultural connections were not metered. So, payments were based on the capacity of the electric pump in terms of horse power, irrespective of power use. This led to the unsustainable use of groundwater.

In this backdrop, the *Jyoti Gram Yojana* was launched in 2003 on a pilot basis. It was later extended to over 18,000 villages and more than 16,000 suburbs attached to villages for non-agricultural activities. Under this scheme, there was 24-hour, 3-phase supply through JGY feeders and 8 hours continuous 3-phase supply through the agricultural feeder. With this, Gujarat has become the first state in which rural areas get 24 hours power supply and farmers get non-stop power supply at 430–440 voltage for eight hours with a strict schedule, checking overuse. Prior to the implementation of feeder separation, consumption of power for agriculture was treated as residual use for accounting purposes. Hence, unauthorised use of power was also counted under agriculture. The following diagram shows the trends in the share of power sales for agriculture—it declined from 36.3% in 2002–03 to 27% in 2015–16 (Fig. 5.6). The decline in the share of agriculture in power consumption was the result of reduction in overuse under feeder separation and also because consumption for agricultural purpose increased more slowly than for industrial use.

Power intensity (total power sale/GCA) in Gujarat declined from 1389 kw/ha in TE 2002–03 to 1087 kwh/ha in TE 2015–16. It can be inferred that feeder separation and

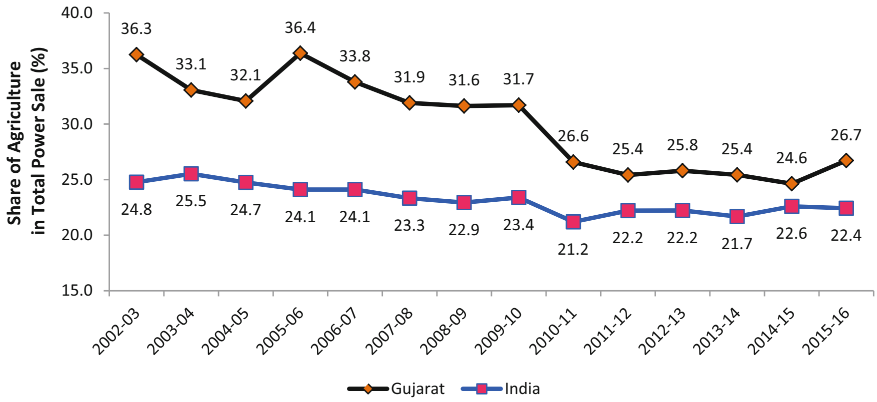


Fig. 5.6 Agriculture share in total power sales. *Source* Planning commission, planning and energy division

power rationing increased the efficiency of water and power utilisation for agriculture, which freed up resources for the non-farm sector. It is evident from the last section (irrigation) that the area under irrigation for each crop has increased significantly. An increase in the area under fruits also implies efficient use of water as important fruits grown in Gujarat like banana and mangoes are water-intensive crops. Drawing its inspiration from Gujarat's success, the Government of India launched the *Deen Dayal Upadhyaya Gram Jyoti Yojana* in 2015 as a flagship programme with focus on feeder separation (rural households and agriculture) and strengthening the sub-transmission and distribution infrastructure.

5.2.4.3 Ports and Roads

Gujarat has one major port Kandla, which ranked first in terms of tonnage handling. There has been a huge jump in the tonnage handled at Kandla port after 2004–05 especially due to the capacity extension work initiated during the global recession in 2008–09 (Dholakia et al. 2010). The state has 40 non-major ports which handle around 80% of the total tonnage handled by all non-major ports in India (Table 5.3). The state has one of the best minor road port connectivity in the country. In 2015, Gujarat's minor port surfaced road network's length stood at 142 km. Private ports like Mundra with an annual capacity of 200 million tns also played a major role in infrastructure development.

Roads play an important role in the development of agriculture as they reduce transportation costs and minimises rotting of perishable items. Sometimes, farmers are forced to sell their products at a low price to middlemen because the lack of transport facilities prevents them from reaching the market after the harvest. The state government was motivated to invest in road development right from the sixties to accommodate to the needs of the state's growing co-operative dairy and fruits and

Table 5.3 Percentage share of tonnage handled by major Indian seaports

	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17
Kolkata (KDS)	2.5	2.3	2.3	2.4	2.2	2.2
Haldia (HDC)	7.3	6.3	6.3	5.7	6.8	6.8
Paradip	11.5	13.7	13.7	13.7	13.1	13.1
Visakhapatnam	9.5	9.0	9.0	11.1	11.2	11.2
Ennore	4.5	4.2	4.2	4.2	4.7	4.7
Chennai	11.9	11.5	11.5	9.9	9.7	9.7
Tuticorin	4.8	4.5	4.5	5.1	6.1	6.1
Cochin	6.0	6.0	6.0	5.7	5.1	5.1
New Mangalore	7.3	10.3	10.3	8.9	8.1	8.1
Mormugao	6.0	4.9	4.9	5.0	5.1	5.1
Mumbai	6.4	6.0	6.0	5.1	5.1	5.1
Jawaharlal Nehru	9.2	8.8	8.8	9.1	9.3	9.3
Kandla	13.1	12.5	12.5	13.9	13.6	13.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source India Ports Association

vegetables sector. A study by the Asian Development Bank showed that prices of crops (dairy, fodder, fruits and vegetables) improved in Gujarat with better roads and rural electrification. Currently, Gujarat is one of the best performers in terms of road development in the country, with 914 km of road per 1000 sq km of area, of which 87% is *pucca*/surfaced road. The road density increased from 413 km in 1990–91 to 914 km in 2015–16 (Fig. 5.7).

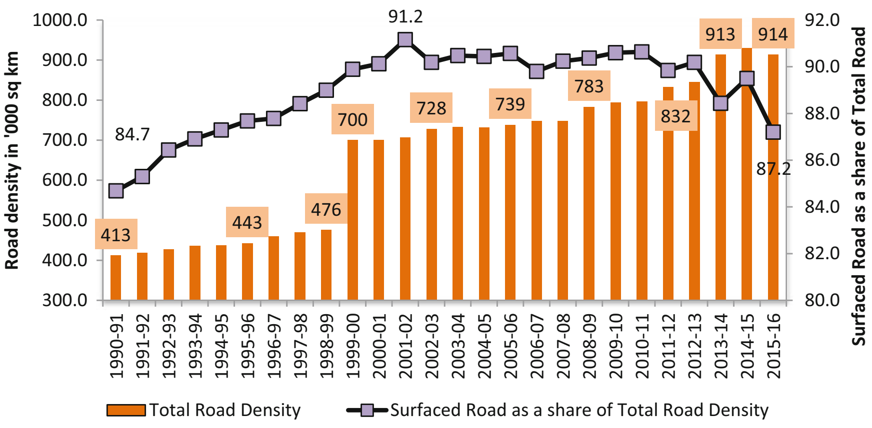


Fig. 5.7 Road development in Gujarat. *Source* Ministry of roads, transport and highway, several issues of basic road statistics of India

The *Pradhan Mantri Gram Sadak Yojana* was launched in 2000 to provide all-weather roads to unconnected habitations in rural areas. About 7420 habitations in the state were unconnected at the start of the scheme. Until 2016–17, 4573 roads were sanctioned under PMGSY, of which 4480 have been completed (http://rnbgujarat.org/basic-activities/panchayat.aspx accessed on 25/1/2017). In March 2015, the length of PMGSY roads was 18,441 km. 92% of rural roads are surfaced in Gujarat, which is very high compared to the national average of 61%.

5.3 Composition of the Agricultural Sector and Sources of Agricultural Growth

The composition of agriculture and allied activities in Gujarat gives an idea of the potential of different segments. Figure 5.8 shows that in TE 2015–16, livestock was the largest segment in Gujarat, comprising 26.2% of the total value of output from agriculture and allied activities, followed by fruits and vegetables (16.7%), fibre (12.7%) and oilseeds (11.8%). The most prominent change was in the case of fibre (cotton)—its share in GVOA increased from 5.9% in TE 2002–03 to 12.7% in TE 2015–16 (Fig. 5.8).

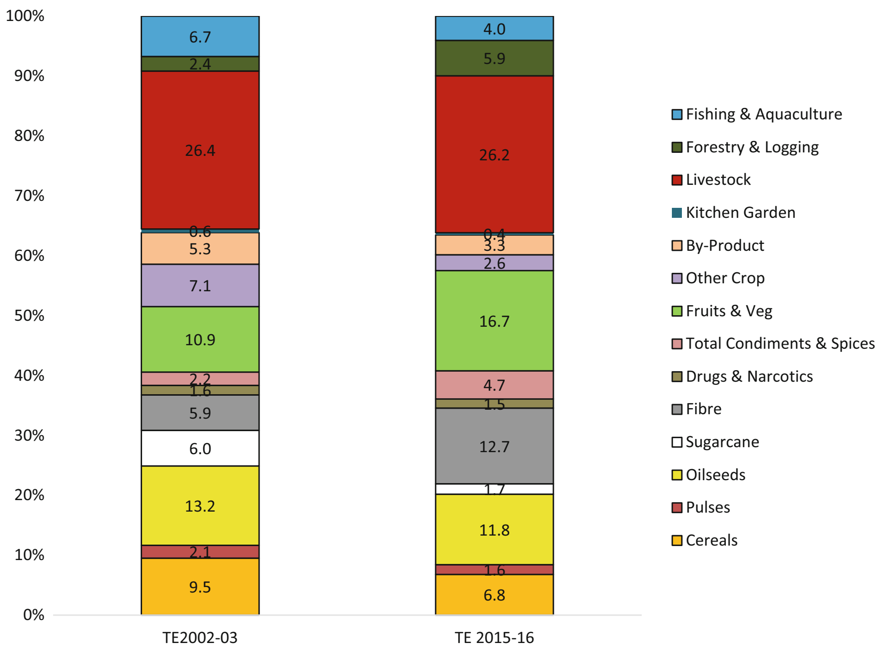


Fig. 5.8 Sector-wise shares in total value of output from agriculture and allied activities (at current prices). *Source* CSO

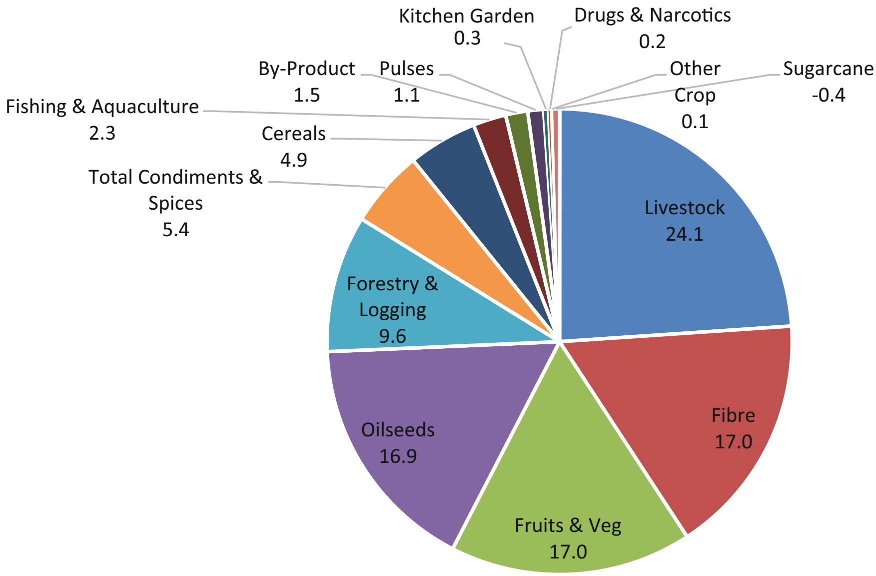


Fig. 5.9 Segment-wise growth in value of output (2000–01 to 2015–16). *Source* Calculated by author based on data from MOSPI

To calculate the sources of growth, the current series of value of output of each segment has been deflated by the WPI of all commodities at 2011–12 prices. Then, the year-on-year growth of each segment has been calculated by taking the absolute year-on-year difference in GVOA from each segment as a proportion of previous year's GVOA from agriculture and allied activities. The gross value of output from this sector grew at 9.1% in the period 2000–01 to 2015–16. The contribution of different sub-sectors to the total growth of agriculture and allied activities is presented in the following Fig. 5.9. The highest contribution has been from livestock (24.1%) followed by fruits and vegetables (17%), fibre (17%) and oilseeds (16.9%) (Fig. 5.9).

5.3.1 Food Grain Segment

Over the years, Gujarat has moved from the production of coarse cereals to wheat. The area under *jowar* and *bajra* declined from 5.6% and 11.1% in TE1992–93 to 0.9% and 3.4%, respectively, in TE2016–17. The area under wheat increased from 5.4 to 7.8% in the same time period. In tandem with the expansion of acreage under wheat cultivation, the production of wheat has also increased from 1.4 million MT to 2.8 million MT (Fig. 5.10). However, Gujarat's productivity in wheat production has only marginally improved from 2.3MT/ha in TE 1994–95 to 2.8 MT/ha in TE 2016–17.

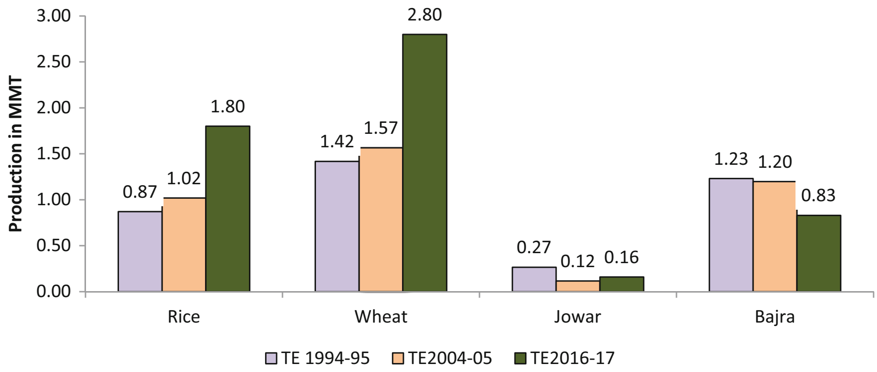


Fig. 5.10 Production of important cereals in Gujarat. *Source* Directorate of economics and statistics, Goverment of India

5.3.2 *Horticulture*

Fruits and vegetables are an important segment in Gujarat accounting for around 7.4% of its GCA (NHB). The share of fruits and vegetables in the total value of output from agriculture and allied activities has increased from 10.9% in TE 2002–03 to 16.1% in TE 2014–15 (Fig. 5.11). Gujarat is the third largest producer of fruits, contributing around 9.7% of total fruit production, after Maharashtra (15.1%) and Andhra Pradesh (11.8%). Further, the state is the fifth largest producer of vegetables after West Bengal, Uttar Pradesh, Bihar and Madhya Pradesh among the major producing states.

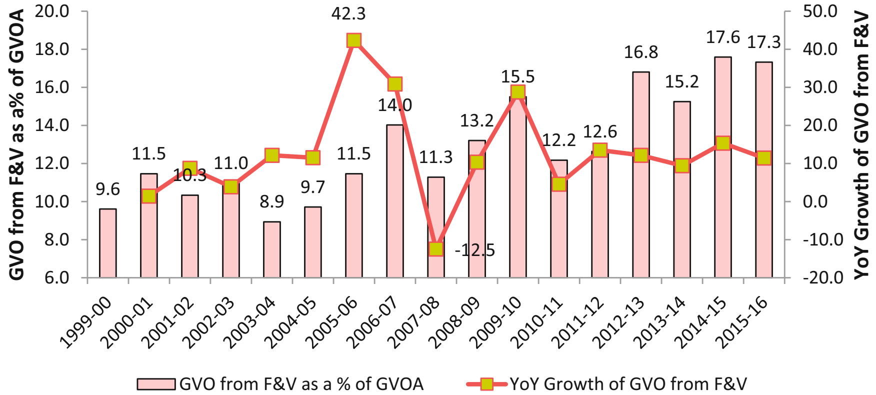


Fig. 5.11 Value of output from fruits and vegetables as a percentage of GVO from agriculture and allied activities. *Source* CSO, government of india, state-wise estimates of value of output from agriculture and allied activities

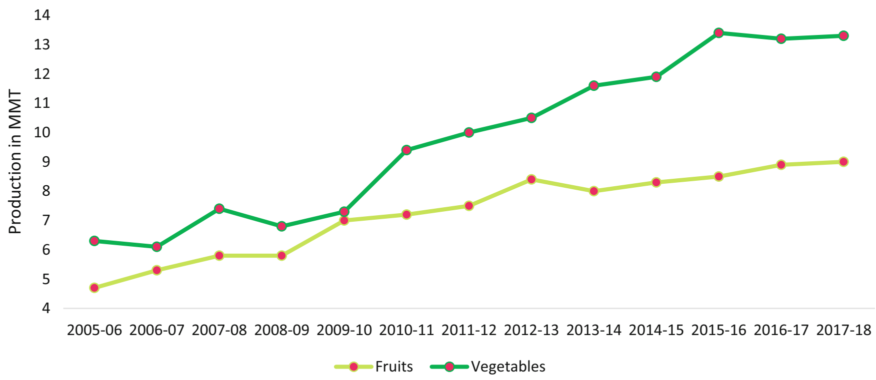


Fig. 5.12 Production of vegetables and fruits in Gujarat. *Source* National horticulture database

The acreage under vegetables increased from 2.32 lakh hectares in 2001–02 to 6.5 lakh hectares in 2017–18. In tandem with this increase, the production of vegetables has also increased from 3.3 million MT to 13.3 million MT between 2000–01 and 2017–18 (Fig. 5.12). Similarly, the area under fruits increased from 1.49 lakh hectares in 2001–02 to 4.1 lakh hectares in 2017–18, and production of fruits increased from 2.3 million MT to 9 million MT in the same time period. In 2017–18, Gujarat contributed 9.5% of total fruit and 6.7% of total vegetable production in the country. The increase in production can be attributed to an increase in yield per hectare for both vegetables and fruits. Productivity of fruits increased from 15.7 MT per hectare in 2001–02 to 21.7 MT per hectare in 2017–18, while vegetable productivity increased from 14.1 MT to 20.5 MT per hectare in the same period.

Currently, Gujarat is the largest producer of beans (30.8% of total production) and third largest producer of brinjal (11.7% of total production) after West Bengal and Odisha (2015–16, National Horticulture Board Database). Further, the state ranks third in potato (8.2% of total production) cultivation. In terms of productivity, the state figure is higher than the all-India average except in the case of cabbage.

Important fruits cultivated in the states are banana, papaya, mango, citrus, *sapota* and pomegranate. Gujarat is currently second highest in banana production after Tamil Nadu and the highest in papaya production. The state produces 14.4% of banana and 22% of papaya of the country's total production of these fruits. Further, the state is the second largest producer of pomegranate and *sapota* with shares of 14% and 25%, respectively, in India's total production of these fruits. Although the largest share of land is devoted to mango production and it saw the highest production growth, the state is only the sixth largest producer in the country.

The state's strong co-operative marketing structure played a crucial role in the development of the horticulture sector. Gujarat has 265 cold storages having a capacity of 12.50 lakh MT. There are about 42 co-operative marketing societies and 197 APMCs dealing with the sale and purchase of horticulture products (Directorate of Horticulture, Gujarat State). The onion dehydration industry in Gujarat is the biggest in the country, accounting for 80% of onion dehydration units. Mahuva, a small coastal town in Bhavnagar district around 265 km from Ahmedabad, is the largest hub of onion dehydration plants and one of the largest white onion growing regions in India. Mahuva has around 130 dehydration plants (110 in Mahuva and rest around Mahuva) engaged in the processing of onion, garlic and other vegetables. However, it is the dehydration of onion which is the main interest of these plants as it gives 90% of the revenue. Out of the total onions used for dehydration in Mahuva, 75% is white onion, 15% red onions and 10% pink onions. The minimum capacity is 6 tonnes per day per plant in Mahuva, and the average capacity ranges between 7 and 8 tonnes per day. This capacity is way below the capacity of Jain Irrigation System Limited, which is the largest dehydration plant in India located in Jalgaon, Maharashtra. The total capacity of all the Mahuva units is around 1.25 lakh tonnes annually, and the total value of dehydrated onion is around Rs. 750–800 crore. Around 85% of the final product is exported overseas, mainly to Europe, Russia, Africa and Middle East countries. But they have not yet been successful in branding their products (Gulati, Wardhan and Sharma, Forthcoming ICRIER working paper).

5.3.3 Non-food Crops

In TE 2015–16, the non-food segment, comprising oilseeds, fibre and sugar, contributed around 26% of the total value of output from agriculture and allied activities, which is very high compared to the national average of 12.9%. Oilseeds alone comprise 11.8% of GVOA, while fibre/cotton contributes 12.7% of the GVOA. Further, around 47% of total value of output from oilseeds is accounted for by groundnuts and 37% by castor.

Currently, Gujarat is the largest producer of groundnut and castor, and the second largest producer of cotton. There has been a steady increase in the share of the value of output from fibre/cotton in GVOA, while the trend is erratic for groundnuts. As discussed earlier, there has been a decline in the area under oilseeds, which has been replaced by cotton. Production has increased for cotton, groundnuts and castor from TE1994–95 to TE 2016–17 (Fig. 5.13). Cotton production picked up after 2000 as Bt Cotton was officially approved for cultivation in 2002, while a major increase in groundnut production took place in the period between TE 1994–95 and TE 2004–05.

5.3.4 Livestock

Livestock is the largest segment in Gujarat, contributing around 26% of the total value of output from agriculture and allied activities in TE 2015–16. Around 82% of the total value of output from the livestock segment was contributed by milk, while meat accounted for around 10% of the total value of output from livestock in TE

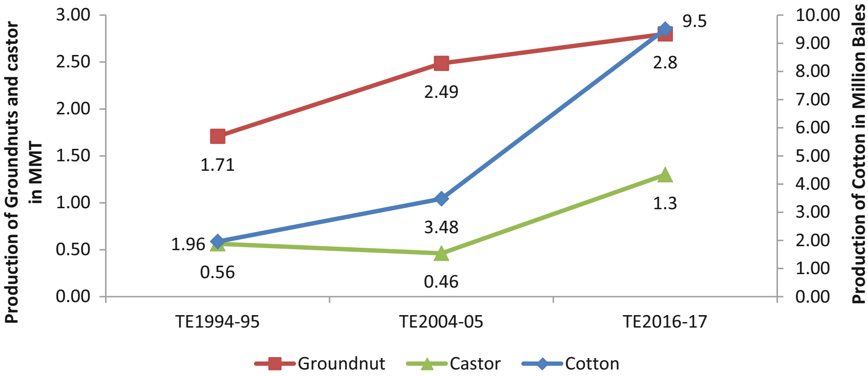


Fig. 5.13 Production of cotton, groundnut and castor. *Source* Directorate of economics and statistics

2015–16. The share of milk in the total value of output from the livestock segment has fallen from 87% between TE 1993–94 to 82% in TE 2014–15 while that of meat has increased marginally from 7 to 10%.

5.3.4.1 Dairy Sector

Milk production in Gujarat increased from 5.3 million MT in 2000–01 to 12.8 million MT in 2016–17 (Fig. 5.14). The average annual growth of milk production for the period of 2001–02 to 2016–17 is 5.7% per annum for Gujarat compared to the national annual average growth rate of 4.6%. In terms of volume, Gujarat is the fourth largest milk producing state, contributing around 8% of total milk production with Uttar Pradesh, Rajasthan and Madhya Pradesh being the top producers.

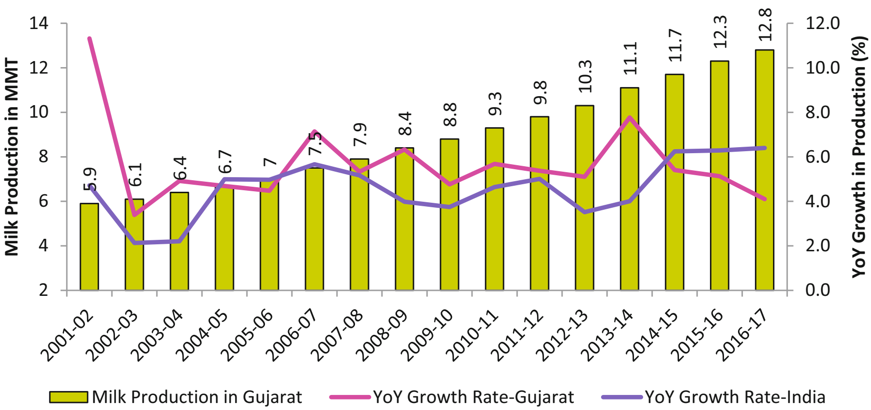


Fig. 5.14 Milk production in Gujarat. *Source* National dairy development board (NDDB)

Both supply- and demand-side factors played significant roles in the growth of the livestock sector in Gujarat. At the initial stage of development, starchy staples account for a very high share of calorie and protein consumed. But as a nation grows, the food basket gets more and more diversified and simple carbohydrates are replaced with animal products, leafy vegetables, fruits and so on. In Gujarat, the average per capita monthly intake of milk increased from 5.4 litres in 1993–94 to 6.1 litres in 2011–12. This is higher than the all-India average of 4.6 litres per capita per month in 2011–12. There has been a significant change in the pattern of consumer expenditure spent on different food items in Gujarat. There has been a decline in share of expenditure spent on cereals. This decline has been picked up by "milk and milk products" with a significant increase in consumer expenditure on this food group. With Gujarat being predominantly a vegetarian state, milk is a major item in the consumption basket of a large section of the population.

On the supply side, better productivity, institutions and a conducive environment played a significant role in influencing the dairy sector.

It is well known that the co-operative milk model is the dominant procurement system in Gujarat. The state holds the first position in milk procurement by the organised sector in major producing states (Fig. 5.15).The Gujarat Co-operative Milk Marketing Federation Ltd. is the state's largest food product marketing organisation. In 2015–16, the total number of working co-operative societies in Gujarat was 18,149 with a total of 3.6 million producer members. In TE 2017–18, 53.7% of total milk produced was procured by co-operatives (Fig. 5.15).

In the budget for 2018–19, the finance minister announced that the facility of *Kisan* Credit Card would also be extended to animal husbandry. Gujarat, with its successful model of milk procurement by co-operatives, can increase the penetration of loans, particularly short-term loans, through KCCs for animal husbandry and dairy sectors

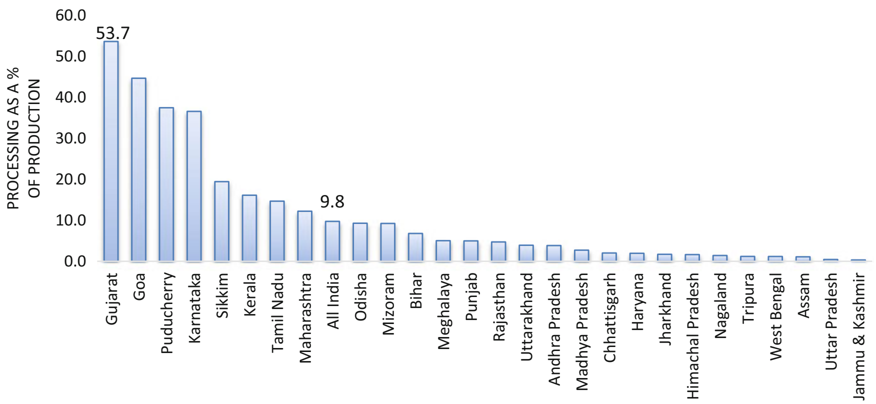


Fig. 5.15 Processing by organised sector (percentage of production) in major producing states, TE2017–18. *Source* Calculated from NDDB data

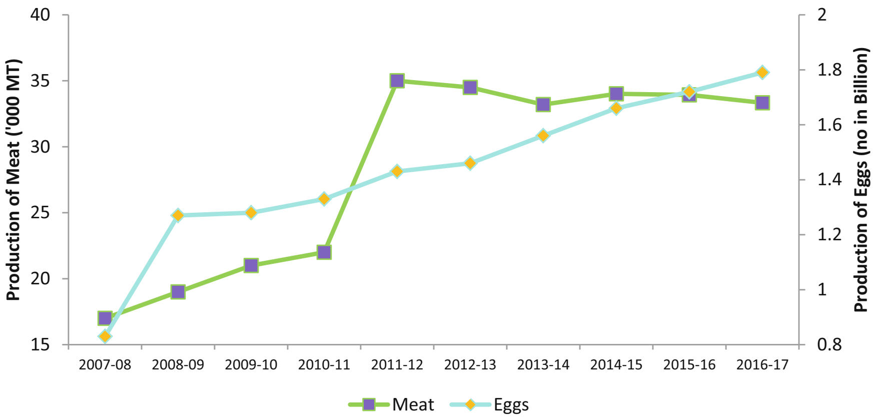


Fig. 5.16 Production of meat and eggs. *Source* CSO, government of India, state-wise estimates of value of output from agriculture and allied activities and basic animal husbandry and fisheries statistics

by publicising the new facility. Similarly, Gujarat may formulate appropriate projects that can be funded from the newly announced Animal Husbandry Infrastructure Development Fund.

5.3.4.2 Meat and Egg Segment

Production of meat and eggs together constitutes 3.2% of the total value of output from agriculture and allied activities in Gujarat. Between 2000–01 and 2014–15, the value of output of eggs and meat increased at an annual average rate of 17%. The production of meat increased from 17 thousand metric tonnes to 33.2 metric tonnes in 2016–17. In the same period, the production of eggs increased from 0.83 billion to 1.79 billion (Fig. 5.16).

5.3.5 Fisheries

Gujarat has the longest coastline of 1290 km. It contributes 25% of India's marine fish production. Marine fish constituted 88% of the total fish production in the state in 2013–14. At present, the Gujarat fisheries department owns 36,090 boats of which 23,927 are machine operated (Commissioner of Fisheries, Government of Gujarat). The gross value of output from fisheries as a share of GVOA was 6.7% in TE 2002–03; it declined to 4.04% in TE2015–16. The production of fish increased from 6.61 lakh MT in 2000–01 to 8.10 lakh MT in 2015–16 (Fig. 5.17).

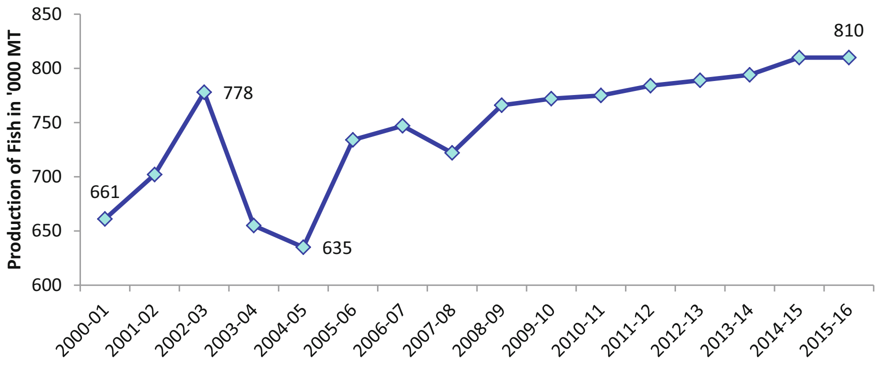


Fig. 5.17 Production of fish in Gujarat. *Source* Handbook of fisheries statistics

5.4 Drivers of Agricultural Growth: Econometric Analysis

Agricultural growth is influenced by many supply- and demand-side factors. We would expect agricultural growth to be influenced by (i) technology (irrigation, seed replacement ratio, fertiliser consumption, farm mechanisation, extension, etc.) (ii) incentives (ToT, MSP) and (iii) infrastructure (electricity, road). However, it is difficult to analyse the effect of all the variables in one single framework, since many of these variables are correlated among themselves.

Hence, we use different models to analyse the potential drivers of growth. The correlation matrix is presented in the Annexure Table 5.5.

In our model, the log of GSDP from agriculture at 2004–05 prices and the variables mentioned above are the independent variables using data from 2000–01 to 2015–16. We have run many equations but presented only those variables that have a significant impact on agricultural GDP (Table 5.4).

Table 5.4 Construction of variables

IRR	Share of irrigated area as a share of GCA	Directorate of Economics and Statistics (DES)
Fertilisers	Fertiliser consumption per ha of GCA	Fertiliser association of India, DES
SR_Density	Surfaced road length(km) per 1000 sq km of geographical area	Ministry of Roads, Transports and Highway
TOT	Agriculture deflator/industry deflator	CSO
VOF	Value of output from fibre as a share of the value of output from agriculture and allied activities	CSO

Model 1:

$$\mathrm{GSDPA} = \underset{(2.15)}{1.86} + \underset{(0.26)}{1.42\mathrm{IRR}^{***}} + \underset{(0.43)}{1.22\mathrm{SR\ Density}^{**}}$$

Adjusted R Square = 0.91
Model 2:

$$\mathrm{GSDPA} = -\underset{(3.47)}{1.44} + \underset{(0.37)}{0.65\mathrm{VoF}^{*}} + \underset{(0.64)}{2.24\mathrm{SR\ Density}^{**}}$$

Adj R square = 0.77
Model 3:

$$\mathrm{GSDPA} = \underset{(1.07)}{12.54^{***}} + \underset{(0.25)}{0.47\mathrm{ToT}^{*}} + \underset{(0.23)}{0.53\mathrm{fertiliser}^{**}}$$

Adj R square = 0.73

Note: (i) Numbers in the parentheses are t values. (ii) *** significant at 1% level (p-value < 0.01); ** significant at 5% level (p-value < 0.05)

In model 1, irrigation and roads have a significant and positive impact on agricultural GDP. The two variables together explain around 91% of the variation in agricultural GDP. As we have estimated a double log function, the coefficients can be interpreted as the elasticities, i.e. a 1% growth in irrigation will increase GSDPA by 1.42% ceteris paribus. Similarly, a 1% growth in surfaced road density will increase GDPA by 1.22%. In model 2, the value of output from fibre as a share of GVOA and total road density has significant impact on GSDPA. In model 3, terms of trade between agriculture and industry and fertiliser consumption have a significant influence on GSDPA.

5.5 Assessment of Budgetary Allocation to Agriculture and Allied Activities

The government has played an important role in promoting agricultural growth in the past years. Our objective is to see if there has been any change in the historical trends of budgetary support provided to the major sub-sectors of agriculture. The responsibility of government is to put the economy on the path of sustained growth in a way that the benefits trickle down to all sections of the population. We have analysed the budgetary expenditure of three financial years– FY 2016–17 (Actual), FY 2017–18 (RE) and FY 2018–19 (BE) (Fig. 5.18). The broad allocation under agriculture and allied sectors for TE 2018–19 shows that crop husbandry (48.9%)

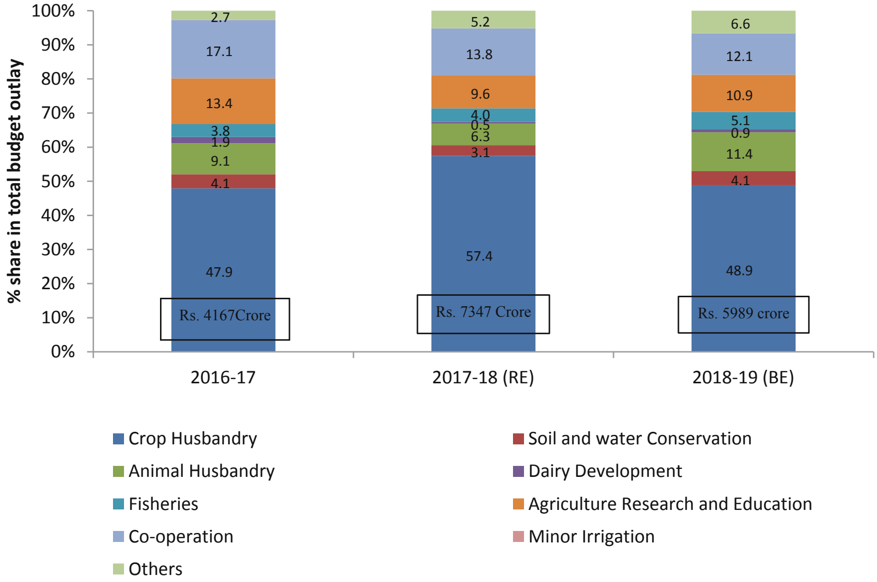


Fig. 5.18 Allocations for broad heads as a share of total allocation to agriculture and allied activities. *Source* Finance Department, Government of Gujarat

had the largest share in total expenditure followed by animal husbandry and dairy development (12.3%) and co-operation (12.2%) in 2018–19 (BE).

Crop husbandry comprises of expenditure on food grains, horticulture and commercial crops. It also includes expenditure on support services attributed to extension services, crop insurance and input subsidies. Within crop husbandry, major allocations were made for the crop insurance programme (38.1%) and horticultural and vegetable crops (17%) in TE 2018-19 (Fig. 5.19).

This section discusses both expenditure in agriculture (cereals, fibre, oilseeds, fruits and vegetables, livestock and fisheries) and expenditure on agricultural infrastructure (road, irrigation, research and education, extension and training) from the state budget documents. It cannot be expected that the share of budgetary expenditure on various segments will exactly correspond to the share of the segments in GVOA. However it is hoped that sub-sectors of agriculture and allied activities that show major potential in boosting farmers' income and bringing sustainability to state's agriculture will attract higher allocation of funding in the budget. The study finds that there is a large mismatch between budgetary allocation in each of the agricultural sub-sectors and their respective contribution to the gross value of output from agriculture and allied activities (Fig. 5.20).

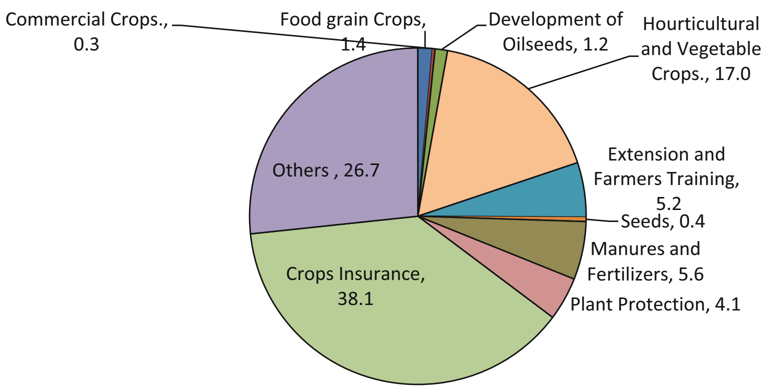
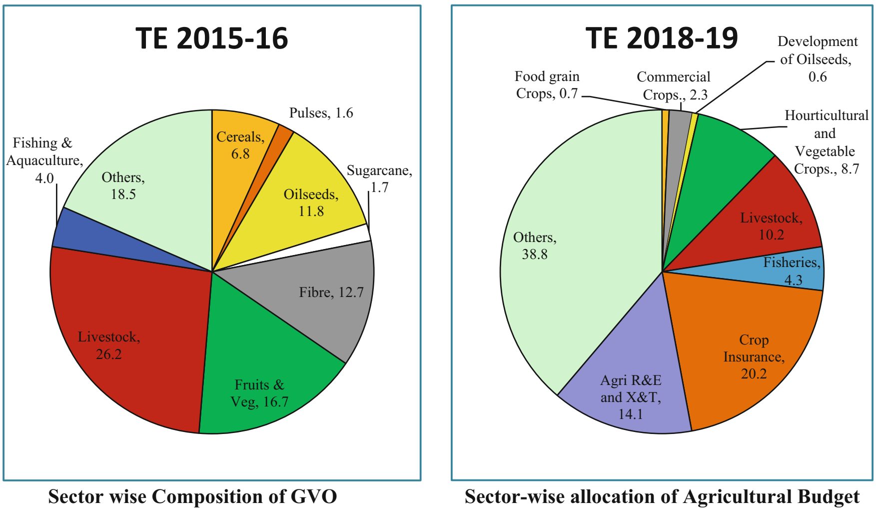


Fig. 5.19 Allocations for broad heads as a share of total allocation to crop husbandry in TE 2018–19. *Source* Finance Department, Government of Gujarat



'Others' in sector wise budgetary allocation include co-operation, soil and water conservation, manure and fertilisers and seeds.

Fig. 5.20 Alignment of agricultural budget with GVO in agriculture and allied activities

Livestock constitutes 26% in GVOA, whereas budgetary expenditure on the sector is 10% of the total budget outlay. Within livestock, the dairy sector is a major contributor to Gujarat's agriculture. An amount of Rs. 54 crore was allocated in FY 2018–19 for dairy development. This is mainly for the purchase of bulk milk coolers, automatic milk collection systems, milk adulteration detection machines, livestock insurance and cattle feed.

One of the major challenges facing the livestock sector is the prevalence of communicable disease like foot and mouth disease in farm animals. According to ICAR, indirect losses due to FMD costs Rs. 30,000–35,000 crore annually. However, the Government of Gujarat has allocated only Rs. 22 crore to check the disease in 2018–19 (BE). The high elasticity of GDP from livestock with respect to expenditure of 5.89 indicates that increasing expenditure on livestock will result in a manifold increase in GDP from the sector. Hence, there is need to increase expenditure on both dairy development and animal husbandry.

Fibre contributes 12.7% of GVOA, whereas expenditure on commercial crops including plant protection is only 2.3% of total budgetary allocation. In the recent past, cotton has been affected by pink bollworm, which could affect productivity. Due to this problem, government has increased allocation on plant protection more than 50 times from Rs. 4.4 crore in 2016–17 to Rs. 206 crore in 2018–19.

Oilseeds contribute 11.8% of GVOA, while expenditure on development of oilseeds crop is only 0.6% of total budgetary allocation. Gujarat is the largest producer of groundnut, but the exportable quality of this crop remains a major concern. This is due to the presence of high levels of aflatoxin in the crop, which is a result of traditional method of harvesting groundnuts. Budgetary expenditure on the development of oilseeds is miniscule and stands at Rs. 39 crore in FY 2018–19. An increase in the provision under this programme will enable farmers to buy modern machinery at subsidised rates. This could help farmers adopt more modern methods of cultivation and fetch higher prices for their produce.

A major expenditure under crop husbandry is directed towards horticultural and vegetable crops. Expenditure has risen to Rs. 365 crore in FY 2018–19. The Government of India (GOI) has approved a new central sector scheme—*Pradhan Mantri Kisan SAMPADA Yojana* (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) with an allocation of Rs. 6000 crore for the period 2016–20. Gujarat is one of the leading producers of vegetables (brinjal, potato, cauliflower and cabbage) and fruits (banana, papaya, pomegranate and sapota). One of the reasons behind the increase in the share of fruits and vegetables in GVOA could be the increased allocation for this sector.

Gujarat has a vast coastline of 1290 kilometres and contributes 25% of India's marine fish production. Currently, both the contribution of fisheries to GVOA (4%) and budgetary expenditure (4.3%) are quite low. Various equipment like fishing nets, fish seeds, fisherman accident insurance scheme, diesel, etc., are available to fishermen at subsidised rates. But there is need to divert more resources towards fisheries so that the contribution of the sector to GVOA increases.

The increased expenditure on crop insurance was mainly due to the implementation of *Pradhan Mantri Fasal Bima Yojana* (PMFBY) in 2016. The insurance premium has been capped at 2% in the *kharif* season and 1.5% in the *rabi* season of total sum insured; the difference between the actuarial rates and the premium rates borne by the farmers is shared by the central and the state governments in equal proportions. This has led to an increased financial burden on state governments, and much of their financial resources devoted to the agricultural sector have had to be transferred to this programme. As a result, the allocation on crop insurance increased almost five times from Rs. 207 crore in FY 2014–15 to Rs.1011 crore in FY 2018–19, taking away almost 20% of the total budgetary allocation.

Gujarat has one of the highest shares of surfaced roads (87% of total road) and rural surfaced road (90% of total rural road) in the country and has performed well in this sector. As a result, allocation is low and expenditure on PMGSY stood at Rs. 55 crore in 2017–18. The expenditure on major, medium and minor irrigation projects in Gujarat was Rs. 9697 crore in TE 2017–18 (RBI, State Finance). One of the most important irrigation projects in the state is the Sardar Sarovar, estimated to cost a total of Rs. 31,522 crore, of which 85% has already been spent. The project will create an additional irrigation potential of 1.85 million hectares (75% of the area is drought-prone). Once the project is completed, Gujarat's irrigation ratio will go up from 47% to 60%. The area under micro-irrigation in Gujarat is the third highest in the country (11% of net sown area). It is necessary to expand the area under minor irrigation suitable for orchards like citrus, banana, papaya and mango, row crops like cotton and groundnuts and vegetable crops like tomato and potato. Under the National Mission of Micro-Irrigation, physical (area under micro-irrigation) and financial targets have always been achieved. Despite achieving these targets, the area under micro-irrigation was only 1.1million ha in 2017 (up to February). Thus, there is a possibility of increasing government expenditure and bringing in more area under micro-irrigation. Expenditure on micro-irrigation under PMKSY has been budgeted at Rs. 226 crore in FY 2017–18.

There are many pre- and post-harvest issues in the cultivation of Bt cotton and groundnuts, which could be addressed with efficient extension services. But in Gujarat, only 2.7% of the total budgetary allocation has been for extension services, which needs to be increased substantially. Expenditure on agricultural research and education, and extension and training accounts for 0.52% of GDPA in Gujarat in 2016–17 as compared to 0.70% of GDPA at the all-India level (2014–15).

5.6 Policy Recommendations

Our research shows that in the recent years, agriculture growth plummeted in the state and farmers' profitability has declined sharply. The situation needs to be taken seriously. We recommend some policies based on our research.

a. Cotton Revolution: Farm-Factory-Fibre-Fashion-Foreign

Gujarat's agriculture was driven by three factors (technology, basic infrastructure and marketing institutions).The development of cotton cultivation was aided by technology adoption. Gujarat benefitted the most from the decision to allow the commercial use of Bt cotton. From nowhere, the area under Bt cotton increased to more than 90% of the area under cotton. Production increased enormously. India's raw cotton exports increased from a meagre $10 million to $4258 million by 2011–12, making India the world's largest cotton producer and exporter (Fig. 5.21). A forthcoming study by Gulati et al. shows the cumulative gain from import saving,

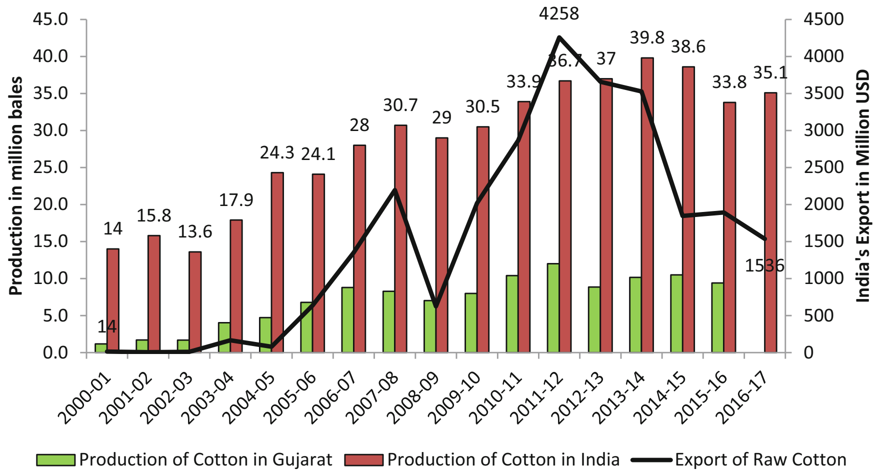


Fig. 5.21 Production and export of cotton, India. *Source* Cotton Corporation of India and Ministry of Commerce

extra raw cotton exports and extra yarn exports– compared to the business-as-usual scenario—between 2003–04 and 2016–17 at an estimated \$67.4 billion at the all-India level.

Gujarat had a big share in this export surge, but since 2011–12, raw cotton exports have declined rapidly because China, which was India's biggest export destination, reduced imports from India. It is time India develops its export value chain by moving away from raw cotton exports to exports of textile and apparel. Currently, Coimbatore is the textile hub of India. Gujarat should exploit its position of being one of the largest producers of raw cotton and its excellent port connectivity to become a major textile export hub, targeting in particular the markets of Europe and the Middle East. GoG should be pro-active in this direction and attract investors in the cotton-textile value chain through suitable incentive packages and reforms in the textile sector, especially in labour laws. Failure to do so is likely to prove a major setback for Gujarat's farmers.

b. Technological Revolution

Bt cotton seeds came to India from a global seed company—Monsanto—in association with an Indian partner, Mahyco. However, recently, a dispute between the centre and Monsanto has resulted in the company's decision to withhold the launch of Bollgard-III. In 2017, farmers in Maharashtra suffered due to the Pink Bollworm, a pest that has developed resistance to Monsanto's second generation biotechnology Bollgard-II seed. It should not be repeated in Gujarat. They must try to get access to the next stage technology of Bt cotton, namely Bollgard-III. The current dispute over trait fees of MMB with its licensees needs to be resolved in an agreeable manner so that farmers do not suffer. Else, there is danger that the gains of the cotton revolution that Gujarat reaped during 2002–17 could disappear.

c. Revolutionary Approach to Ramp Up F&V Sector

Gujarat has been a pioneer in giving India a model of "Operation Flood" in the case of milk (the AMUL model), which aggregates production at the village level and links it to processors and retailers through a well-organised logistics network. It claims to pay to milk farmers 75–80% of the price that consumers pay for milk in urban areas. The model should be extended to other commodities, especially fruits and vegetables, bypassing the *mandi* system. Farmers should receive at least 60% of what consumers pay. "Operation Veggies TOP (Tomatoes, Onions and Potatoes)" should be on the lines of "Operation Flood" so that farmers are able to command a high share of consumer prices. To tackle the crisis in handling perishable products, the Gujarat government has initiated a tie-up with Amul to create a strong co-operative under "Operation Green Gujarat", which is a welcome step. Gujarat has the highest number of onion dehydration plants in the country. Bulk consumption of dehydrated onion can be promoted by supplying it to hotels, the army and schools. Gujarat should also undertake dehydration of mangoes and export it to Western countries. The government's recent decision to delist fruits and vegetables from the APMC Act is a positive step. "Operation Green" should aim at fulfilling three major objectives. First, connect major consumption and production centres to minimise the number of intermediaries. Second, invest in logistics like cold storages and warehouses, which can minimise wastage. Currently, post-harvest losses range from 15–20% of total produce. Third, the processing industry should be linked with organised retailing. At present, only 6–7% of the production is being processed; this should be scaled up to at least 25% of production. By developing such forward and backward linkages, the government can reduce large price fluctuations and increase farmers' share in the price paid by the consumer.

d. Export of Groundnuts: Managing Aflatoxin

India is one of the largest producers of groundnut and also exports some quantities of hand-picked select (HPS) groundnuts, but it has faced lot of difficulties in accessing international market because of high aflatoxin levels, making it unfit for human consumption (permitted level is 4 parts per billion (ppb) in the European Union, 20 ppb in the US and 30 ppb as per Agmark). Harvesting groundnut becomes difficult when the crop has passed the stage of full maturity and the soil has hardened. Farmers generally irrigate the field the previous day so that the soil becomes loose and it becomes easy to pull out the plants along with the pods. But this increases the moisture content in the kernels, leading to fungal infection that raises the level of aflatoxin in the crop. This has resulted in many sanitary and phytosanitary (SPS) notifications being flagged against India. It is time that this traditional method of manual harvesting is replaced by automatic groundnut harvesting machines. The government should provide loans at subsidised rate to enable farmers to buy agricultural machines; alternatively, it should develop custom hiring services that enable affordable access to such machinery.

e. Better Extension Services

Farmers are often unaware of simple practices and technological changes that could help both improve productivity and reduce the chances of pest infestations and the incidence of plant disease that inflict considerable losses. For instance, farmers planting crops with Bt attributes must also plant blocks of crops without the Bt trait. The refuge area prevents pests from developing resistance to technology. It is the duty of the extension service officials to educate farmers about these techniques. Simple pest control tools like pheromone traps should be distributed by extension agents to help monitor and control insect infestations. There is also the chance of pre-harvest contamination due to wrong farming practices as in the case of groundnut. These include the repeated cultivation of host plants on the same piece of land, which leads to contamination of crops in the field. As a result of late planting, crops sometimes suffer end-of-season droughts and insect attacks. Extension service officials are obliged to disseminate knowledge on these issues. There should be proper monitoring of performance of extension service officials.

"Krushi Mahotsav" was a new initiative started by the state to promote extension services. This needs to be evaluated by a third party to assess its impact, and if need be, modify it in line with emerging requirements. Digital initiatives can also be useful to provide farmers with best techniques and farming practices. Agricultural entrepreneurs can be brought into deliver farm services from technology information to marketing of produce, and who can be incubated in FPOs under public–private partnerships. Their knowledge can be regularly updated with emerging new technologies and best practices in production and marketing.

f. Promote Micro-Irrigation

The success of agriculture in Gujarat lies in irrigation. Water harvesting has a positive effect on agriculture in a year of good monsoon, but droughts may create a crisis. Dams should be connected with small water conservation units in order to save flood water. Gujarat (11% of NSA) has the third highest area under micro-irrigation systems after Andhra Pradesh (21% of NSA) and Haryana (16% of NSA). Drip irrigation is suitable for orchards like citrus, banana, papaya and mango, row crops like cotton and groundnuts and vegetable crops like tomato and potato. Sprinkler irrigation is suitable to all soil types and topographic situations and all types of crops except rice and jute. Gujarat can incentivise and scale up the area under drip and sprinkler irrigation, giving a much needed fillip to the "more crop per drop" slogan. In fact, this needs to be combined with solar power driven micro-irrigation at farmers' fields, with a provision enabling the sale of excess solar power back into the grid. This would not only ensure higher water use efficiency and enable the cultivation of at least two crops by the farmer; it would also augment farmers' incomes through solar power as "third crop". Appropriate incentives at the policy level with sizeable budgetary support for this, therefore, would usher micro-irrigation-cum-solar power technologies in rural Gujarat, promoting sustainable, productive and profitable agriculture.

g. Institutional Reform

Ad hoc export bans and stock limits deter private investment and restricts the flow of resources into food processing and cold storage facilities. Policies in India have generally been pro-consumer, allowing large quantities of imports of some agricultural products like edible oils and pulses at low to negligible import duties to keep domestic prices low. This hurts farmers cultivating oilseeds and pulses. At times, even cotton exports have been banned or restricted, which particularly hurt Gujarat farmers. It is time now to switch to agricultural trade and tariff policies that help the farming class. This would mean ensuring that there are no export bans, abolishing stocking limits on private trade, carrying out marketing reforms of the archaic *mandi* system so that processors and retailers can buy directly from farmers/FPOs, etc.

h. Continue investing in roads and power to improve quality

Gujarat has performed very well in improving the basic infrastructure of roads and power over the last 15 years. However, it is still necessary to continue on that path for the next 10 years as it gives very high returns in terms of improving the performance of agriculture and raising farmers' incomes. Focus may have to shift from the quantity to the quality of these services.

Annexure

See Table 5.5.

Table 5.5 Correlation matrix

	GSDPA	IRR	SR_Density	TOT	VoF	Fertilisers
GSDPA	1					
IRR	0.94***	1				
SR_Density	0.87***	0.78***	1			
TOT	0.88***	0.90***	0.90***	1		
VoF	0.79***	0.90***	0.73**	0.88***	1	
Fertilisers	0.78***	0.87***	0.58**	0.73**	0.88***	1

*** significant at 1%, ** significant at 5%

References

Ahluwalia, M. S. (2000). Economic performance of states in post-reforms period. *Economic and Political Weekly*, 1637–1648.

Bagchi, A. K., Das, P., & Chattopadhyay, S. K. (2005). Growth and structural change in the economy of Gujarat, 1970–2000. *Economic and Political Weekly*, 3039–3047.

Basic Animal Husbandry & Fisheries Statistics. (2014). *Department of Animal Husbandry, dairying and Fisheries*. Ministry of Agriculture.

Census. (2011). *Census of India*. Retrieved May 2019, from Registrar General of India, Ministry of Home Affairs, Government of India.

Chand, R. (2015). *Subsidy Structure too complex for knee-jerk response*. In Farmers' Forum (Vol. 14, No. 6).

Dholakia, H., & Datta, S. (2010). *High growth trajectory and structural changes in Gujarat agriculture*. New Delhi: Macmillan Publishers India Ltd.

Fan, S. et al. (2007). *Investment, subsidies, and pro-poor growth in rural India* (Discussion Paper No. 00716). New Delhi: IFPRI.

Government of India. (2008). *State-wise and item-wise estimates of Value of Output from Agriculture and allied activities (1999–00 to 2005–06)* . Central Statistic Office, Ministry of Statistics and Programme Implementation.

Government of India. (2016). *State-wise and item-wise estimates of Value of Output from Agriculture and allied activities (2011–12 to 2013–14)* . Central Statistic Office, Ministry of Statistics and Programme Implementation.

Gulati, A., Shah, T., & Shreedhar, G. (2009). *Agriculture performance in Gujarat since 2000: Can it be a divadandi (lighthouse) for other states?* International Water Management Institute (IWMI); International Food Policy Research Institute (IFPRI).

Gulati, A., Manchanda, S., & Kacker, R. (2016). *Harvesting solar power in India*. ZEF-Center for Development Research University of Bonn, Working Paper, 152.

Gulati, A., Wardhan, H., & Sharma, P. (Forthcoming). *Deconstructing value chains of tomatoes, onions and potatoes (TOP)*. New Delhi: NABARD-ICRIER.

Hirway, I. (2000). Dynamics of development in Gujarat: Some issues. *Economic and Political Weekly*, 3106–3120.

Livestock Census. (2007). *16th Livestock Census-2007 All India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Livestock Census. (2012). *19th Livestock Census-2012 All India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Shah, T., Gulati, A., Shreedhar, G., & Jain, R. C. (2009). Secret of Gujarat's agrarian miracle after 2000. *Economic and Political Weekly*, 45–55.

Wooldridge, J. M. (2009). *Introductory Econometrics: A modern approach*. South Western CENGAGE Learning. IWMI Water Policy Research Highlight.

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http://dfpd.nic.in/.
http://eands.dacnet.nic.in/.
http://www.imdpune.gov.in/.
http://www.indiastat.com/agriculture/.
http://www.mospi.gov.in/
http://www.nddb.org/information/stats.

http://www.seedsindia.org/.
http://financedepartment.gujarat.gov.in/budget.html.
http://gujecostat.gujarat.gov.in/?page_id=12.
http://inputsurvey.dacnet.nic.in/.
https://doah.gujarat.gov.in/dairy-development.htm.
http://www.amul.com/.
http://ggrc.co.in/webui/home.aspx.
https://agri.gujarat.gov.in/index.htm.
http://www.jains.com/.
http://ipa.nic.in/

Chapter 6
Performance of Agriculture in Madhya Pradesh

Ashok Gulati, Pallavi Rajkhowa, Ranjana Roy, and Pravesh Sharma

6.1 Introduction

Madhya Pradesh emerged as the state with the highest growth rate in agriculture. Long clubbed with the so-called BIMARU group of poor northern, central and eastern states, MP successfully broke ranks to set a scorching pace of growth, which has been unparalleled in the past quarter-century. Understanding the factors that helped to drive this growth and drawing lessons for other states at similar levels of development is the main objective of this chapter. Madhya Pradesh's agricultural GDP increased at 8.1% per annum during 2005–06 to 2016–17, surpassing even record holder Gujarat's 6% agricultural growth in the same period. The last three years have been even more spectacular: agricultural GDP increased at 11.8% per annum. Keeping this background in mind, this chapter has used secondary data published by the government to study the composition, sources and drivers of agriculture growth in Madhya Pradesh and the lessons that can be drawn for developing states. Although MP has recorded a significant decline in poverty rates from 53.6% in 2004–05 to 35.7% in 2011–12, there is still much to be done to improve the livelihood of the rural population. Moreover, MP's per capita income is low, standing at Rs. 51,798 per annum (FY14 at current prices) as compared to the national annual average income of Rs. 74,380. Although it is much better than that of Bihar (Rs. 31,199) and Uttar Pradesh (Rs. 36,250), it remains way below top-performing states like Sikkim (Rs. 176,491), Maharashtra (Rs. 114,392), Haryana (Rs. 133,427) and Gujarat (Rs.

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106,831). Therefore, the study also makes policy suggestions to bolster agricultural growth in MP.

Among the many measures taken by the state government to make rapid strides in agriculture, three interventions stand out—expanded irrigation, a strong procurement system put in place for wheat along with bonus over MSP for wheat and all-weather roads to connect farmers to markets. Irrigation coverage through tube wells was expanded through the state government's strategy of initially focusing on providing good quality power supply to farmers during the wheat irrigation season. Canal irrigation, on the other hand, was expanded by utilising financial resources to complete several major and medium irrigation projects that had been under construction for quite a few years. Once irrigation cover expanded for wheat cultivation, acreage and production under the crop increased significantly. Consequently, the government strategised to improve the supply chain of wheat by re-modelling the procurement system through digitisation and initiating "e-*Uparajan*" and by increasing storage capacity significantly. The third important factor that contributed to agricultural growth was the expansion of all-weather roads.

The chapter is organised into three sections as follows:

After a brief Introduction in Sect. 6.1, we provide an overview of the state's agriculture in detail in Sect. 6.2. In Sect. 6.3, we analyse the composition and sources of agricultural growth in Madhya Pradesh. Section 6.4 presents the econometric analysis to identify the drivers of agricultural growth in the state. Finally, in Sect. 6.5, we present some concluding remarks based on our empirical and econometric analysis and recommend policy prescriptions to sustain high growth in Madhya Pradesh.

6.2 Overview of Agriculture in Madhya Pradesh

Madhya Pradesh (MP), located at the centre of India, is often called the "Heart of India". It is a landlocked state, surrounded by Uttar Pradesh, Chhattisgarh, Maharashtra, Rajasthan and Gujarat. Until 2000, it was the largest state in the country in terms of geographical area; however, in November 2000, Chhattisgarh was carved out of the south-eastern part of erstwhile Madhya Pradesh. Currently, MP is the second-largest state in India after Rajasthan and it spreads over a geographical area of about 308 lakh ha, which is about 9% of the total area of the country. The average rainfall received by MP is around 95.2 cm during the monsoon season. This accounts for around 91% of the total rainfall in the state. In MP, the eastern parts receive relatively higher monsoon rainfall (105.1 cm) as compared to the western parts (87.6 cm).

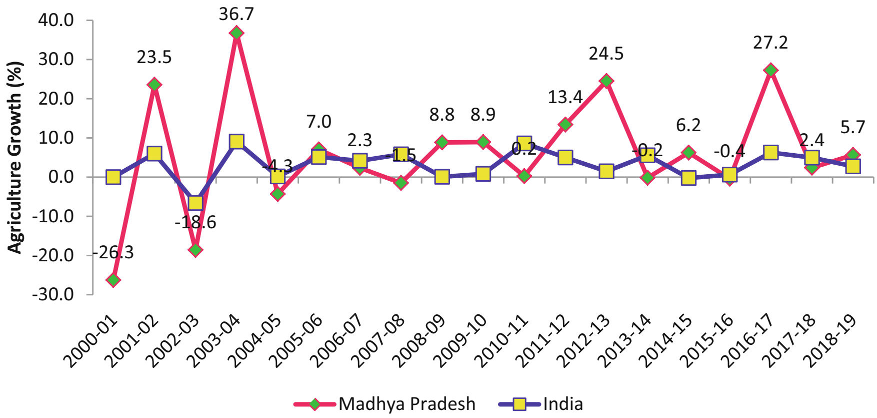

Fig. 6.1 Year-on-year agricultural growth in Madhya Pradesh. *Source* MOSPI

6.2.1 Agricultural Growth in Madhya Pradesh

In the recent past, MP has been lauded for its excellent agricultural performance—MP's agricultural GDP increased at 7.5% per annum during 2005–06 to 2018–19. The last three years have been even more remarkable: agricultural GDP grew at 11.5% per annum as compared to the national average of 4.7%. The sector faced instability, but the extent of volatility has declined in recent years. The coefficient of variation for agriculture growth stood at 626% in the period of 2000–01 to 2008–09 and declined to 113% in the period between 2009–10 and 2018–19. In the initial years, agriculture was affected by successive droughts. However, in later years, investment in irrigation enabled the sector to overcome rainfall deficiencies (Fig. 6.1).

6.2.2 Agricultural Livelihood in Madhya Pradesh

According to the 2011 Census, Madhya Pradesh has a population of 72.7 million and the estimated population for 2018 is 82.3 million, which is 6% of India's population. Madhya Pradesh had 54.6% of its workforce engaged in agriculture in 2015–16 (Labour Bureau, 2015–16) while the contribution of agriculture to overall GSDP was 40% in TE 2018–19 (CSO). The agricultural sector is largely dominated by small and marginal farmers. In 2015–16, 75.5% of small and marginal farmers with a holding size of less than 2 ha accounted for 48% of the total area operated. The average size of landholding declined from 2.28 ha in 1995–96 to 1.78 ha in 2010–11 and further to 1.57 ha in 2015–16 (Table 6.1).

Table 6.1 Operational holding in Madhya Pradesh, 1995–96 to 2015–16

	1995–96			2010–11			2015–16		
	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)
Marginal	8.2	40.4	0.46	12.1	43.9	0.49	17.62	48.33	0.49
Small	15.2	24.1	1.44	21.9	27.6	1.42	30.58	27.24	1.41
Semi-medium	24.2	20.0	2.76	28.5	18.6	2.73	28.20	16.74	2.70
Medium	33.6	12.9	5.94	28.7	8.9	5.76	18.38	7.07	5.67
Large	18.8	2.7	16.08	8.8	1.0	15.77	5.22	0.63	14.83
All	100	100	2.28	100	100	1.78	100	100	1.57

Source Agricultural census

The average monthly income per farm household stood at Rs. 7919 in 2015–16, which is lower than the all—India average of Rs. 8931. But the growth rate of income (3.7%) is the same as that achieved at all—India level (NABARD and NSSO, 2002–03 and 2015–16).

6.2.3 Cropping Pattern in Madhya Pradesh

In Madhya Pradesh, 50% of the reported utilised area was under cultivation. Madhya Pradesh is primarily a food grain-growing state—around 62% of its gross cropped area (GCA) was under food grains and 32% under oilseeds in TE 2014–15. Within food grains, 39% of GCA was under production of cereals while 23% was under pulses. Wheat is the most important cereal grown in the state, accounting for around 24% of the GCA. Among pulses, gram is the main crop grown with around 13% of GCA dedicated to the crop (63% of pulse area), followed by *arhar* (2% of GCA and 10% of area under pulses). Wheat is the major crop grown during the *rabi* season and it is intercropped with gram while in the *kharif* season, MP mostly grows oilseeds, specifically soybean. Around 25.2% of GCA is under soybean cultivation.

Moreover, acreage under the two main crops in MP—wheat and soybean—has increased significantly over the years. Acreage under wheat increased from 4 million ha in TE 1994–95 to 5.6 million ha in TE 2014–15. Similarly, the acreage under soybean increased from 3.2 to 6.0 million ha in the same period. Further, the relative importance of wheat has also increased over the given period. In TE 1994–95, wheat contributed around 16% of GCA; this has increased to 24% in TE 2014–15 (Fig. 6.2). Similarly, the share of area under soybean as a percentage of GCA has increased from 13 to 25%, almost doubled in the past two decades. Acreage under gram, on the other hand, has increased only marginally from 2.4 million ha in TE 1994–95 to 3.0 million ha in TE 2014–15. Consequently, its share in GCA has only increased from 10 to 13% in the same period.

Although MP is one of India's major food grain-producing regions, there has been an increasing trend towards the cultivation of horticultural crops as a cash crop. There has been a significant expansion of area under vegetables in MP after 2010–11. Acreage under vegetables increased from 284,000 ha in 2010–11 to 930,000 ha in 2017–18. This has almost tripled the share of area under vegetables in GCA from 1.3% in 2010–11 to 3.9% in 2017–18. While the expansion of area under vegetables was sudden and took place after 2010–11, in the case of fruits, the expansion began as early as 2008–09. The area under fruit cultivation increased from 47,000 ha in 2007–08 to 92,000 ha in 2008–09 and further to 355,000 ha in 2017–18.

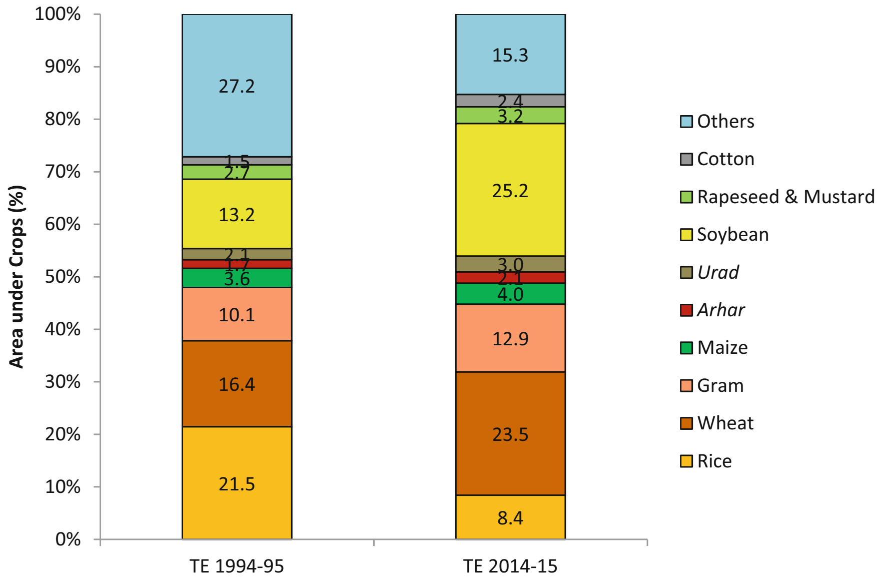

Fig. 6.2 Cropping pattern in Madhya Pradesh. *Source* Directorate of economics and statistics

6.2.4 Determinants of Agriculture Growth

Physical infrastructure such as irrigation, power and roads play an important role in stimulating investment in agriculture and agricultural growth (FAO 1996). Further, several studies (Fan et al. 2007; Fan and Zhang 2004) have shown that investment in rural infrastructure has the potential to increase a farmer's access to input and output markets, stimulate the rural non-farm economy and vitalise rural towns and increase consumer demand in rural areas. In this section, we discuss the development of infrastructure in MP to understand the reasons for the rapid agricultural growth in the state.

6.2.4.1 Irrigation

Irrigation has played a critical role in the growth and development of agriculture in the state. Gross irrigated area has increased from 4.3 million ha in 2000–01 to 10.3 million ha in 2014–15.

Figure 6.3 shows the position of MP as compared to the position at the country level during the period 2000–01 to 2014–15. At the outset (2000–01), the irrigation ratio in MP was 24%, which was around 17.1% points lower than the all—India average. By 2014–15, the ratio had moved up to 43.3%, decreasing the gap with the all—India average to 5.7% points, which is a commendable achievement for the state.

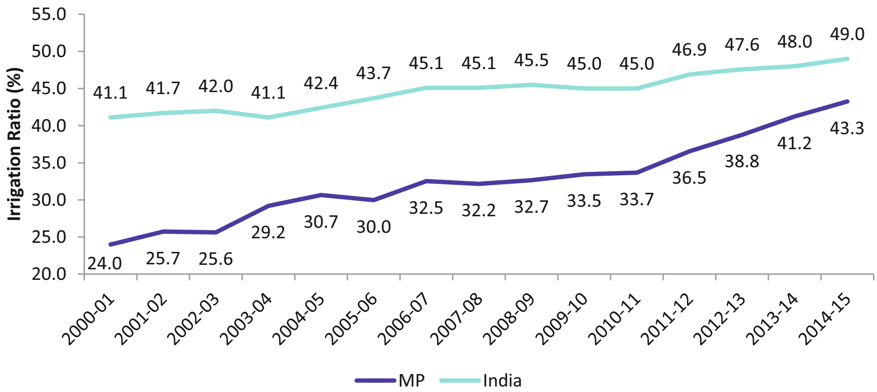

Fig. 6.3 Gross irrigated area as a percentage of gross cropped area. *Source* Directorate of economics and statistics

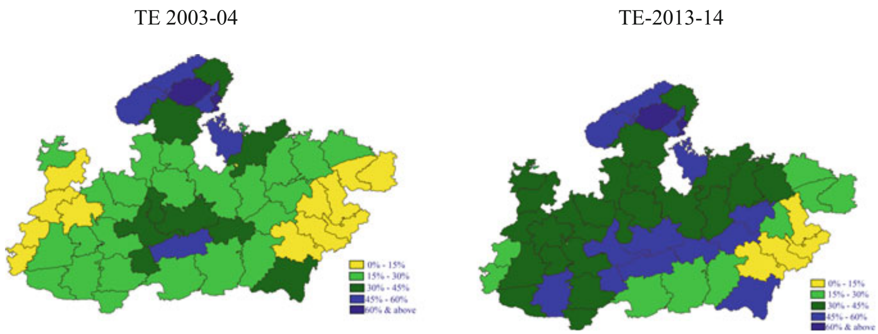

Fig. 6.4 Region-wise irrigation coverage. *Source* Created by authors

Figure 6.4 shows the region-wise expansion of irrigation coverage. The left-hand graph presents the district-wise irrigation ratio for TE 2002–03 and the right-hand side graph gives the irrigation ratio for TE 2013–14. In TE 2002–03, around 42% of the districts had an irrigation ratio in the range of 15 to 30%, 18% of the districts in the range of 30–45% and 12% of the districts above 60%. By TE 2013–14, the proportion of districts with an irrigation ratio between 15 and 30% decreased to 14%, while the proportion of districts with irrigation ratio in the range of 30–45% increased to 54% and the proportion of districts with irrigation ratio above 60% increased to 26%. The areas that have benefited from irrigation projects have shown an increase in yields leading to higher agricultural growth, changing cropping patterns and an increase in gross cropped area, moving away from a mono-crop regime to double cropping; in some regions, farmers have also been encouraged to take a third crop like *moong* in the summer season (Madhya Pradesh Agriculture Economic Survey 2016).

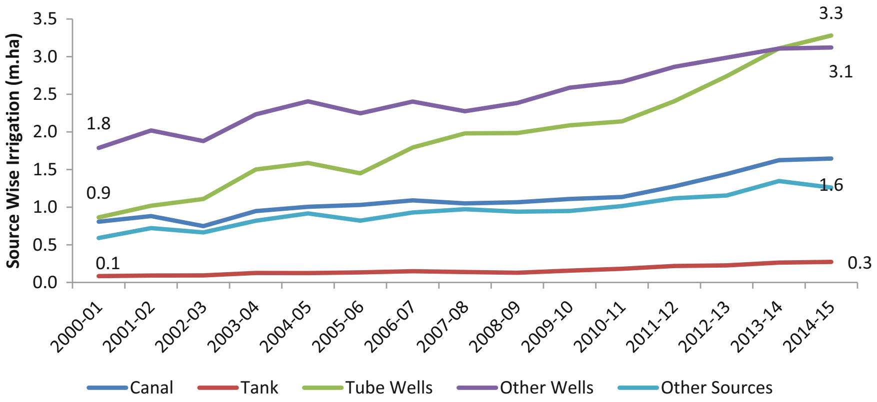

Fig. 6.5 Source-wise irrigation in Madhya Pradesh. *Source* Directorate of economics and statistics

Source-wise irrigation data reveals that of the various sources of irrigation, dug wells and tube wells occupy the maximum share with 67%, followed by government canals with 17%, followed by other sources with 13% and tanks/ponds with 3%. Figure 6.5 shows that irrigation coverage via all sources expanded between 2000–01 and 2014–15. Specifically, the area under tube well irrigation increased from 0.9 million ha in 2000–01 to 3.3 million ha in 2014–15; dug wells increased from 1.8 to 3.1 million ha. The sharpest increase in irrigation coverage was via tube wells, followed by canals. Private sector investment in the expansion of irrigation through tube wells, wells and ponds and tanks were incentivised through the development of a strong procurement system as well as assured electricity provided by the government. Further, canal irrigation in MP showed robust expansion in all river basins.

Power for Agriculture

As mentioned in the previous section, one of the main reasons for the rapid expansion of tube well irrigation in MP was the government's conscious efforts to ensure assured power for agriculture. The state government started with the unbundling of the power business to bring efficiencies in 2005, and it has made special efforts to ensure separate feeders for power supply to rural areas. The main reason to undertake feeder separation was that rural feeders in MP earlier provided power supply to mixed load for an average of approximately 12 h. There was no supply during the rest of the day due to constraints in generation. Consequently, the agriculture sectors faced several bottlenecks, which are listed below.

- Agricultural pumps during the "pre-feeder separation" period usually received three-phase supply for 6–8 h; for the rest of the period, only one phase supply was available.
- Villages did not get power supply round the clock.
- There was unbalanced loading on distribution transformers (DTR) and power transformers (PTR).
- There were frequent load shedding and high technical losses.

The government made the following interventions to improve the electricity situation for agricultural use in the state:

- Ensured 24 h power supply in the state, out of which 8 h power supply was exclusively for agricultural purposes.
- Provided power to agriculture at a flat rate of Rs. 1200/year, with the facility to pay in two instalments.
- Provided separate rural feeders for agriculture; 43,517 villages have been provided with a separate feeder of 11 KW line comprising 71,688 km and 1516 transformers of 21 KW, which are the country's largest feeders for the agricultural sector.

The *Deen Dayal Upadhaya Gram Jyoti Yojana* (DDUGJY) is a centrally sponsored scheme, which was initiated in 2014 with a feeder separation component. The scheme makes funds available to state governments to take up works to strengthen the distribution system and the separation of feeders for agricultural and non-agricultural consumers. Under DDUGJY, a sum of Rs. 28.7 billion has been sanctioned for MP so far, of which Rs. 15.8 billion is to strengthen the system and Rs. 8.2 billion is for the segregation of feeders.

The objective of the programme is to separate domestic load from irrigation in rural areas and to provide uninterrupted, quality power supply to domestic rural consumers. In other words, feeder separation refers to the supply of electricity to agricultural consumers and to non-agricultural consumers (domestic-non-domestic) separately through dedicated feeders. This arrangement allows the distribution company to regulate power supply to agricultural consumers as and when needed for effective demand-side management (DSM). The separation of feeders helps flatten the load curve by shifting the agricultural load to off-peak hours and thus facilitates peak load supply to agricultural consumers and continuous power supply to non-agricultural consumers in rural areas (DDUGJY 2014).

The efforts of the state government to attract investment for power generation and to expedite feeder separation were long-term policy reforms. In the short-term, the state government strategised to provide temporary power connections for the winter season. Irrigation demand for power during winter was high and farmers were willing to pay a premium of Rs. 2.7–3.0 per unit for assured electricity. The state government contracted advance power purchase for the winter months and began liberally issuing winter season irrigation connections (Shah et al. 2016). Between 2010 and 2013, the state issued 3.12 million winter connections to farmers, increasing the area under wheat cultivation by 1.8–2 million ha/year, leading to increased production.

These efforts have resulted in an increase in the use of electricity for agricultural purposes in MP. It has gradually increased from 4843 MW in 2003 to 10,231 MW in 2013 (GoMP 2016). The share of agriculture in total power consumption in MP is around 33.7%, which is much higher than the national average of 20.8% and higher than in states like Karnataka (33.7%), Punjab (30%), Gujarat (23.6%) and Maharashtra (22.0%).

Although the share of agriculture in total power sales is high (41.4%) (Fig. 6.6), total power sales/gross cropped area (GCA) is low standing at 641 kWh/ha in TE 2015–16 as compared to states such as Tamil Nadu (2019 kWh/ha), Andhra Pradesh

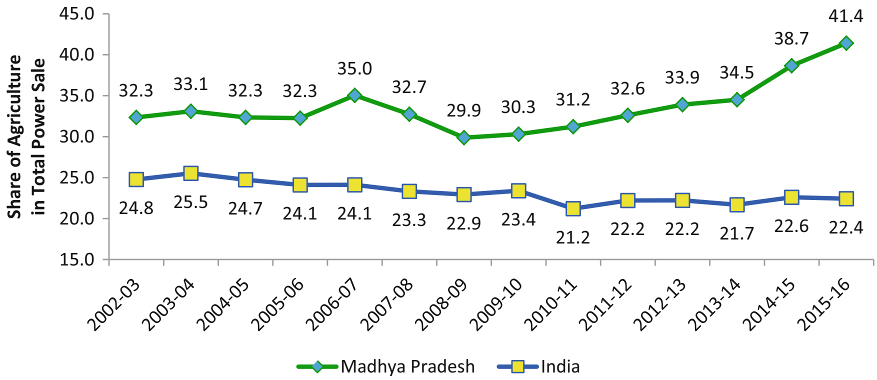

Fig. 6.6 Share of agriculture in total power sales. *Source Report on the performance of state power utilities, various issues*

(1854 kWh/ha), Karnataka (1517 kWh/ha), Punjab (1356 kWh/ha), Haryana (1414 kWh/ha), Maharashtra (1247 kWh/ha) and Gujarat (1087 kWh/ha). Therefore, there is still scope for improvement in power availability.

Agriculture Mechanisation

It is well accepted that the use of mechanised agricultural tools not only reduces the drudgery faced by farmers but also speeds up agricultural processes, saves costs and enhances agricultural productivity. Despite these benefits, farm mechanisation can become economically unviable if farm holdings are fragmented. In order to reap the benefits of mechanisation and, at the same time, address the problems of small farmers, the government of MP used a two-pronged strategy to increase the use of farm machinery in the state. The *yantradoot* village scheme and a scheme to incentivise rural youth to establish custom hiring centres have both contributed significantly to increased mechanisation in agriculture.

The *yantradoot* village scheme was started initially with district level officers of the Department of Agricultural Engineering periodically demonstrating the use of farm implements to farmers in 25 villages spread across 25 districts in the state and making these implements available on hire for the agricultural community at nominal prices. The scheme aims to make each of these villages into models of agriculturally mechanised villages by using modern farm tools for each stage in the production of crops, starting from soil preparation, for cultivation, removing weeds and destroying insect habitats from the field by deep ploughing, improving the fertility of the soil, maintaining the correct distance between rows of crops, promoting seed treatment and proper harvesting and threshing procedures. The 25 villages were selected on the basis of a baseline survey conducted to study farming practices, the potential for introducing small cost-incurring changes in current practices and identifying areas where the new agricultural equipment could be introduced. Once villages were identified, village meetings were organised and a community level plan was formulated to gradually introduce advanced machinery for various stages

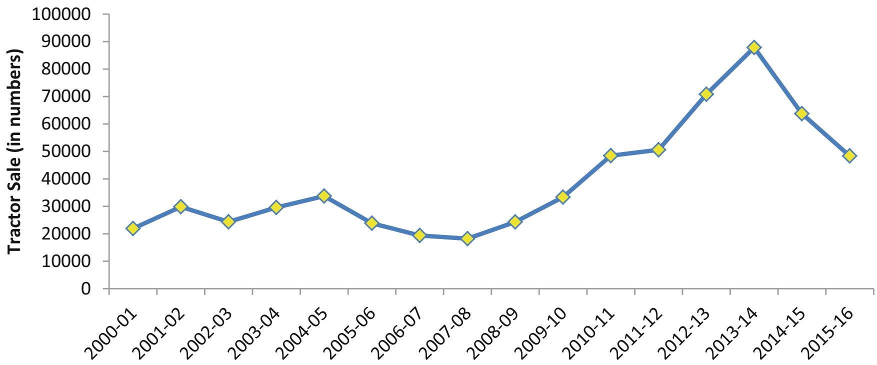

Fig. 6.7 Tractor sale in Madhya Pradesh. *Source* Tractor manufacturers association

of farming. Village demonstrations in each of the 25 villages were conducted and appropriate agricultural tools for the particular season were displayed in the village common area. Agricultural officers provide direct information to farmers about the various tools available and the associated benefits. This scheme currently has been scaled up to cover 139 villages as *yantradoot grams* (fully mechanised villages).

Further, to make costly farm equipment available to small farmers, the state government has been helping rural youth under 40 years with an undergraduate degree to set up custom hiring centres (CHC). It takes around Rs. 25 lakh to establish a CHC. The government subsidises 40% of the total cost, i.e. to a maximum amount of 10 lakh. Applicants are required to raise margin money of Rs. 5 lakh and the rest is financed through bank loans. The applicant has to purchase a mandatory set of equipment required for farm activities from ploughing to harvesting. Each centre is designed and developed to cover around 300 farmers within a radius of 10 km. In the first year of the scheme (2012–13), around 286 CHCs were set up; the number increased to 475 in 2015–16. Consequently, the annual sales of tractors in MP increased almost four-fold during 2008–09 to 2014–15—from about 24,306 tractors a year in 2008–09 to more than 87,831 tractors in 2013–14 (Fig. 6.7).

Procurement Policy

Once assured water was made available for wheat cultivation through assured electricity during the 110 days of the wheat season, acreage under the crop as well as wheat production increased significantly. Improved irrigation along with the Madhya Pradesh government's bonus policy on the minimum support prices (MSP) for wheat over and above the centre's MSP between 2007–08 and 2014–15 played a significant role in increasing the production and procurement of wheat (Fig. 6.8). The state bonus on MSP over and above the centre's MSP for wheat between 2007–08 and 2012–13 was Rs. 100 per quintal, while in 2013–14 and 2014–15, it was Rs. 150 per quintal. Consequently, government purchases from the state swelled from around 2% of total wheat procurement in TE 2002–03 to 23% in TE 2016–17, making MP the third-largest contributor to wheat procurement (Fig. 6.9). However, wheat procure-

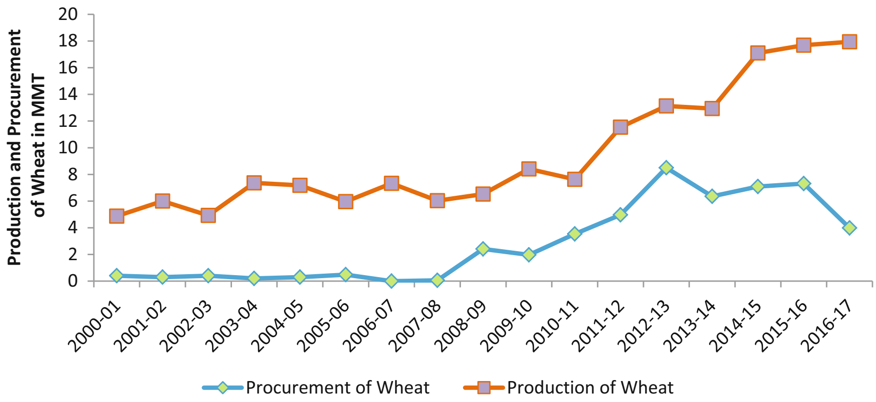

Fig. 6.8 Production and procurement of wheat in Madhya Pradesh. *Source* Department of food and public distribution and directorate of economics and statistics (DES)

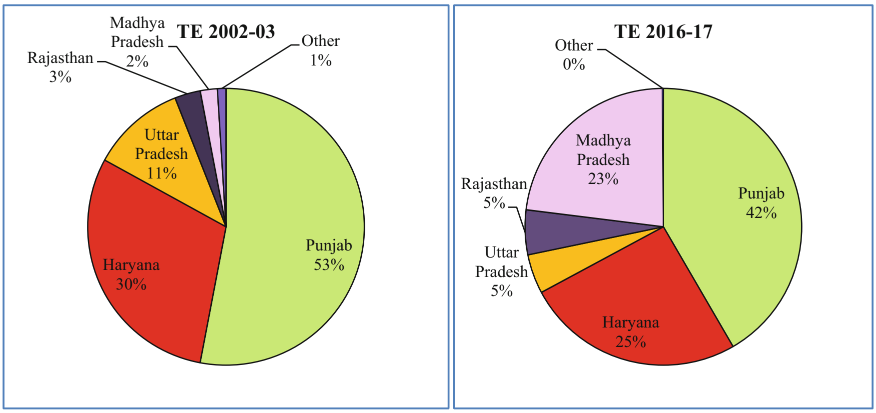

Fig. 6.9 State-wise wheat procurement. *Source* Department of food and public distribution and DES

ment as a percentage of marketed surpluses was around 67% in MP as compared to 81% in Punjab and 74% in Haryana. This shows that despite giving a bonus on MSP, around 33% of marketed surplus was not procured by public agencies, implying that besides public agencies, the private sector too procures wheat. The economic cost of procuring wheat by the Food Corporation of India was around 32 to 43% higher than the MSP during 2008–09 and 2013–14, mainly due to high procurement incidentals (market fees, development cess, *arhatiya* commission, cost of gunny bags, charges to state governments for storage and interest, etc.) and distribution cost. A major contribution to increasing procurement incidentals comes from the high rates of statutory market levies imposed by states. High statutory levies add to the cost of procurement for FCI, which ultimately adds to the food subsidy bill. States have an incentive to keep these levies high since it contributes to their tax revenues.

On the flip side, high taxes deter private sector procurement and make the state the largest buyer in the wheat market. Interestingly, of the three main contributors to the wheat procurement pool, Punjab and Haryana levies a tax of around 14.5% of MSP and 11.6% of MSP respectively, while MP's rate of taxes was around 7%. The lower taxes in MP may have persuaded private trade to buy wheat from MP rather than Punjab or Haryana. Moreover, in Punjab and Haryana, wheat procurement is mainly through *arhatiyas,* while in MP it is through co-operative societies. MP has been successful in organising its procurement as a decentralised procurement system where wheat is procured by state agencies and only the surplus wheat stocks over and above the state's requirement under the targeted public distribution system/National Food Security Act and other welfare schemes have been taken over by the FCI for dispatch to other consuming regions. In comparison, Punjab and Haryana follow a centralised procurement system, wherein state agencies procure wheat and then preserve the stocks under their custody for which carry overcharges are paid to them. Later, FCI takes over the stocks for dispatch to consuming states as per requirement/movement plan (Fig. 6.8).

While there was an increase in the production of wheat in the upstream segment of the value chain, markets in MP had poor market infrastructure to make correct forecasts of the production level and expected procurement. Consequently, once procurement started, markets were crowded with long queues of farmers wanting to sell their produce, leading to overcrowding and the choking of roads leading to the markets and creating chaos. Moreover, manual payments to farmers through cheques led to delay, losses and corruption. In order to deal with these problems, the MP government re-modelled procurement through digitisation. The "e-Uparajan" initiative was conceptualised to regulate the number of farmers bringing their produce by maintaining records of farmers willing to sell at the MSP and allocating a date to each farmer through SMS. This programme's primary objective was to enable a smooth, regulated and efficient procurement process.

Further, to facilitate the procurement of foodgrains, the Madhya Pradesh State Civil Supplies Corporation Ltd (MPSCSC) and MP State Co-operative and Marketing Federation in consultation with the state government made necessary procurement arrangements in the allotted procurement areas. Each district collector appoints societies to open their centres for procurement operations. The numbers of centres and their locations are decided by the district collector. For example, for wheat procurement, 2967 procurement centres were in operation in *rabi* 2015–16 while there were 884 procurement centres for paddy procurement in the same year.

The other related aspect of procurement is storage. In MP, there has been a steady increase in the average capacity and utilisation of warehousing services. In 1999–2000, the average owned capacity of the Madhya Pradesh Warehousing and Logistics Corporation (MPWLC) was 1245.3 thousand MT; this had increased to 1496.6 thousand MT in 2013–14. Despite this, in 2013–14, the total average hired capacity of MPWLC remained at 4361.5 thousand MT and around 81% of the total capacity was occupied. Thus, even though the storage needs of the state were partially met, MPWLC must establish enough storage capacity to reduce dependence on hired capacity. The latest figures reveal that MP has created in total 181.3 lakh MT of storage capacity. The state government has introduced the "Warehousing and Logistics Policy 2012" to promote the establishment of silos. Under this policy, the following incentives were provided.

- The state government will provide land on a licence basis for 30 years (extendable by mutual consent for another five years at a time subject to a maximum period of 10 years).
- The state government will also provide viability gap funding (VGF) up to a maximum of 20%, if required, in addition to the 20% VGF by the Government of India under the VGF Policy. However, projects availing of the benefit will not be eligible for capital investment and interest subsidy. Moreover, the projects are mandated to be awarded through a transparent bidding process and are eligible for a business guarantee for 10 years.

Besides, to increase storage capacity, the state has started building steel silos for food grain storage in nine districts. Currently, steel silos account for 4.5 lakh MT of storage capacity in the state. MPWLC has also undertaken the building of steel silos through public-private partnerships on a design, build, finance, operate and transfer (the "DBFOT") basis. For this purpose, global engineering, development and management consultants, Mott MacDonald, have been appointed by the MPWLC to prepare the feasibility report for setting up steel silos in the state.

The Madhya Pradesh government has also started using silo bags to provide temporary buffer capacity for the state's crops during years of bumper harvest. This was in the wake of the unanticipated shortage of jute bags, despite a meticulously prepared plan for their purchase, to buy and store wheat during the wheat procurement period in 2012. Mechanised equipment is currently being used to fill grain into large bags, which are then sealed shut on both ends to create dry and near-airless storage that acts as a barrier to pests and insects. Such sealed bags can be left on flat and open land for around 18–24 months. Currently, there are two companies in India that offer silo bags—Panama Agritech and Silobag India—both currently operating in Madhya Pradesh. Silo bags in MP are offered as an on-demand, pay per use service. Unlike warehouses or conventional silos where storage capacity needs to be bought and paid for in the long term, regardless of actual usage, silo bags are rented on a per tonne, per month basis. Other benefits of silo bags that have been documented are the following:

(1) Silo bags allow farmers to deposit their loose grain directly for storage, eliminating the need to transport and weigh the grain several times, and reduce losses due to pilferage and wastage. In Madhya Pradesh, silo bag sites are temporarily declared as "*mandis*" by the state government so that farmers can directly bring their grain to the sites from farms.
(2) Customers whether government or private can buy storage capacity in 2–4 weeks compared to the months and years that it takes to plan and erect warehouses or conventional silos.

In MP, there is a pressing need to increase storage capacity due to the increasing procurement of food grains. Moreover, with the growing importance of horticulture in the state, there is also an urgent need to build storage infrastructure for fruits and vegetables because they are highly perishable. Before launching the National Horticulture Mission, the total capacity of multi-purpose cold storage facilities was over 7 lakh tonnes, of which over 50% were used for potatoes. Currently, the state has around 144 cold storages with a storage capacity of 8.05 lakh MT.

Price Deficiency Payments Scheme

The Government of Madhya Pradesh introduced the *Bhavantar Bhugtan Yojana* in September 2017 covering eight *kharif* crops. Under this scheme, farmers selling crops in the notified APMC yard will obtain the difference between the MSP and average sale price (ASP) where ASP is the average of the prevailing modal *mandi* prices in MP and two other states. The crops covered under the scheme are maize, *moong, urad, tur*, soybean, groundnut, sesame and *ramtil*. The scheme also provides warehouse storage incentives (WSI) for registered farmers. A study by Gulati et al. (2018) reviewed the scheme. The analysis shows that MP could benefit only 23% of production, which poses the question whether the scheme benefits the majority of farmers. It also estimates that extending this scheme to other crops will escalate the costs from Rs. 56,518 crore to Rs. 1.13 lakh crore, given that the market price is 10% lower than the MSP.

Development of Roadways

Roads play a very important role in the development of rural areas as it reduces transportation cost, increases competition, reduces marketing margins, connects input and output markets and improves farm incomes. Figure 6.10 shows that road density in MP has increased from 526.8 per thousand sq. km in 2000–01 to around 941 per thousand sq. km in 2015–16. Further, surfaced roads as a percentage of total roads have increased from 49 to 83% in the same period. In the case of rural roads, the *Mukhya Mantri Gramin Sadak Karyakram*a (popularly known as the CMGSY) was launched to supplement the Prime Minister's Rural Roads Programme (PMGSY) in order to improve the connectivity of villages with urban areas. The CMGSY originated to provide road connectivity to each MP village with a population in the range of 250 and 500 that had not been covered by the PMGSY until the year 2013. The Mahatma Gandhi National Rural Employment Scheme (MGNREGA-MP), the Backward Regional Grant Fund and the state plan head are the three functional components for running the CMGSY scheme. The scheme aims to provide employment under MNREGA and create durable assets in rural areas. This initiative by the state will result in an additional 19,386 km length of gravel roads in the state.

Despite making progress in rural road development, the state's road density is still lower than the national average of 1430 per thousand sq. km (2015–16). Moreover, surfaced roads as a percentage of total roads is much higher (above 89%) in states like Haryana, Punjab and Gujarat among others; therefore, MP has potential to improve its road network further. Towards this end, the state has initiated a master plan for rural road construction, up-gradation and maintenance. Under this master plan, the

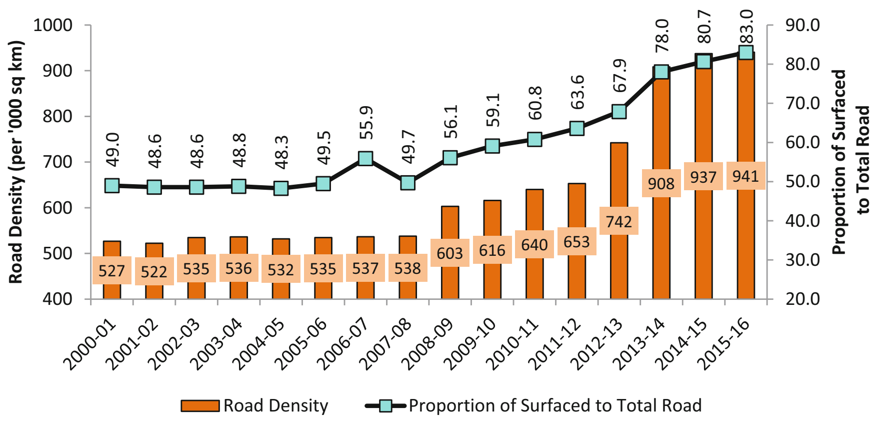

Fig. 6.10 Road development in Madhya Pradesh. *Source* Ministry of roads, transports and highway, several issues of basic road statistics of India

state has undertaken a 'District Rural Road Plan (DRRP)", which is a collection of the existing and proposed road network system in a district. Through the DRRP, the state government has been able to clearly identify proposed networks to connect unconnected habitations to already connected habitations.

6.3 Composition of the Agricultural Sector and Sources of Agricultural Growth

To analyse the composition of agriculture in MP, we have computed the share of the value of output from different segments as a percentage of the gross value of output from agriculture and allied activities (at current prices), and to determine the sources of growth, we have deflated the current series of each segment by the WPI at 2011–12 prices and then decomposed the year-on-year growth in GVO from agriculture and allied activities by taking the absolute year-on-year difference in GVO from each segment as a proportion of the previous year's GVO from agriculture and allied activities.

Figure 6.11 shows that in MP, food grains (cereals and pulses) is the largest segment constituting around 29% of GVOA followed by livestock (19%), fruits and vegetables (18.3%) and oilseeds (12.8%). The share of food grains in the total value of output from agriculture and allied activities fell from 30.9% in TE 2002–03 to 29% in TE 2015–16, while that of livestock fell from 25.4% to 18.9% and oilseeds marginally declined from 15% to 13% in the same period. In comparison, there was a significant expansion in the share of the fruits and vegetables segment from 9.5% in TE 2002–03 to 18.3% in TE 2015–16. This shows that although food grains continue to be a dominant segment, MP is also diversifying towards high-value crops such

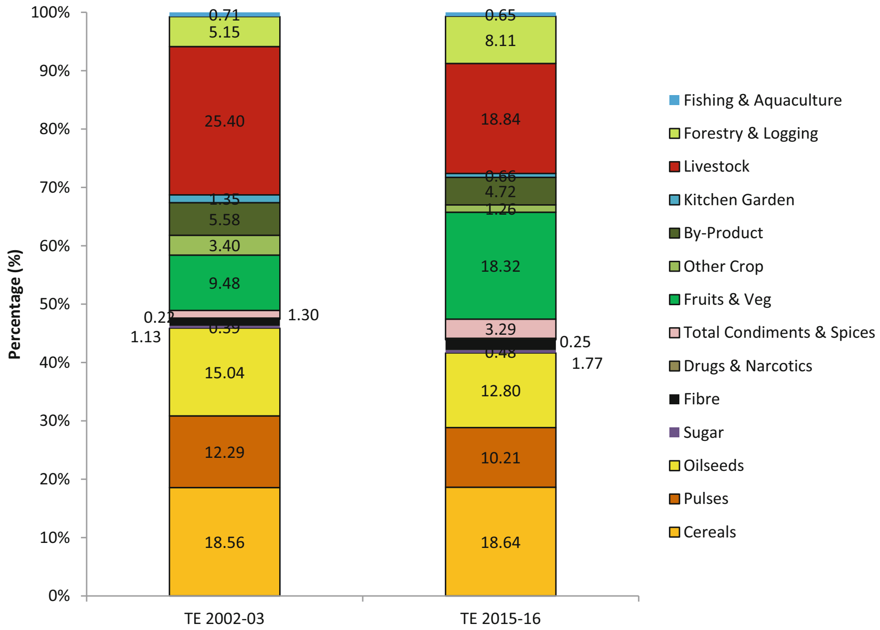

Fig. 6.11 Sector-wise share in total value of output from agriculture and allied activities (at current prices). *Source* State-wise estimates of value of output from agriculture and allied activities, CSO, MOSPI

as fruits and vegetables. In the following section, we look in greater detail at the disaggregated changes within each segment.

The primary source of agricultural growth in MP for the period 2000–01 to 2015–16 was fruits and vegetables, followed by livestock, cereals and oilseeds. Of the 8% average growth in GVOA for the period 2000–01 to 2015–16, 27% was contributed by food grains, 21.2% by fruits and vegetables, 12.5% by oilseeds and 17.6% by livestock (Fig. 6.12).

Foodgrains Sector

In MP, the largest segment in terms of acreage and value is food grains. Within cereals, wheat and rice are the major crops produced in MP; gram and *arhar* are important pulses. The decline in the share of food grains has been because of a decline in the share of *jowar*, barley, maize and small millets within the cereals segment. Wheat, the main cereal grown in MP, has shown a gradual increase in importance in the production basket.

In line with the expansion of acreage under wheat cultivation, the production of wheat also increased significantly in MP from 6.4 million metric tonnes in TE 1994–95 to 17.6 million metric tonnes in TE 2016–17. Between 2010–11 and 2011–12, wheat production jumped by 51% from 7.6 million metric tonnes to 11.5 million metric tonnes and thereafter, kept a high growth trajectory. Currently, MP is the

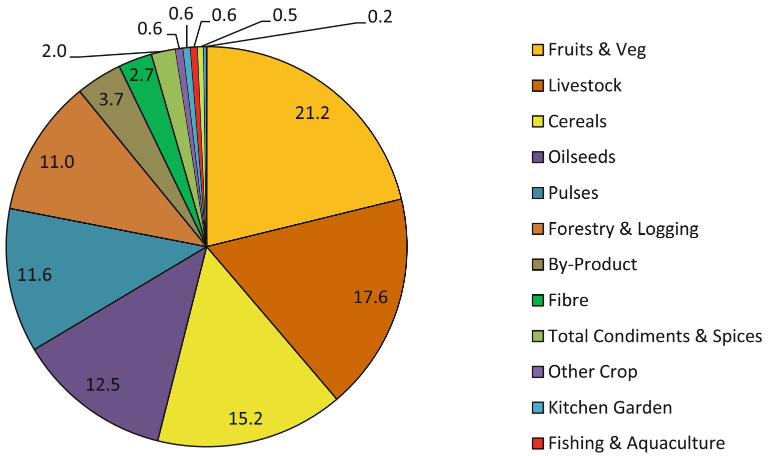

Fig. 6.12 Sources of growth 2000–01 to 2015–16 (Share in growth contributed by each segment). *Source* CSO, Government of India, state-wise estimates of value of output from agriculture and allied activities

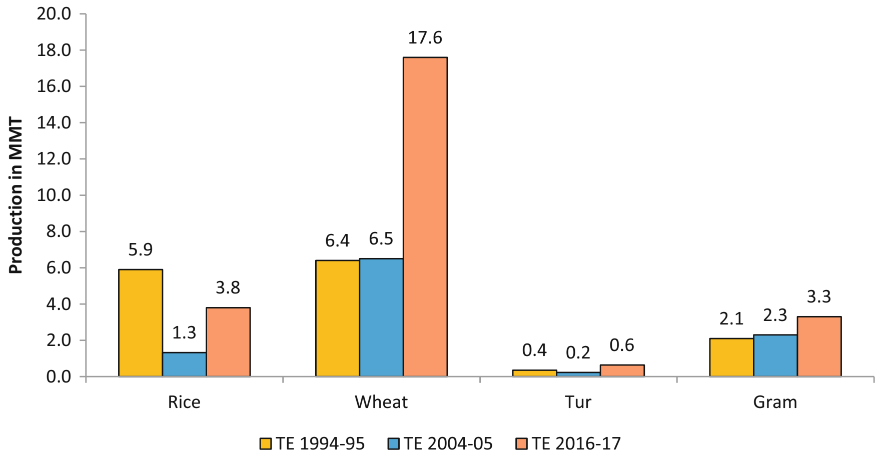

Fig. 6.13 Production of major cereals in Madhya Pradesh. *Source* Directorate of economics and statistics

second-largest wheat producer, after Uttar Pradesh, contributing around 16% of total production. However, this was not the case in the early 2000s. In TE 2002–03, MP contributed only 8% to total production of wheat and it was the fourth-largest producer after Uttar Pradesh (36%), Punjab (22%) and Haryana (14%). Productivity of wheat cultivation in the state also increased from 1.5 MT/ha in TE 2002–03 to 2.9 MT/ha in TE 2016–17. However, MP has much to achieve in terms of productivity as its productivity is still lower than that of Punjab (4.7 MT/ha), Haryana (4.4 MT/ha) and Rajasthan (3.0 MT/ha).

In comparison, the share of the pulses segment in GVOA declined in both the major pulse crops—gram and *arhar*. However, in terms of production, gram production increased from 2.1 million metric tonnes in TE 1994–95 to 3.3 million metric tonnes in TE 2016–17 while *arhar* production increased from 0.4 million metric tonnes to 0.6 million metric tonnes in the same period (Fig. 6.13). Currently, MP is the largest producer of gram (39% of the total production) and third-largest producer of *arhar* (13% of total production) in India.

Horticulture

The largest increase in production has been in the fruits and vegetable segment. Figure 6.14 shows the increase took place after 2010–11, with the value of output from fruits and vegetables as a percentage of GVOA increasing from 8.5% in 2010–11 to 19.5% in 2013–14. Private sector investment in irrigation augmented productive capacity and the involvement of public investment in roads connected the hinterland to markets, bolstering the production of perishables like fruits and vegetables.

Production of vegetables increased from 3.7 million metric tonnes in 2010–11 to 18.2 million metric tonnes in 2017–18. This remarkable increase has improved MP's position in vegetable production from 8th in 2010–11 among other states to become the third-largest vegetable producer in the country in 2017–18, only after Uttar Pradesh and West Bengal; this helped increase MP's contribution to total production from 2.8 to 10% in the same period. The productivity of vegetables stood at 19.6 MT/ha, which was higher than the national average of 17.8 MT/ha. In terms of acreage, the top three vegetables cultivated in MP are potatoes, onions and tomatoes. Potatoes and onions account for round 18% of the area under vegetable cultivation

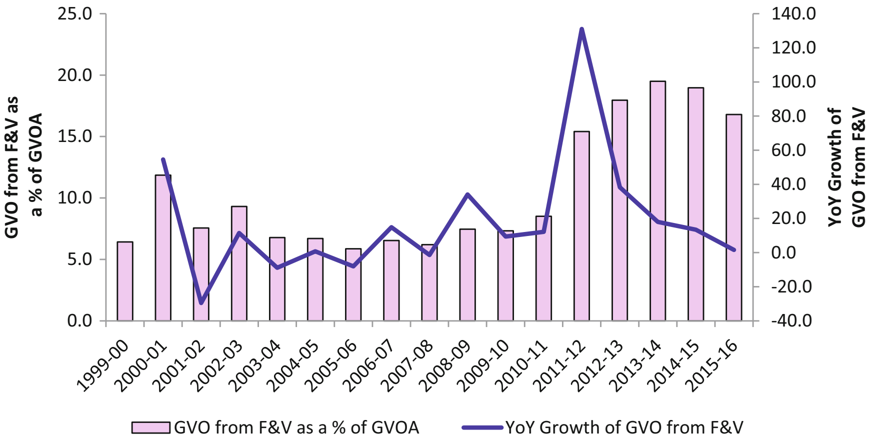

Fig. 6.14 Value of output from F&V as a percentage of gross value of output from agriculture and allied activities. *Source* CSO, Government of India, state-wise estimates of value of output from agriculture and allied activities

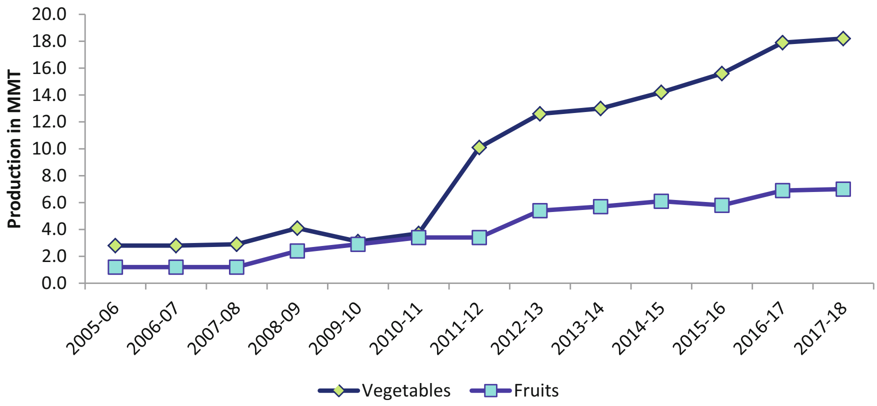

Fig. 6.15 Production of vegetables and fruits in Madhya Pradesh, 2005–06 to 2017–18. *Source* National horticulture database

in the state while tomatoes account for 11%. Currently, MP is the second-largest producer of onions (after Maharashtra with 14% of total production); fourth-largest producer of potatoes (with 5% of total production) and third-largest producer of tomatoes (after Maharashtra and Andhra Pradesh with 15% of total production).

In MP, 1.5% of gross cropped area is devoted to the production of fruits in the state. The production of fruits has been increasing steadily since 2007–08. Around 35% of the area under fruits is under citrus fruit cultivation, 26% under orange cultivation and 14% under banana; the production of all these fruits has increased since 2007–08 (Fig. 6.15).

The horticulture segment has become the sunrise sector for MP. Given the huge potential in the state for horticulture, the Government of Madhya Pradesh announced the "Horticulture Hub (H2) Establishment Policy, 2012". The purpose of this policy was to establish protected cultivation of horticultural crops in a commercial and organised manner. One or more centralised facilities will be made available for the production of high-quality plantation material, grading, sorting, packaging, etc., for products to be grown in horticultural clusters. It is expected that generally more than one cluster (village groups) will be linked with a hub. In 2012–13, Rs. 250 million was made available to establish horticultural hubs in the state. Under this policy, facilities are expected to be established by engaging private investors through the MP Agro-Industries Development Corporation. As per the policy, land is allotted to information technology companies investing in Madhya Pradesh on a 99-year lease. Prior to the H2, land was allotted to such companies on a 33-year lease under the Information Technology Policy, 2006. Hubs are expected to be established after preparing detailed project reports and getting the reports endorsed by an empowered committee headed by the Chief Secretary. The hub will run under the PPP mode.

Further, to promote agricultural processing, the state initiated the agro and food processing policy in 2012. Under this policy, land allotment to MSMEs is done at a concessional rate of 25% and exemption of stamp duty and registration charges of Rs.

1 per 1000. Moreover, fruits, vegetables, floriculture and other notified agricultural produce purchased in any market area of the state for processing/production are exempted from paying the *mandi* fee. Additionally, power has been subsidised at Rs. 1.5 per unit, subject to a ceiling of 25% of the electric units consumed in cold storage, cold chambers, ripening chambers and individual quick freezing enterprises for five years. In 2009–10, there were 812 agro-based food product industries in MP, accounting for nearly one-fourth of the total industries. This sector contributes an average 30% to the total value of industrial output in Madhya Pradesh. The sector is one of the highest growing sectors in terms of gross capital formation as well as gross value addition with an annual compound growth rate of 37 and 25% respectively (GoMP 2016).

Non-Food Crops

In TE 2015–16, the non-food segment consisting of oilseeds, fibre and sugar comprised around 15% of the total value of output from agriculture and allied activities. In MP, oilseeds alone constitute around 12.8% of GVOA vis-à-vis the national average of 5.3%. At a disaggregated level, soybean accounts for around 78% of the total value of output from oilseeds while rapeseed and mustard account for around 10% and groundnut 5%. The production of soybeans has doubled from 3.3 million tonnes in TE 2002–03 to 6 million tonnes in TE 2016–17. MP was the largest producer of soybeans contributing around 51% of the total production in the country, followed by Maharashtra (35%) in 2016–17.

Livestock

Livestock is the second-largest segment after food grains in MP, contributing around 18.8% of the GVOA. The milk segment contributes around 83% of the total value of output from livestock and the meat segment contributes around 5%. The livestock sector's share in GVOA has declined from 25.4% in TE 2002–03 to 18.8% in TE 2015–16. This is primarily because other segments such as fruits and vegetables have expanded more than livestock.

Milk Segment

In MP, the share of milk in the GVOA has declined from 21% in TE 2002–03 to 16% in TE 2015–16. However, this segment continues to be an important segment for improving farmers' livelihood in MP.

Milk production in MP has grown from 4.8 million metric tonnes in 2000–01 to 13.4 million metric tonnes in 2016–17 (Fig. 6.16), an average annual growth rate of 6.6%. Around 45% of milk production is cow milk and 49% is buffalo milk.

In terms of volume, MP is the sixth largest milk-producing state contributing accounting for around 7% of the total milk production in the country. Although milk production in the state has been increasing, milk productivity in MP is lower than in some other states; for example, while MP's productivity in milk production stood at 0.8 MT per female animal, Punjab's productivity was 2.4 MT per female animal, Gujarat's 1.1 MT per female animal and UP's 1.0 MT per female animal.

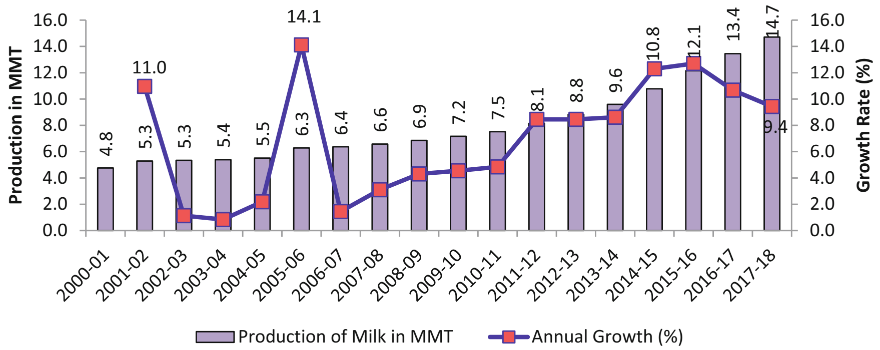

Fig. 6.16 Milk production in Madhya Pradesh. *Source* NDDB

One of the factors for low milk productivity could be the lower proportion of genetically superior cattle (crossbred). The exotic/crossbred female cattle population in Punjab is 91.5% of total female cattle population while that in MP is only 6.0% in 2012 (livestock census). Although this proportion is still low, the state has shown a rise in the proportion from 3.2% in the 5 years since 2007. However, the state requires significant scaling up of the population of crossbred/exotic female cattle population in order to improve milk productivity. The yield from crossbred cows is much higher as compared to indigenous breeds. On average, a crossbred cow yields 7.2 kg/day nationally while an indigenous cow yields 2.5 kg/day. In MP, the average yield of exotic/crossbred cow is around 6.5 kg/day while indigenous cows yield around 2.1 kg/day.

Milk in MP is mainly marketed by dairy co-operatives. The Madhya Pradesh State Co-operative Federation is the apex body and it has five regional milk unions located in Bhopal, Gwalior, Indore, Jabalpur and Ujjain for procurement. On average, these unions procure around 9.3 lakh kg of milk per day from 2.4 lakh members. These members are associated with 6219 dairy co-operatives (2015–16). Only about 15% of MP's total milk production is processed by the organised sector compared to 49% in Gujarat.

Meat and Eggs Segment

Meat accounts for only 5% of the total value of output from the livestock segment. Its share in GVOA has marginally increased from 0.6% in TE 2002–03 to 1% in TE 2015–16. Between 2006–07 and 2014–15, meat production increased from 20,000 to 60,000 tonnes (Fig. 6.17), an increase of 200%. The poultry segment in MP got a stimulus with the establishment of the Madhya Pradesh Women Poultry Producer Company Pvt. Ltd. (MPWPCL). It has ten producer organisations operating under it, each holding a stake in the producer company. Each of these producer organisations is an independent entity involved in providing services such as raw materials, working capital assistance, risk mitigation from input and output price movements and production support, besides marketing broiler poultry for its members and

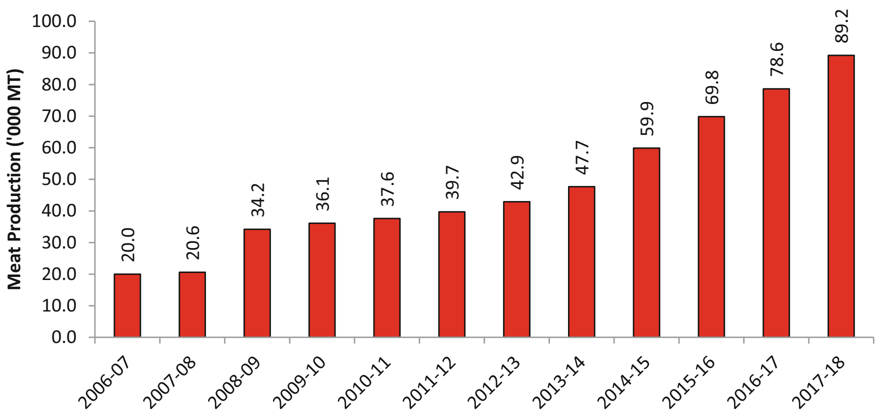

Fig. 6.17 Production of meat in Madhya Pradesh. *Source* Basic animal husbandry and fisheries statistics

providing training and building capacity among women. The co-operative membership extends to 4214 women poultry producers belonging to poor tribal and Dalit families. Currently, MPWPCL is one of the biggest producers of broiler chicken in the state. This was achieved by first establishing four feed processing units, which supplied feed to the co-operatives, and then taking on the contract for manufacturing medicines. Marketing is done under the brand name "Sukhtawa Chicken". In 2011, a parent farm and hatchery were commissioned. The end-to-end integration and scale of operations under MPWPCL has given producers the bargaining power to influence market decisions and protect farmers from market volatility and depletion in their profit margin (Garg and Kumar 2011).

Egg production in MP has also increased significantly from 951.8 million in 2006–07 to 1942 million in 2017–18. Such a phenomenal rise in the production of meat and eggs requires enlargement of storage capacity so as to minimise wastage and damage. Although there are at present around 122 cold storages in the state with a total capacity of approximately 712.3 million MT (2012–13), there is a pressing need to develop storage and marketing infrastructure to further bolster the segment.

Fisheries

Since Madhya Pradesh is landlocked, inland fishery is favourable in the state. Although only 0.65% of the GVOA is contributed by fishery, this sector has huge potential. MP has around 4.03 lakh ha of reservoirs and tanks, which can be utilised for fishing.

Fish production has increased from 47.5 thousand tonnes in 2001–02 to 109.1 thousand tonnes in 2014–15, (Fig. 6.18) a CAGR of 5.7%. MP contributes only about 1.6% of the total inland fish production, while major inland fish producing states in India such as Andhra Pradesh and West Bengal contribute around 26% and 23% respectively (GoMP 2016).

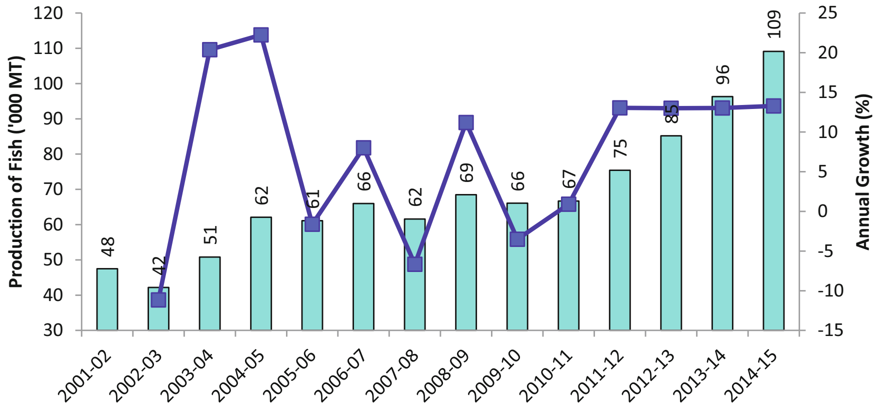

Fig. 6.18 Fish production in Madhya Pradesh. *Source* GoMP 2016

6.4 Drivers of Agriculture Growth: Econometric Analysis

Agricultural growth is influenced by a number of supply-side factors. A priori, we would expect (i) technology (seed replacement rate, irrigation, fertiliser use, farm mechanisation, extension, etc.), (ii) incentives (terms of trade), (iii) infrastructure (electricity, roads) and (iv) weather conditions to drive agricultural growth. However, it is difficult to analyse the effect of all variables in a single framework, both because of paucity of data and because many of these variables can be correlated. The correlation matrix of these variables is presented in annexure Table 6.3. Therefore, we use a parsimonious model to analyse the potential drivers of growth.

Estimating Equation

In our model, log GDPA is the dependent variable and the variables mentioned above are independent variables. The equation has been estimated using data from 2000–01 to 2015–16. The variables that had a positive and significant correlation with GSDPA that have been used in our regression model are: (i) irrigation ratio (IRR), (ii) surfaced road density (Road) and (iii) terms of trade between agriculture and industry (ToTAI).

$$\ln\text{GSDPA} = \beta_0 + \beta_1 \ln\text{IRR} + \beta_1 \ln\text{Road} + u_t \tag{6.1}$$

$$\ln\text{GSDPA} = \beta_0 + \beta_1 \ln\text{IRR} + \beta_1 \ln\text{ToTAI} + u_t \tag{6.2}$$

The results from these regression models have been presented in Table 6.2.

In Model 1, it can be seen that irrigation and roads have a significant and positive effect on agricultural GDP. The two independent variables together explain around 96% of the variation in agricultural GDP for the studied period. Since we have estimated a double log model, the results can be interpreted as follows: *ceteris paribus*, a

Table 6.2 Regression results

	Model 1	Model 2
Irrigation ratio (lnIRR)	1.25***	1.43***
Surfaced road density (lnRoad)	0.20**	
Terms of trade between agriculture and industry (lnToTAI)		0.26*
Constant	10.3***	10.9***
No of observations	16	16
Adj R-square	0.96	0.96

*** significant at 1% ** significant at 5% * significant at 1%

1% growth in irrigation ratio increases agriculture growth by 1.25%. Similarly, a 1% growth in surfaced road density increases agriculture growth by 0.20%. In Model 2, it is observed that irrigation and terms of trade in favour of agriculture have a significant and positive effect on agricultural GDP. The two independent variables together explain around 96% of the variation in agricultural GDP. As in the case of Model 1, the second model can be interpreted as follows: *ceteris paribus*, a 1% growth in the irrigation ratio increased agriculture growth by 1.43 and a 1% change in terms of trade in favour of agriculture increased agriculture growth by 0.26%.

6.5 Conclusion and Policy Implications

As discussed before, the five main factors that have contributed to agricultural growth in Madhya Pradesh are (i) expanded irrigation through tube wells and canals, (ii) increased power supplies to agriculture, (iii) assured and remunerative price for wheat (including bonus over MSP) by strengthening the wheat procurement system, (iv) expansion of all-weather roads and (v) suitable incentives and signals for the private sector to increase the level of investments to reap the benefits of trunk infrastructure and improved services. Public investment in the development of infrastructure in the state (especially roads, power supplies and canal irrigation) has also played a vital role in transforming agriculture in MP. These findings have important policy implications for many other states like Bihar, Odisha, Uttar Pradesh, etc., which have ample scope to accelerate growth in their agriculture sector. While initiatives in each state will have to be designed to cater to local needs and priorities, the major takeaways from the experience Madhya Pradesh in agricultural development for moderate performing states can be summed up as follows.

(i) Expand ground-water and surface water irrigation through assured power supplies to rural areas through power feeder separation.
(ii) Establish a strong procurement system so that farmers can reap the benefit of the government minimum support price scheme.

(iii) Invest in all-weather surfaced roads for efficient movement of products and inputs to and from rural areas and link farmers to processing units and consumers.
(iv) Public investments in key infrastructure such as improved power supply and better road connectivity to incentivise and attract private investment at the farm level in the form of increased investment in tube wells, expansion of area under horticulture, especially the adoption of high-value crops such as seasonal vegetables, and setting up of dairy units.

To sustain agricultural growth in Madhya Pradesh, the following points are worth considering:

1. Up to the Eleventh Plan, irrigation potential created (IPC) as a percentage of ultimate irrigation potential (UIP) was 22.3% for micro-irrigation projects; it was 51.5% for major and medium projects. There is still scope for investment in order to bridge the gap between IPC and UIP.
2. It is also noteworthy that MP has significant under-utilised sub-soil water resources in almost all regions, especially in the eastern part. There is a case for addressing power infrastructure and supply gaps in the eastern part on a priority basis to attract farm level investment in private tube wells to exploit available water resources. This is likely to result in an expansion in assured irrigation and promote both productivity growth in existing crops and diversification into horticulture.
3. Although road density in MP has increased over the years from 526.8 per thousand sq. km in 2000–01 to around 941 per thousand sq. km in 2015–16, it remains lower than the national average of 1431 per thousand sq. km. Besides, surfaced road as a percentage of total roads in MP at 83% is much lower than in states like Punjab and Gujarat where the percentage of surfaced roads is over 89%. Therefore, MP has the potential to improve its road network further.
4. The share of agriculture in total power sales is high (33.7%) but total power sales/GCA is low, standing at 518 kWh/ha in TE 2012–13 as compared to states such as Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Haryana, Gujarat and Maharashtra that use over 1000 kWh/ha for agriculture. Therefore, there is still scope for improvement in power availability, which will increase uptake of private irrigation.
5. With the increasing importance of the horticultural sector, there is a need to expand and strengthen infrastructure such as cold storage, warehouses, processing units and organised retail for value chain development. In particular, MP has emerged as the second-largest producer of onions after Maharashtra in recent years but has been unable to fully leverage its proximity to the major consuming markets of northern India due to inadequate storage capacity. Addressing this gap through incentives to create storage facilities both at the farm level as well as organised cold storages based on solar power will significantly enhance the capacity of the state's farmers to benefit from price differentials during lean supply months.

6. MP was among the first of the major states to remove horticultural produce from the monopoly of the Agriculture Produce Marketing Committee (APMC) controlled *mandis* in 2012. It needs to follow up this decision with policy incentives to attract private market yards offering electronic and sample-based trading. This will bring bulk buyers, processors, exporters, etc., to the state to source fresh produce and provide greater marketing choice to farmers. At present, MP is a net exporting state for fruits and vegetables, given its low urban population. Its favourable location, enabling quick access to both major northern and western urban markets, could be leveraged successfully with appropriate policy incentives.
7. A related issue in the agricultural marketing policy is the roll-out of the Government of India's e-NAM electronic marketing portal, where MP has been a relatively low key participant so far. Given the wide range of crops offered by the state and its location in the centre of the country, accelerated expansion of the e-NAM platform could benefit farmers in due course in terms of increased selling choices. MP pioneered the e-*chaupal* initiative over a decade and a half ago with a private sector partner (ITC) and saw improved price realisation for soybean farmers. e-NAM is a public initiative and could bring benefits to a much larger number of farmers across a larger area, if patronised by the state and implemented after due assaying, grading of produce and setting up of an effective dispute settle mechanism between buyers and sellers.
8. We have already commended the role played by public procurement of wheat in incentivising area expansion, higher returns to farmers and other spin-off benefits. MP is well placed to replicate the model in the case of pulses, which is of critical importance to the rain-fed regions of the state, especially the Bundelkhand and Baghelkhand regions, and is the mainstay of smallholder agriculture in these regions. With the Government of India announcing a policy decision to create a buffer stock of 2 million MTs of pulses, MP can deploy its tested e-*Uparajan* initiative for the benefit of pulse farmers. Even if no bonus is paid over and above the MSP, it will result in large gains for the average cultivator of pulses by reducing their market risk. Public procurement of pulses is likely to see a repetition of some of the favourable outcomes witnessed in the case of wheat and is a low hanging fruit ready to be plucked.
9. Although milk production has increased from 4.8 million tonnes in 2000–01 to 10.8 million tonnes in 2014–15, milk productivity in the state is lower than in some of the other states. For example, while MP's productivity in milk production stood at 0.8 MT per female animal per year, productivity in Punjab was 2.4 MT per female animal per year, Gujarat 1.1 MT and UP 1.0 MT per female animal per annum. One of the factors for this low milk productivity could be the lower proportion of genetically superior cattle (crossbred). In Punjab, the exotic/crossbred female cattle population as a proportion of the total female cattle population was around 91.5%, while in MP, it was only 6.0% in 2012. The state needs to significantly scale up the population of crossbred/exotic female cattle population to improve milk productivity.

10. MP recently passed legislation to legalise agricultural tenancies, based on the model draft circulated by the Government of India. This is a major reform measure in a state that hitherto did not permit legal leasing of land. Implementation guidelines to follow up on the law have still to be issued. These should be released expeditiously to enable registration of tenancy under the new legal provisions. The new law should be publicised widely and a transparent dispute resolution mechanism put in place to build public confidence in this measure. Implemented fairly, the land leasing law could help increase investments in better technology and irrigation, as stable tenures and fair rents will encourage tenants to invest in productivity-enhancing measures.
11. A large number of farmer producer organisations (FPOs) have emerged in the state in the past decade, thanks to progressive policies to encourage their growth. Some of these FPOs are now doing impressive work in agricultural production, marketing and value addition. The state has put in place a set of incentives to strengthen these farmer-owned organisations through financial support, infrastructure building and relaxation of the provisions of the APMC Act. However, ready access to affordable working capital remains a challenge for many FPOs, given their weak equity base. Given that equity concerns are well addressed by such bodies, there is a justifiable case to enhance the level of public support to registered FPOs. Among the most effective measures would be a state-level credit guarantee fund, which would provide comfort to all institutional lenders licensed by the RBI for loans advanced to FPOs up to a limit (say Rs. 200 lakh).

Annexure

See Table 6.3.

Table 6.3 Correlation matrix

	GSDPA	Irrigation ratio	Fertiliser consumption	Total	
GSDPA	1				
Irrigation ratio	0.93***	1			
Fertiliser consumption	0.80***	0.92***	1		
Road	0.94***	0.83***	0.72***	1	
ToT	0.93***	0.85***	0.81***	0.97***	1

*** Significant at 1% **Significant at 5% * Significant at 10% ## Variables are in log form all variables in log form

References

Basic Animal Husbandry & Fisheries Statistics. (2014). *Department of animal husbandry, dairying and fisheries*. Ministry of Agriculture.

CSO. (2019). *State-wise gross state domestic product*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

CSO. (Various Issues). *State-wise gross domestic product*. New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Fan et al. (2007). *Investment, subsidies, and pro-poor growth in rural India.* Discussion Paper No. 00716. IFPRI: New Delhi.

Garg, S., & Kumar, N. (2011). *Flying in a flock*. Case Study on Madhya Pradesh Women's Poultry Producer Company Limited in Catalysing Markets through Collectives: Experiences from the Allied Sector. Access Development Services.

Government of Madhya Pradesh. (2016). *Madhya Pradesh agriculture economic survey 2016*. Department of Planning, Economics and Statistics, Government of Madhya Pradesh.

Gulati, A., Chatterjee, T., & Hussain, S. (2018). Supporting Indian Farmers: Price support or direct income/investment support? ICRIER Working Paper Number 357.

Livestock Census. (2007). *16th livestock census-2007 all India report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Livestock Census. (2012). *19th livestock census-2012 all India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Shah, T., Verma, S., Durga, N., Rajan, A., Goswami, A., & Palrecha, A. (2016). Har Khet Ko Pani (Water to Every Farm): Rethinking Pradhan Mantri Krishi Sinchai Yojana (PMKSY).

Subbarao, D. (2012). Agricultural credit—Accomplishments and challenges. Speech delivered at the thirty years anniversary celebration of NABARD at Mumbai on July, 12.

UNCTAD. (2004). Financing commodity based trade and development: Innovative agriculture financing mechanisms. Report prepared by the UNCTAD secretariat for the Expert Meeting on Financing Commodity-Based Trade and Development: Innovative Financing Mechanisms.

Verma, S., Gulati, A., & Hussain, S. (2017). *Doubling agricultural growth in Uttar Pradesh: sources and drivers of agricultural growth and policy lessons* (No. 335). Working paper No. 335. Indian Council for Research on International Economic Relations: New Delhi

Wooldridge, J. M. (2009). *Introductory econometrics: A modern approach. South Western CENGAGE Learning*. IWMI Water Policy Research Highlight.

Website

http://www.ddugjy.in/
http://dfpd.nic.in/
http://eands.dacnet.nic.in/
http://www.imdpune.gov.in/
http://www.indiastat.com/agriculture/2/fisheries/101/fishproduction19502014/450250/stats.aspx
http://www.mospi.gov.in/
http://www.nddb.org/information/stats

http://www.seedsindia.org/
http://www.tmaindia.in/tma.php
https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=State+Finances+%3a+A+Study+of+Budgets

Chapter 7
Performance of Agriculture in Uttar Pradesh

Ashok Gulati, Prerna Terway, and Siraj Hussain

7.1 Introduction

Uttar Pradesh is an agrarian economy where 47% of the population is directly dependent on agriculture for their livelihood. Even though the share of agriculture in overall GSDP has dropped to only 12% in TE 2017–18, agriculture still remains an important sector because the income of a substantial section of the workforce still comes from this sector.

UP is blessed with the fertile Indo-Gangetic plains and, given the size of the state's geographical area, it is a significant contributor to the food security of the nation. About 28% of India's wheat and 12% of rice is produced by the state. Sugarcane is also produced in large quantities, accounting for 44% of the country's total production. However, farm distress is prevalent in the state. Given the enormous size of the state, its four regions namely—Western region, Eastern region, Central region and Bundelkhand—will be studied in this paper. There is large variation in the agricultural performance in these regions of the state. Western UP is the most progressive region in terms of its contribution to value of output from agriculture and allied activities while Bundelkhand lags far behind.

Over the past few years, the contribution of cereals to the value of output has declined while there has been a rise in the share of the livestock sector. Milk is the most important sector contributing significantly to UP's agricultural growth and it has the potential to enhance farmers' income in future. UP is also well endowed with

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resources needed to produce a variety of fruits and vegetables. The state must focus on agricultural diversification, which will not only result in additional income for farmers but will also provide them better nutrition.

In this chapter, we focus on the performance of the agricultural sector in Uttar Pradesh by identifying the sources of growth as well as the role of existing policies. Section 7.2 discusses the overview of agriculture in the state of Uttar Pradesh. Section 7.3 deals with the composition and the sources of growth of agriculture. Section 7.4 presents the drivers of agricultural growth in the state. Section 7.5 makes an assessment of the budgetary allocations to agricultural and allied activities followed by section 7.6 on the conclusion and policy recommendations.

7.2 Overview of Agriculture in UP

UP is surrounded by Uttarakhand, Himachal Pradesh, Haryana and Delhi in the North and West; Rajasthan, Madhya Pradesh and Chhattisgarh in the South-West and South; and Jharkhand and Bihar in the East. This is the fourth largest as well as the most populous state in the country occupying 7.33% of the total area of the country with 199.8 million people (Census 2011), accounting for 16.5% of India's total population.

UP is divided in nine agro-climate zones—Terai, western plains (WP), mid-western plains (MWP), western semi-dry plains (SWDP), mid-western south plains (MWSP), south-western semi-dry plains (SWSDP), Bundelkhand (BUND), north eastern plains (NEP) and Vindhyachal (VIND) (Fig. 7.1). There are wide climatic variations across the zones—while Bundelkhand is drought-prone, eastern UP sees frequent floods and waterlogging. Given the large size of the state and its diverse geography, climate and topography, UP is generally divided into 4 zones or regions—Western, Central, Eastern and Bundelkhand.

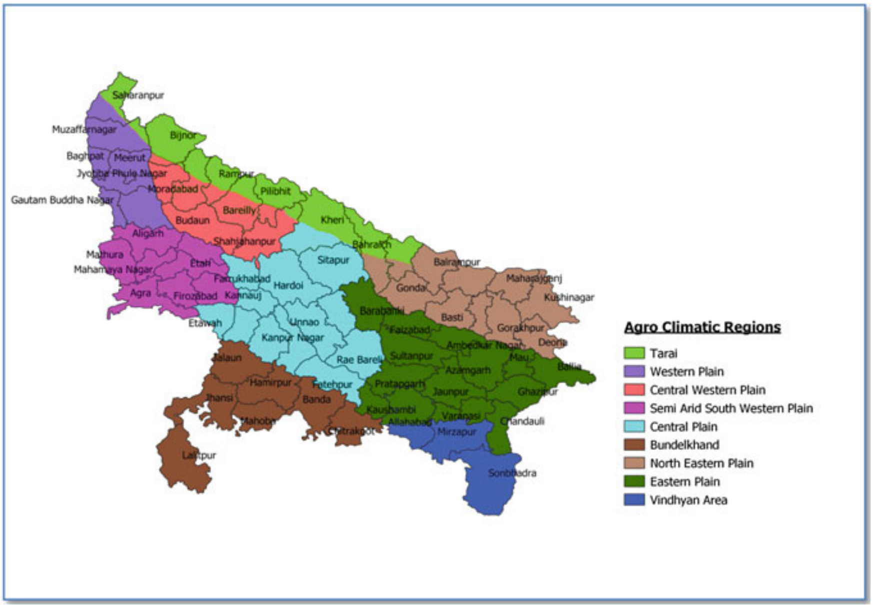

Fig. 7.1 Agro-climatic zones of Uttar Pradesh. *Source* Created using QGIS from Government of Uttar Pradesh's data

7.2.1 Agricultural Growth in Uttar Pradesh

The state's agricultural growth has been lower than the all-India average in most years. In the period between 2005–06 and 2018–19, the agricultural growth rate was 3.0% per annum (at 2011–12 constant prices) while the all-India average rate of growth was 3.6% per annum (Fig. 7.2). However, agricultural growth in Uttar Pradesh has been relatively less volatile than that experienced at the all-India level in the past two decades.

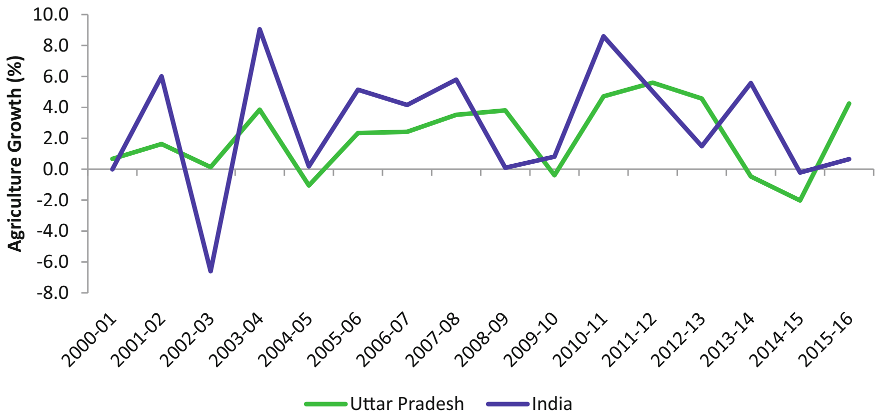

Fig. 7.2 Agricultural growth in UP and India. *Source* Central Statistical Organization, MoSPI

7.2.2 Agricultural Livelihood in Uttar Pradesh

Uttar Pradesh is largely dominated by small and marginal farmers with 93% of agricultural households operating 65% of land. The average landholding size declined marginally from 0.76 ha in 2010–11 to 0.73 ha in 2015–16. (Table 7.1)

Agriculture is the main occupation in the state. According to the Situation Assessment of Agricultural Households (2012–13), UP had 18 million agricultural households, which accounted for 20% of the total agricultural households in rural India.

In 2012–13, the average monthly income per agricultural household was the fifth-lowest in Uttar Pradesh and stood at Rs. 4923; other states lower than UP were Bihar, Jharkhand, Uttarakhand and West Bengal. The situation worsened in 2015–16 and UP ranked last in farmers' income (NABARD, Financial inclusion survey, 2018). According to this survey, the average monthly income per agricultural household

Table 7.1 Distribution of operational holding in UP

	Area (%)	2010–11		Area (%)	2015–16	
		Number (%)	Size of holding (ha)		Number (%)	Size of holding (ha)
Marginal	40.69	79.45	0.39	41.82	80.18	0.38
Small	24.08	13.01	1.40	23.92	12.63	1.39
Semi-medium	20.59	5.72	2.72	20.40	5.51	2.71
Medium	12.48	1.71	5.52	11.89	1.58	5.51
Large	2.16	0.11	15.01	1.97	0.10	14.98
All	100.0	100.0	0.76	100.0	100.0	0.73

Source Agricultural census

stands at Rs. 6668, which is about 25% lower than the all India average of Rs. 8931 in 2015–16 (Fig. 7.3).

According to the Situation Assessment Survey (SAS), the share of income from cultivation and farming of animals has increased from 54.4% in 2002–03 to 69% in 2012–13 while the share of receipts from non-farm business and wages has decreased in the same period (Fig. 7.4). However, the NABARD All India Rural Financial Inclusion Survey (NAFIS) shows that the first two components declined and income from wages registered an increase in 2015–16.

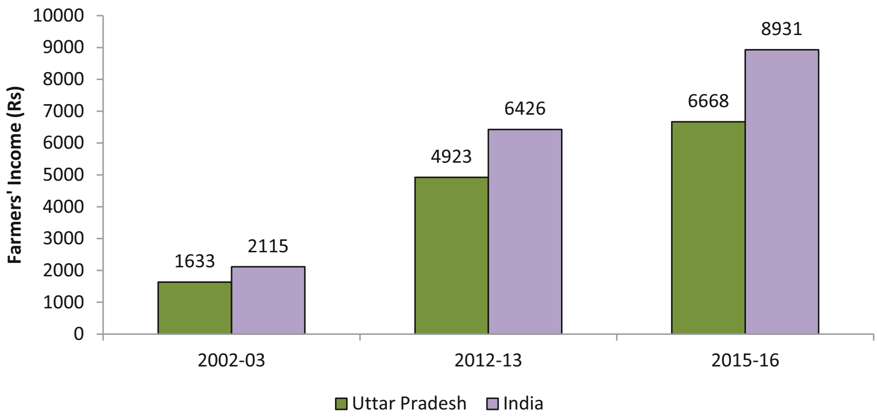

Fig. 7.3 Farmers' income in UP and India. *Source* NSSO and NAFIS

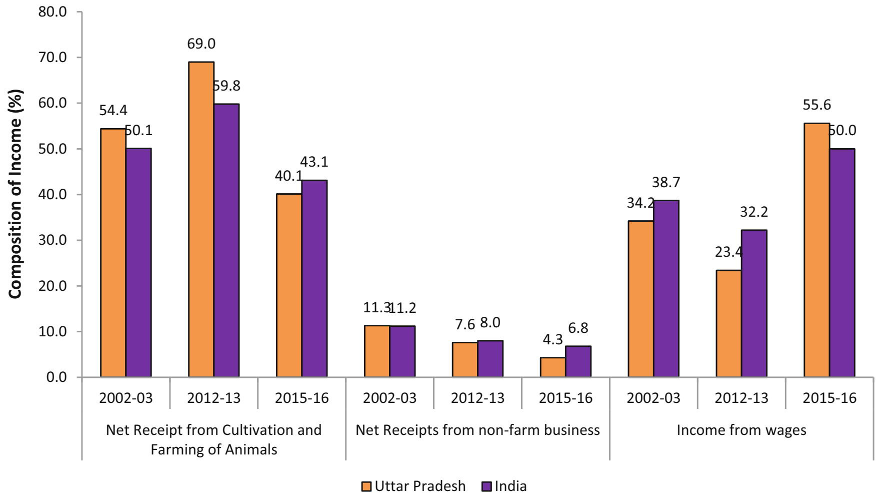

Fig. 7.4 Change in the composition of farmers' income from 2002–03, 2012–13 and 2015–16. *Source* NSSO

7.2.3 Land use and Cropping Pattern

The land use pattern has remained unchanged in the state. The net sown area has declined marginally from 68.9% in TE 2004–05 to 68.5% in TE 2014–15. The area under forest and fallow land is 6.9% and 7% respectively. Other uncultivated land excluding fallows is 3.7% and area not available for cultivation stood at 14.3% of total geographical area in this period.

The gross cropped area (GCA) has increased marginally from 25 million ha (mha) to about 26 million ha between TE 2002–03 and TE 2014–15. Gross irrigated area has also increased from 17.9 mha to 20.5 mha during the same period. With an increase in area under irrigation, cropping intensity increased from 150 to 157% in this period.

Even though agro-climatic conditions vary widely in the state, food grains comprise an important component of UP's production basket. It is one of the major producers of food grains in the country. Cereals accounted for 69% and pulses for 9.1% in the GCA in TE 2014–15. Within cereals, wheat is the most important crop, accounting for 38% of GCA. Sugarcane is another important crop in Uttar Pradesh accounting for roughly 8.5% of GCA and its share has remained almost the same since TE 2002–03. The area under oilseeds has seen a marginal rise as a proportion of GCA from 3.3% in TE 2002–03 to 4.4% in TE 2014–15. The share of vegetable in GCA increased from 3.3% in TE 2002–03 to 4.4% n TE 2014–15 whereas GCA under fruits has marginally declined from 1.2% to 1.1% in this period. The share of

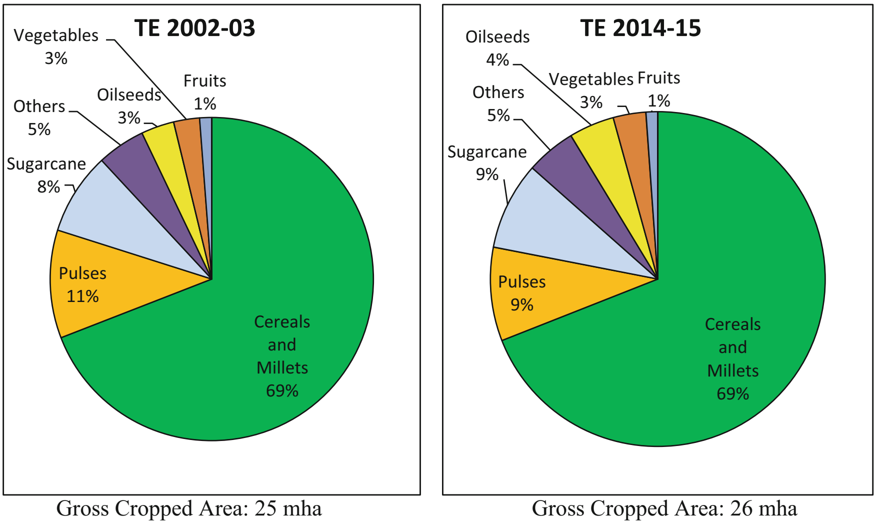

Fig. 7.5 Share of major crops, fruits and vegetables in gross cropped area in UP. *Source* Directorate of economics, and statistics, GoI

vegetables has increased mainly because of an increase in the area under potatoes where GCA has increased by almost 27%age points between 2002–03 and 2014–15 (Fig. 7.5).

7.3 Determinants of Agriculture Growth

Physical infrastructure such as irrigation, power and road plays a critical role in the growth of this sector. In this section, we discuss the development of infrastructure in Uttar Pradesh to understand which factors helped in stimulating high productivity and growth in the agricultural sector.

Irrigation

One of the most important variables that has positively influenced agriculture in UP is irrigation. The state is well-endowed with a rich irrigation system with a gross irrigated area of 80.2% in 2014–15 (Fig. 7.6). It ranks relatively higher than most Indian states and stands next only to Punjab (98.7%) and Haryana (89.1%).UP has about 74,659 km of canals, 28 major and medium-lift canals, 249 minor lift canals, 69 reservoirs/*budhis* and about 32,000 running tube wells operated by the government. The major source of irrigation is wells (80.2%) followed by canal irrigation (17.9%).

Within the state, however, there are wide variations in irrigation coverage. While regions like Western UP, Central and Eastern UP have a high irrigation ratio of 90%, 83% and 77% respectively; Bundelkhand has less than half its area (48%) under irrigation.

The GoI had identified 99 ongoing major/medium irrigation projects under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKS) for completion by December

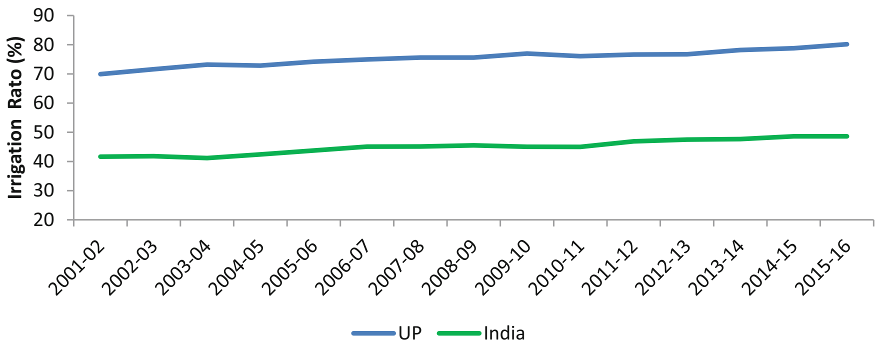

Fig. 7.6 Irrigation ratio in Uttar Pradesh and India. *Source* Directorate of Economics and Statistics

2019. These projects were sanctioned under the Accelerated Irrigation Benefits Programme (AIBP) and had been under implementation for several years.[1]

Up to March 2014, 33.59 million hectares has been created through major, medium and minor irrigation projects (Ministry of River Development and Ganga Rejuvenation). Several canal systems are more than fifty years old. These include the upper Ganga canal, eastern Yamuna canal, Agra canal, lower Ganga canal, Sharda canal, etc. Sedimentation of dams and canals has affected their efficiency. Repair works have not been taken up on time, farm development works below the outlets have not been done and average water use efficiency is in the range of 30–40% only. Moreover, cropping patterns have changed and several crops requiring large quantities of water, e.g. paddy and sugar cane, now occupy a much larger area. Cutting of distributaries and minor canals is very common, leading to farmers at the tail end of canals suffering from water shortages.

In August 2013, the World Bank sanctioned the second phase of the USD 515-million water sector restructuring project in UP to improve water use and agricultural productivity and ensure a proper policy framework for more efficient use of water resources. Modernisation and rehabilitation of irrigation and drainage systems are also covered in the project. It seeks to promote participatory irrigation management.

As of March 2018, the progress of the water restructuring project was quite satisfactory on many parameters but there are a number of other important deliverables on which progress has been rather slow. Figure 7.7 portrays source-wise irrigation in Uttar Pradesh in TE. 2002–03 and TE. 2013–14.

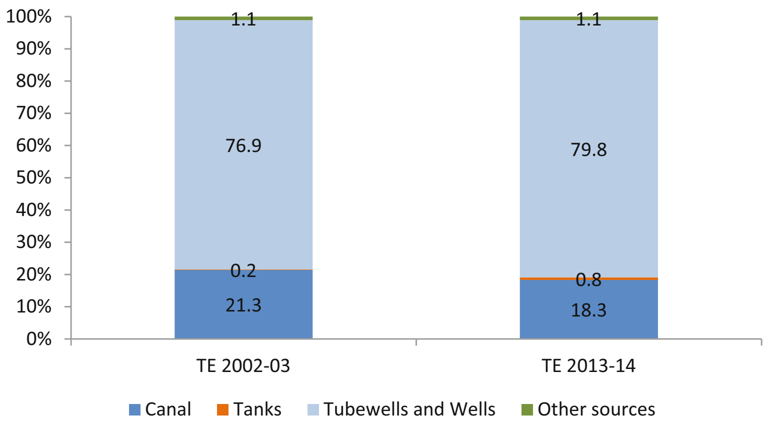

Fig. 7.7 Source-wise irrigation in Uttar Pradesh in TE 2002–03 and TE 2013–14. *Source* Directorate of Economics and Statistics

[1]There were four projects identified in UP. These were Banasnagar canal, Arjun Sahayak in Bundelkhand, Madhya Ganga canal phase II and Saryu Nahar. Of these four projects, having the potential of irrigating 16.53 lakh hectare, the Banasnagar canal project, started in 1978, was finally inaugurated by Prime Minister on July 15, 2018, in Mirzapur. Other projects are scheduled to be completed by June 2019.

Micro Irrigation

Until 2018, the area under micro-irrigation in UP was only 82,546 hectares, comprising less than one per cent of the total area under micro-irrigation in the country as compared to 1.8 million hectares in Rajasthan or 1.6 million hectares in Maharashtra. It is clear that there is enormous scope for expanding the area under micro-irrigation, not only in Bundelkhand but also in the cane growing region of western UP, which is increasingly faced with deficient rainfall.

Of the 75 districts in UP, 34 are in the category of overexploited, with fast depleting levels of groundwater. According to the Central Ground Water Board, out of 822 blocks, 37 blocks are overexploited, 13 are critical and 88 are semi-critical. Therefore, micro-irrigation practices need to be promoted in all these blocks, especially in districts having a low irrigation ratio like Bundelkhand.

Roads

The development of roads plays a significant role in the growth of the rural economy. It helps farmers realise better prices for their produce through better connectivity with urban areas. A good road network system helps reduce transportation costs, accelerates the movement of farm inputs and opens up opportunities for agricultural trade. Thus, roads are found to have a powerful impact on poverty alleviation and in accelerating agricultural growth. In UP, the total road density increased from 690 km per 1000 km^2 in TE 2002–03 to 1711 km per 1000 km^2 in TE 2015–16. The surfaced road density went up from 337 km per 1000 km^2 to 1410 km per 1000 km^2 in the same period (Fig. 7.8).

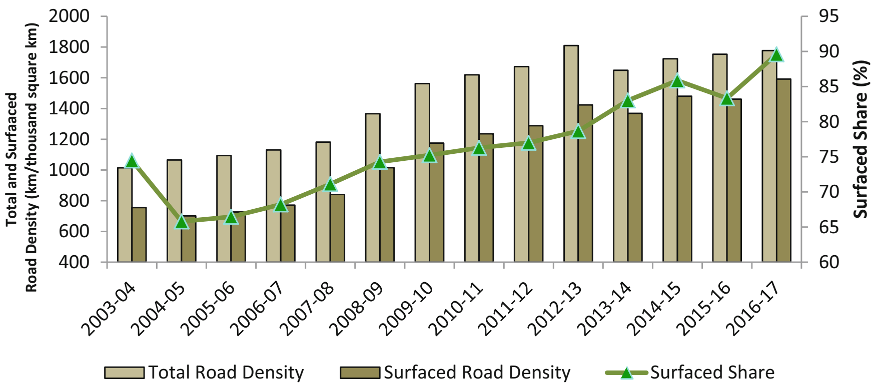

Fig. 7.8 Roads in Uttar Pradesh. *Source* Ministry of Road Transport and Highways

Procurement Policy

In the absence of a robust procurement system, a large number of farmers in UP are forced to sell their produce below the market price or MSP. Although UP is the largest producer of wheat in the country, the share of total procurement of wheat as a percentage of production in the state is only 8% as compared to 65% in Punjab in TE 2017–18 (Fig. 7.9). Similarly, in the case of rice, the share of rice procured in UP is 21% of total production as compared to 88% in Punjab (Fig. 7.11). Moreover, there are large fluctuations in the quantity of wheat or paddy that is being procured by the government at MSP as seen in Figs. 7.10 and 7.12.

Taking this into account, the government in Uttar Pradesh decided to purchase wheat at a minimum support price (MSP) of Rs. 1735 per quintal, with an additional Rs. 10 per quintal as transport charges in March 2018, for rabi marketing season 2018–19. It was further directed that the policy would be totally transparent and the farmers would be paid online within 72 hours of their sale. The government would purchase wheat from farmers between April 1 to June 15 and all purchase centres would be linked online.

For paddy, the government set a target of 50 lakh metric tonnes of paddy in *kharif* 2018 and laid emphasis on the RTGS (real-time gross settlement) mode of payment to farmers. Under this policy, MSP for the common variety of paddy was fixed at Rs. 1750 per quintal while that for grade A was fixed at Rs. 1770 per quintal. Besides, Rs. 20 per quintal for winnowing and cleaning the paddy was also added to MSP by the state government.

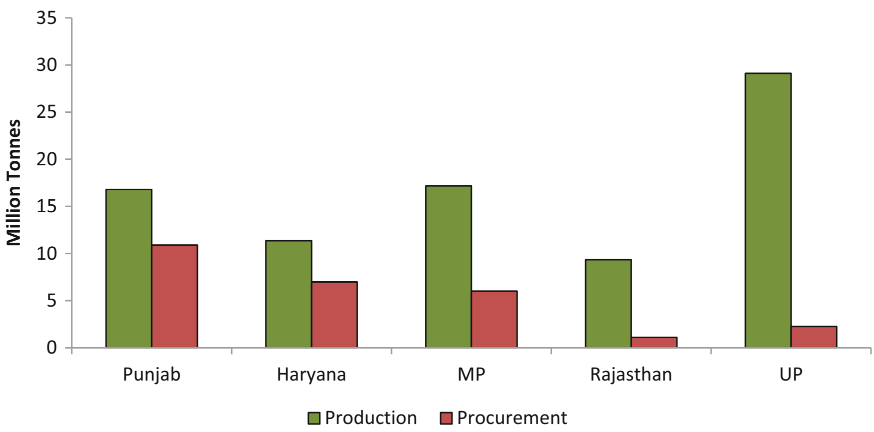

Fig. 7.9 State-wise production and procurement of wheat in TE 2017–18. *Source* Department of Food and Public Distribution, GoI

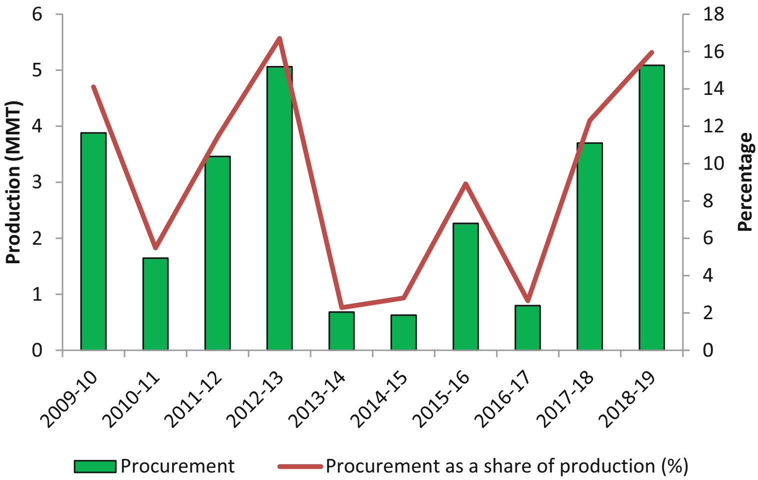

Fig. 7.10 Procurement of wheat in Uttar Pradesh (2009–10 to 2018–19). *Source* Department of Food and Public Distribution, GoI

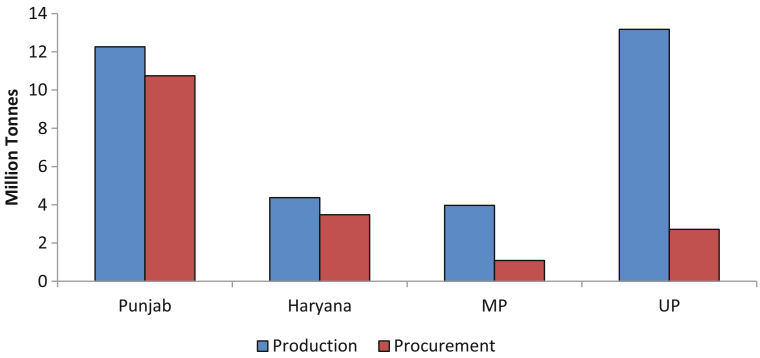

Fig. 7.11 State-wise production and procurement of paddy in TE 2017–18. *Source* Department of Food and Public Distribution, GoI

Power

Uttar Pradesh requires a sustainable power sector to augment agricultural growth and productivity. Figure 7.13 shows the share of agriculture in total power sales and the trend in power intensity in the agriculture sector. The share of agriculture in total power sales in UP remained stagnant from 2004–05 to 2015–16. However, power intensity in the state's agricultural sector has increased from 199 kwh/ha in 2004–05 to 483 kwh/ha in 2015–16. The power sector in Uttar Pradesh suffers from high transmission and distribution losses, which amounted to 24.5% in 2015–16. Due to erratic and inadequate power supply to the agriculture sector, most small and marginal farmers depend on diesel pump sets for irrigation. The state government

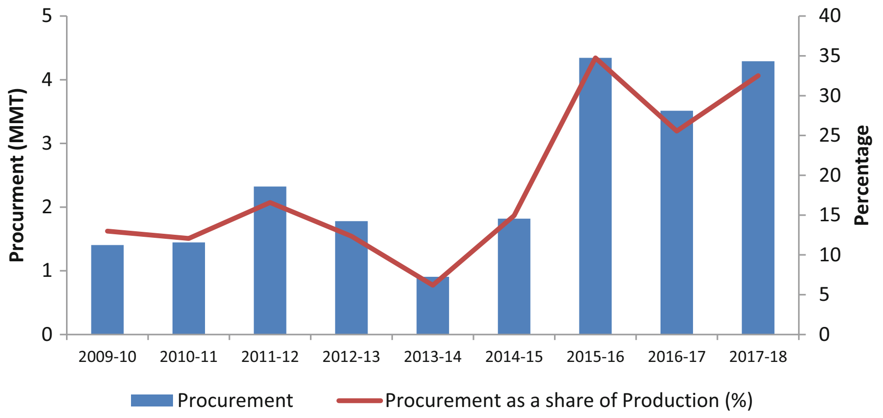

Fig. 7.12 Procurement of Paddy in Uttar Pradesh (2009–10 to 2018–19). *Source* Department of Food and Public Distribution, GoI

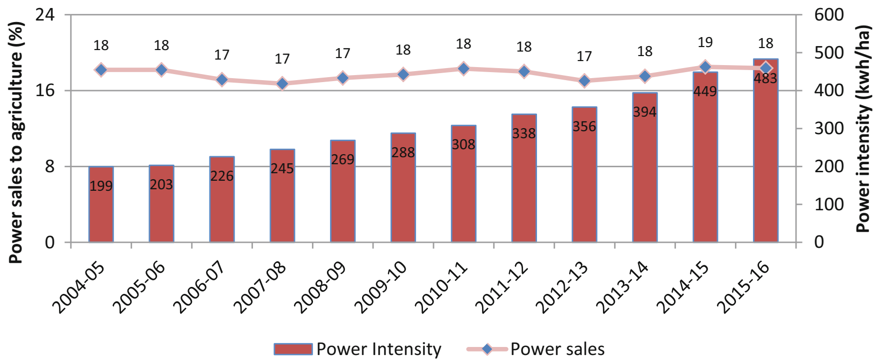

Fig. 7.13 Power sales (%) and Power intensity (kWh/ha) in the agricultural sector (UP), 2004–05 to 2014–15. *Source* Statistical abstract of Uttar Pradesh, various years

needs to address power shortages, which often lead to inadequate irrigation. UP government can improve power supply to the agricultural sector by replacing diesel pumps with solar pumps, especially in the case of small and marginal farmers.

7.4 Sources of Agricultural Growth in Uttar Pradesh

To arrive at the contribution of various sources to agricultural growth, the ratio between the value of output from different segments and the total value of output from agriculture and allied activities (at current prices) has been calculated. To determine the sources of growth, we have deflated the current series of each segment by the

WPI at 2011–12 prices and then decomposed the year-on-year growth in the GVO from agriculture and allied activities by taking the absolute year-on-year difference in GVO from each segment as a proportion of the previous year's GVO from agriculture and allied activities.

Figure 7.14 shows the shares of different sectors in the value of output of agriculture and allied activities for two periods—TE 2002–03 and TE 2015–16. There is a significant decline in the share of food grains in the value of output from agriculture—the share of cereals declined from 30% in TE 2002–03 to 20.6% in TE 2015–16, and that of pulses declined from 4.1 to 2.1%. The share of fruits and vegetables has also declined from 13.8% to 13.4% during this period. The decline in the contribution of these sectors has been picked up by livestock and fisheries. The value of output from the livestock sector has increased from 24.7% to 33% between TE 2002–03 and TE 2015–16, and that of fisheries from 1.0% to 1.2% during this period.

In the 16-year period between 2000–01 and 2015–16, the value of agriculture and allied activities in UP grew at an average annual rate of 5.1% at 2011–12 constant prices. Decomposing this growth into various sectors, the largest share (41.9%)

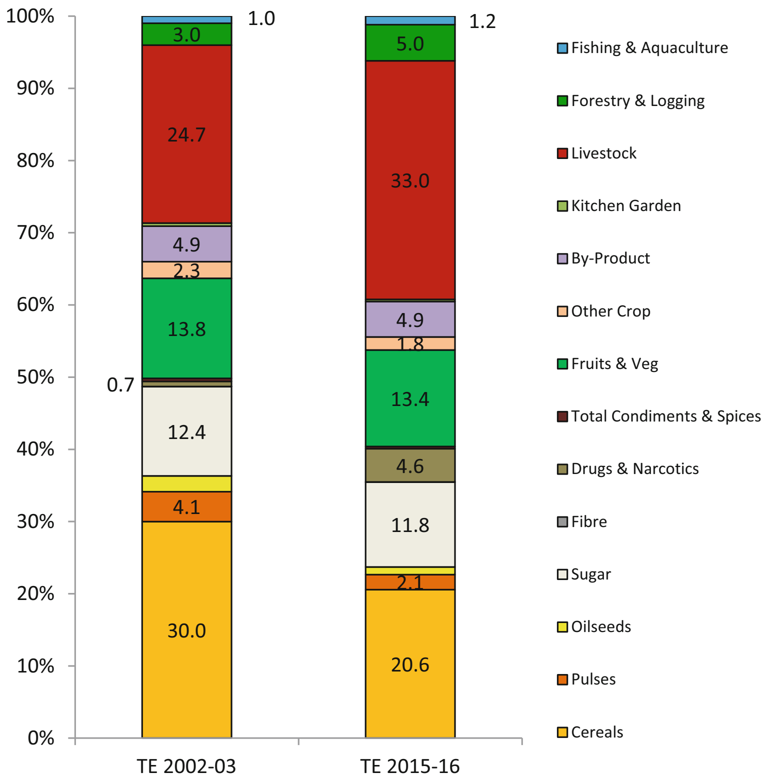

Fig. 7.14 Share of sectors in the value of output of agriculture and allied activities. *Source* Calculated by authors using CSO data

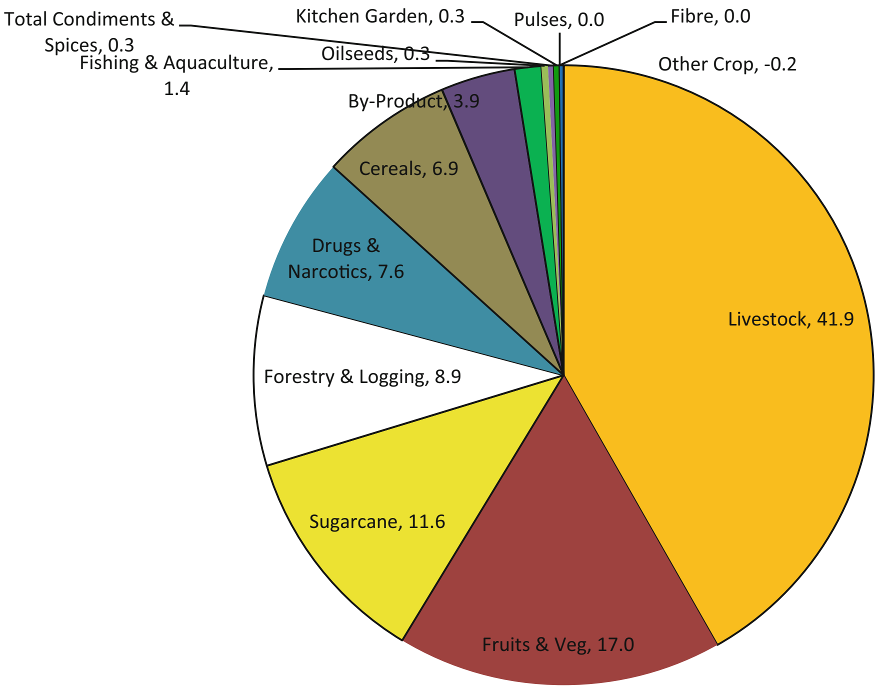

Fig. 7.15 Shares of sectors in average annual growth of value of output of agriculture and allied activities between 2000–01 and 2015–16. *Source* Calculated by authors using CSO data

comes from the livestock sector, followed by fruits and vegetables (17%). Sugar contributes 11% of the value of agriculture and allied activities—almost all of it coming from sugarcane and *gur*. Forestry is the next most important contributor (8.9%), followed by drugs and narcotics (7.6%) cereals (6.9%) and fisheries (1.4%). Oilseeds contribute a meagre 0.3% to agricultural growth. Within the livestock sector, milk has the highest share in agricultural growth followed by meat (Fig. 7.15).

Within UP, there is wide regional variation in the value of output from agriculture and allied activities. The Western region contributed 49.6% of the total value of output from agriculture and allied activities, followed by the eastern region (27.7%), central region (17.2%) and Bundelkhand (5.5%) in TE 2015–16 (Fig. 7.16). In the western region, most of the value of output was from livestock (34%), followed by cereals (16%) and sugarcane (15%). In the eastern region, livestock and cereals together contribute 62% of the total value of output. In the central region, livestock accounts for 27%, followed by cereals (22%) and sugarcane (16%). In the Bundelkhand region, which is the lowest contributor to UP's agriculture, livestock and cereals contribute about 46% to the value of output from agriculture and allied activities(Fig. 7.17). Thus, most of the value of output in agriculture in UP comes from the livestock, cereals and sugarcane sectors.

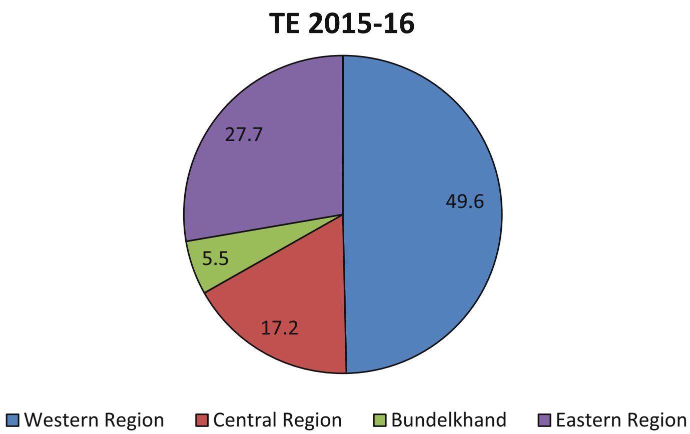

Fig. 7.16 Region wise contribution in value of output from agriculture and allied activities. *Source* Economics and Statistics Division, State Planning Institute, Planning Department, GoUP

7.4.1 Food Grains

Food grains are an important source of agricultural growth in UP, contributing 7.2% to agricultural growth between 2001–02 and 2015–16. The state is the largest producer of foodgrains in the country, producing 17% of the total produce and accounting for 15.8% of the total area under food grains in TE 2015–16. Wheat is the most important crop in UP, covering 31.5% of the total area (9.7 mha) under wheat in the country and contributing 28.1% of the total production (26 million tonnes) in TE 2015–16. However, its yield is 3113 kg/ha lower than the all-India average of 3200 kg/ha. Rice is the second most important crop, contributing 12% of the total produce and covering 13.5% of the total area under rice cultivation in TE 2015–16. UP is one of the few states in the country that recorded an increase in the production of coarse cereals from 3.7 million tonnes in 2012–13 to 3.9 million tonnes in 2016–17. Its productivity is higher at 1947 kg/ha in 2016–17 against the all India average of 1750 kg/ha. Thus, despite being a high producer of foodgrains, the state is grappling with the issue of low productivity.

7.4.2 Fruits and Vegetables

With its varied agro-climatic zones, UP is able to produce a wide variety of horticultural crops. These include fruits, vegetables, flowers, medicinal plants, mushrooms, honey and spices and so on. In 12th five-year plan, special emphasis was given to the development of horticulture in UP. It was envisaged that an increase in production and productivity will not only result in additional income for farmers but will also provide them with better nutrition.

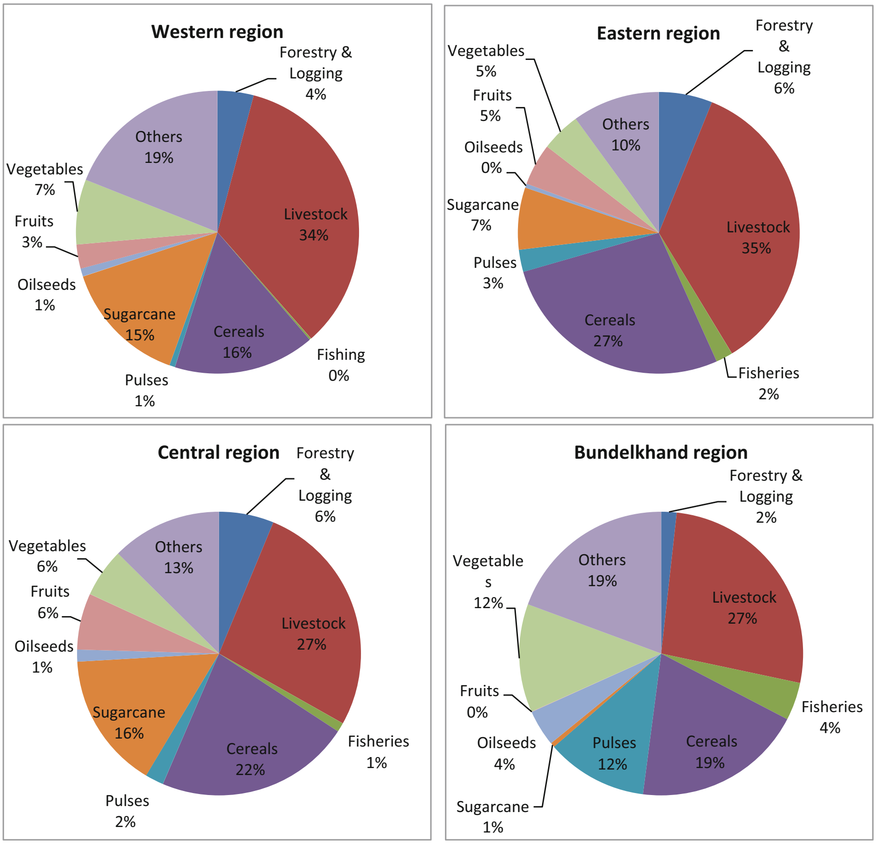

Fig. 7.17 Value of output from agriculture and allied activities in TE 2015–16: regionwise. *Source* Adapted from an upcoming ICRIER study of the performance of agriculture in Uttar Pradesh: district wise analysis

UP is the third-largest producer of fruits in the country with 11.2% (10.35 MMT) of total fruit production in 2016–17. The state is the largest producer of vegetables, accounting for 13.6% of the all-India area under vegetables. UP produced 15.1% (26.4 MMT) of the country's total vegetable production in the same year. Fruits and vegetables together contributed 17% to overall growth in agriculture in UP between 2000–2001 and 2015–16. However, the share of fruits and vegetables in the value of agricultural output has declined marginally from 13.8% in TE 2001–02 to 13.4% in TE 2015–16. UP is the largest producer of mango, guava, muskmelon and watermelon among fruits, and potato, peas and bottle gourd among vegetables.

Potato is the major horticultural crop in UP. In 2016–17, UP produced 15.54 million tonnes of potato, which was 31.9% of India's production. UP has created large infrastructure for cold storage. It has 31.6% of the total cold storages that account for 42.8% of the total capacity (Task Force on Cold Chain, MoFPI). Based on current consumption patterns, a 2015 study done by NABCONS estimated that 10.56 million tonnes of bulk cold storages, 1.09 lakh tonnes of hub cold storages, 72,945 tonnes of onion storage and 10,691 tonnes of ripening chambers will be required in UP (NCCD—All India Cold Chain Infrastructure Capacity—Assessment of Status Gap, 2015).

In March 2017, potato prices in UP crashed to Rs. 200–250 per quintal, forcing farmers to dump potatoes on the streets. Many farmers did not lift their potato stored in cold storage. On April 11, 2017, the state government announced a plan to procure one lakh tonnes of potato at Rs. 487 per quintal but there were problems of quality specifications and ultimately, only 13,000 kg of potatoes were procured. By December 2017, cold storages started dumping potato on the streets and fields.

Although UP is the largest producer of potatoes, there are only a few processing units in the state. UP produces the table variety of potato while processable varieties (*kufri, chipsona* I and II, *Rosetta* and *Santana*) are not produced in large quantities. In 2014, the UP government announced *Aaloo Vikas Neeti* for seeds of varieties of potato that can be used by food processing industry. Under the scheme, a grant of Rs. 10,000 per hectare was to be given to farmers on a first come first serve basis in identified districts.

Mango is the major fruit produced in UP. The state produces the best of succulent varieties—*dussehri, chausa, langda.* The productivity of mango in UP at 17.14MT/ha is almost twice the all-India average of 8.71 MT/ha. UP contributed the largest share of the value of output from mango at the all-India level, accounting for 22.8% in 2015–16. In 2016–17, India exported 52,761 tonnes of mangoes (valued Rs. 443.66 crore) but mango exports from UP were negligible. The value chain for the export of mango varieties produced in UP has not been developed and the grading facilities developed by UP *Mandi Parishad* near Lucknow remain grossly underutilised. For the export of mango to the USA, registration of orchards with pack houses and irradiation at minimum absorbed dosage of 400 GRAYS is mandatory. Interventions similar to those taken in grapes in Maharashtra are needed for mangoes, if UP has to emerge as a significant exporter of mangoes. In the case of grapes, the Government of Maharashtra and ICAR have set up a comprehensive system of traceability and testing of grapes. In 1997, ICAR set up a national research centre for grapes at Pune. In 2016–17, India exported 2.32 lakh tonnes of grapes and earned foreign exchange of USD 314.11 million.

Banana has also emerged as a major fruit crop in the state and its production has gone up from 1.9 MMT in 2014–15 to 3.1 MMT in 2016–17.

7.4.3 Sugarcane

UP is the largest producer of sugarcane in the country and it plays a critical role in UP's economy, especially in Western UP. The area under sugarcane is largely irrigated. There has been a decline the area under sugarcane from 22.47 lakh hectare in 2006–07 to 21.6 lakh hectare in TE 2016–17. The yield of sugarcane in UP was 59.6

tonne/ha in 2006–07; this increased to 64.7 tonne/ha by TE 2016–17. The recovery rate of sugar from sugarcane has almost always been lower than that in Maharashtra. In 2006–07, the average recovery rate in UP was 9.47% while it was 11.39% in Maharashtra. The recovery rate of sugarcane in UP has risen to 10.61% while that in Maharashtra was still 11.34v in 2016–17.

In 2006–07, sugar production in UP was only 84.8 lakh tonnes; this increased to 119.2 lakh tonnes in 2017–18. The increase in production, productivity and recovery of sugar from sugar cane is attributed to the development of a new variety of sugarcane—Co-0238—by Dr Bakshi Ram of the sugarcane breeding institute, Karnal. The variety gives a yield of 80 tonnes per hectare, which is about 10 tonnes higher than the yield of CoS 767, CoSe 92423 and other varieties that were grown in UP until recently. In 2017–18, the area under this variety reached 12.08 lakh hectares, which is 52.6% of total cane area in UP.

The processing of cane and payment of sugarcane price continue to be major challenges for any government in UP. The FRP (Fair and Remunerative Price) for 2017–18 was Rs. 255 per quintal, based on a recovery rate of 9.5%. Every increase in recovery of sugar by 0.1% increases the FRP by Rs. 2.68 per quintal. For a long time, the Government of UP has been declaring a SAP (state advised price) for sugarcane, which is higher than the FRP. The following figure (Fig. 7.18) shows the FRP and SAP price of sugar.

The announcement of SAP has remained a sore issue between sugar mill owners and farmers. Since the SAP is not linked to the market price of sugar, mill owners keep complaining that they are unable to pay the SAP to farmers for many years as their realisation from sugar was not enough. For the 2018–19 season, the UP government has retained the SAP at Rs. 315 per quintal although farmers were demanding Rs. 340 per quintal.

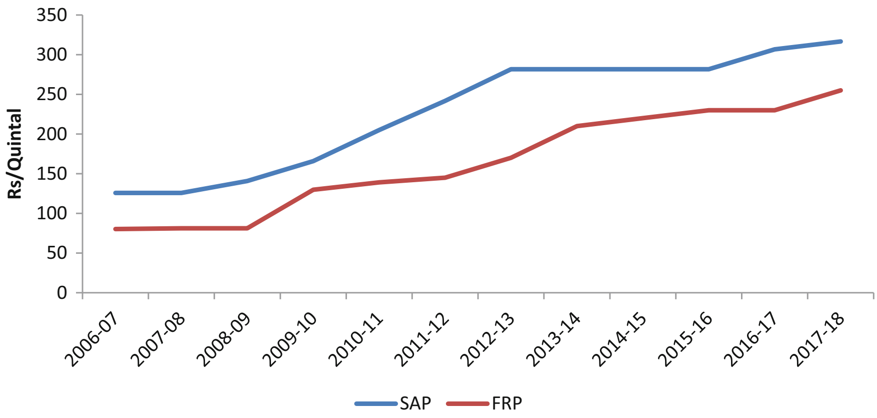

Fig. 7.18 FRP and SAP for sugarcane in UP. *Source* CACP Sugarcane Reports

7.4.4 Livestock

The entire livestock sector in UP registered a high rate of growth between 2001–02 and 2015–16. Milk contributed the most to agricultural growth followed by meat. Other livestock products such as wool, skin, eggs, etc., made small contributions to agricultural growth.

UP faces a shortage of green as well as dry fodder since the area under fodder (8.78 lakh hectares) has remained almost stagnant. Therefore, animals largely eat agricultural crop residues.

The poultry sector in UP has not witnessed the fast growth observed in the milk sector and UP has to import about one crore eggs and 972 lakh broilers every day from other states including AP, Haryana and Punjab (Annual Plan Document 2016–17, Government of UP).

Goat rearing is another major occupation of the poorer sections of UP's rural population. There are 155.85 lakh goats, which are mostly reared for meat.

Livestock is a major occupation for small and marginal farmers who combine it with growing crops. It is mostly women who are engaged in the care and management of livestock. The development of the livestock sector, therefore, can help reduce poverty and add to the income of farmers. Male buffalo calves are not nurtured by farmers to save on milk and the cost of feeding. If slaughter of buffaloes is not discouraged, it is quite possible that farmers will rear male calves for the production of meat, adding to their income.

NABARD launched a scheme for salvaging and rearing of male calves under which loan and interest subsidy were available for financing and rearing of male calves. However, the scheme did not take off and the cumulative sanctions until November 2017 were only Rs. 40 lakh in the entire country.

7.4.5 Milk

UP is the largest producer of milk in the country. In 2016–17, milk production in UP was 27.5 million tonnes, which was 16.8% of India's milk production. About 70% of milk produced in UP comes from buffaloes. The processing of milk in the organised sector in UP is only 12% while the all-India average is 17% and that of Gujarat, 49%. UP announced a milk policy in January 2018 that proposed increasing the processing of milk in the organised sector to 30%. The policy objectives include an increase in the production of processed milk and milk products, remunerative prices to dairy farmers, increase in their income and improvement in infrastructure to attract private investment. It also aims to create awareness about the quality of milk and milk products and develop marketing and research & development in the milk sector.

In order to attract investment, the policy provides a 25% subsidy (with a cap of Rs. 50 lakh) for the establishment, expansion and modernisation of milk processing units to be given on a first-come, first-serve basis. Further, the policy provides for interest subsidy to tiny and small milk processing units for loans taken for plant and machinery, civil works, etc. The entire interest paid by such units can be claimed as subsidy. For other milk processing units, interest subsidy of 7% can be claimed for five years with a cap of Rs. 50 lakh per year. The impact of this policy will be known only after a few years.

The co-operative sector in UP has not been doing very well. The Pradeshik Co-operative Dairy Federation (PCDF) has seen a decline in the number of village dairy co-operatives from 16,856 in 2006–07 to 7255 in 2015–16. Farmers' membership in the village dairy co-operatives (VDCs) has also come down from 5.9 lakh in 2006–07 to 3.1 lakh in 2015–16. The PCDF has been incurring huge losses.

The biggest challenge to the dairy sector in UP is the widespread adulteration of milk. In a Public Interest Litigation (PIL) petition in the Supreme Court, the UP government's food safety assistant commissioner himself admitted (India Today: Drink milk from UP at your own risk, January 30, 2014) that out of 4503 samples collected between January 2012 and May 2013, 1280 samples were found adulterated with detergent, starch, carbohydrates and whitener.[2]

Setting up of modern milk processing plants can help UP shed this image of being at the centre of milk adulteration. In recent years, UP has been able to attract a number of dairy projects in the private sector. MoFPI has sanctioned grants to six dairy projects in UP under its cold chain scheme. NABARD recently sanctioned projects of Rs. 766 crore to set up eight new milk processing units. In addition, NABARD is funding the refurbishment of four existing milk processing units. However, the reach of the co-operative sector is quite limited and the state needs to aggressively pursue private investment in the dairy sector.

In the last few years, the Gujarat Co-operative Milk Marketing Federation (GCMMF), the owner of brand Amul, has entered UP through the Banas Dairy Co-operative. It has already commissioned milk processing units at Lucknow and Kanpur with a capacity of 5 lakh litres per day. GCMMF also proposes to increase milk procurement to 20 lakh litres per day by 2021. However, of about 8 crore litres of milk produced per day, PCDF and Amul procure just about 3 lakh litres per day. Even though PCDF is implementing the Rs. 983 crore NABARD-funded expansion project, the co-operative sector is not truly independent of government intervention and there is no stability in the tenure of its chief executive. It is unlikely that PCDF can find the resources to substantially increase procurement of milk by setting up additional processing units. Therefore, investment by the private sector in milk processing is the only way UP can substantially increase the processing of milk in the organised sector.

[2]While disposing of the PIL, the SC (Swami Achyutanand Tirth and others vs. Union of India and others decided on August 5, 2016) directed the union and state governments to implement the FSSAI Act, 2006, in a more effective manner. FSSAI was also directed to identify high-risk areas and times (festivals, etc.) when the risk of adulteration is high.

7.4.6 Meat

In 2014, India became the largest exporter of bovine meat (USD 4.78 billion), higher than the traditional earning from the export of rice (USD 4.5 billion). In the entire country, there are 78 export-oriented abattoirs (as on July 4, 2018) from where buffalo meat is exported. These are registered with APEDA and they have integrated facilities for animals waiting to be slaughtered (lairage), stunning, slaughter lines, dehiding, washing, deboning, chilling, blast freezing and packaging. Of these, UP has 42 export-oriented integrated abattoirs with processing units. All these projects are in the private sector and they exported 67% of India's buffalo meat from UP.[3]

In the last three years, several cases of violence against cattle traders have been reported from UP. The production of buffalo meat in UP decreased from 14.17 lakh tonnes in 2015–16 to 13.46 lakh tonnes in 2016–17. Restrictions on the transportation of animals are likely to affect the income of small and marginal farmers due to the lower market price for animals because of the fear of violence during transportation. It is also likely that due to the closure of municipal abattoirs, small meat shops may be slaughtering animals in residential localities, thus causing the pollution of drains. It is necessary that the state government invests in the modernisation of municipal abattoirs so that the local population can get clean and hygienic meat and the pollution of drains and rivers is minimised. In fact, there is a need to ensure that even poultry slaughtering is done in approved municipal abattoirs.

Another option for the state government is to invite private investment in the public-private partnership mode under which private investors are invited to invest in the modernisation and upgradation of municipal abattoirs. Under this model, the private investor is allowed to use one shift of the abattoir for export while another shift is used for local consumption. In UP itself, the Bareilly Municipal Corporation modernised its abattoir in the PPP mode at a cost of Rs. 23.62 crore. It has a capacity to slaughter 200 buffaloes and 550 sheep or goat each day. The entire investment in this project has been made by a private investor.

[3]For local consumption of meat, UP's Municipal Corporations Act, 1959 mandates municipal bodies to construct and maintain abattoirs. Most of the municipal abattoirs, however, do not meet the stringent norms of the UP Pollution Control Board. In 2015, the Board identified 129 industrial units as very hazardous for the environment. Of these, there were 44 abattoirs owned by municipal boards. The list included abattoirs in the major cities of UP including Lucknow, Lakhimpur Kheri, Sitapur, Barabanki, Agra, Basti, Mau, Allahabad, Varanasi, Mirzapur, Bareilly, Pilibhit, Shahjahanpur, Bulundshahr, Badaun, and even Aligarh, which has a number of private APEDA-approved abattoirs. All of these municipal abattoirs are closed for slaughtering, some for several years; it is not clear where the animals for local consumption are being slaughtered. While municipal abattoirs have been closed, it seems other polluting units included in the list of 129 notified by UPPCB are still operating. These include paper and pulp, textile and yarn and aluminium smeltering units.

7.4.7 Fisheries

The contribution of fisheries in UP was 1.4% to overall growth in agriculture and allied activities between 2000–01 and 2015–16 and its share in the value of output of agriculture and allied activities has risen significantly from 0.98% in TE 2002–03 to 1.19% in TE 2015–16. Fish production in UP has increased from 28,958 tonnes (4.4% of all-India production) in 2005–06 to 504,808 tonnes (4.7% of all-India production) in 2016–17. The state ranks ninth in fish production in the country.

Uttar Pradesh has a vast area of freshwater resources in terms of a network of rivers and canals, flood plain wetlands, reservoirs, ponds and tanks that can be used for fishery. Some of the challenges faced by Uttar Pradesh may be attributed to non-availability of quality fish seeds, feed, non-scientific fish farming practices and low subsidy for fish farming that is limited to only a few selected species.

7.5 Drivers of Agriculture Growth

The performance of the agricultural sector in any state is influenced by a host of supply-side factors such as the use of inputs (irrigation, power, agricultural-credit) in farming operation, price incentives and infrastructure facilities. In this section, we make an attempt to find out the drivers of agricultural growth in UP through a simple econometric model. In this study, we have used irrigation as representative of the inputs used in agriculture, terms of trade between agriculture and industry and surfaced road density for infrastructure. The model shows that GSDPA shows a significant and positive correlation with these three variables.

The function is defined as:

$$Y_t = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots \tag{1}$$

Here, X_1 is irrigation ratio; X_2 is surfaced road density; and X_3 is terms-of-trade between agriculture and industry.

In our model, the logarithmic value of GSDPA is the dependent variable and the log values of the variables mentioned above are the independent variables. The equation has been estimated using data from 2001–02 to 2014–15. We have run the model with different variables and have presented only those variables that have a significant effect on agricultural GDP (Tables 7.2 and 7.3).

The results from the model show that (i) irrigation (ii) terms of trade and (iii) surfaced road density, have a positive and statistically significant impact on gross domestic product from agriculture and allied activities. Model 1 shows that a one per cent increase in the irrigation ratio increases UP's agricultural GSDP by 2.38%, while a one per cent increase in terms of trade increases agricultural GSDP in the state by about 0.25%. Similarly, Model 2 shows that a one per cent increase in TOT

Table 7.2 Variables and definitions used for the model

Variable	Definition
Ln_GSDPA	GSDPA is the log of gross domestic product from agriculture and allied activities (2011–12 prices)
Ln_IRR	Log of ratio of gross irrigated area (GIA) to gross cropped area (GCA)
Ln_TOT	Log of the ratio of the GDP deflator for agriculture and industry in UP
Ln_SRD	Log of surfaced road length per thousand square kilometer of area

Table 7.3 Regression results for determining drivers of agricultural growth in UP between 2000–01 and 2014–15

	Model 1	Model 2
Constant	6.28 (4.51)***	15.47 (145.53)***
Ln_IRR	2.38 (7.36)***	
Ln_TOT	0.25 (2.6)**	0.25 (3.43)***
Ln_SRD		0.17 (10.07)***
R-squared	0.89	0.93
Adjusted R-squared	0.87	0.92
Number of observations	15	15

Note ***Significant at 1% level (p-value < 0.01); **significant at 5% level (p-value < 0.05); *significant at 10% level (p-value < 0.1)

increases UP's agricultural GSDP by 0.25% and a one per cent increase in surfaced road density increases agricultural GSDP by about 0.17%.

7.6 Assessment of Budgetary Allocation to Agriculture and Allied Activities

The allocation of budgetary expenditure on agriculture has a significant impact on poverty alleviation. Results from a modelling exercise comparing investments and input subsidies in agriculture reveal that the marginal returns in terms of the number of people brought out of poverty from investments in R&E, roads, education and irrigation outweigh the benefits from input subsidies in power, fertiliser and irrigation (Gulati and Terway upoming paper). In this section, we make an attempt to analyse how resources are allocated in this state and how well these expenditures are aligned with growth in various agricultural sub-sectors.

We have analysed the budgetary expenditure of the three latest financial years—FY 2015–16 (Actual), FY 2016–17 (RE) and FY 2017–18 (BE) (Fig. 7.20). The broad allocation under the agriculture and allied activities for TE 2017–18 is shown in

Fig. 7.19. It shows that food grains (35%) accounted for the highest share followed by animal husbandry and dairy development (25.6%) and fisheries (11.7%) in TE 2017–18 (Fig. 7.19). Within crop husbandry, most of the resources have been allocated for farmers' extension and training (24.4%), followed by food grains (21.3%) and crop insurance (18.1%) (Fig. 7.21). The government had announced loan waivers to small and marginal farmers and had allocated Rs. 32,400 crore for this purpose in 2017–18. This forms the largest chunk of expenditure under crop husbandry and if this figure is combined with the total budget under this segment, it takes away 88% of the total budgetary allocation. Thus, there is a clear diversion of resources away from long-term investments towards ad hoc policies such as loan waivers.

This section discusses both expenditure in agriculture (cereals, fibre, oilseeds, fruits and vegetables, livestock and fisheries) and expenditure on agricultural infrastructure(road, irrigation, research and education, extension and training) from the state budget documents (Fig. 7.19).

Livestock is the largest contributor in the gross value added in agriculture comprising 33% of the value of output in TE 2015–16 and it makes up to about 25.7% in the total budgetary allocation in TE 2017–18. UP is the largest producer of milk in the country, contributing 16.8% of India's total milk production. However, the total allocation of dairy development has decreased from Rs. 388 crore in 2015–16 to Rs. 269 crore in 2018–19. Several new programmes, such as *Nand Baba Puraskar*, establishment of the Dairy Development Fund and setting up several plants with loan from NABARD to increase processing capacity in the state have been initiated by the state government in 2018–19 to enhance the milk sector of UP. The allocation towards animal health and veterinary services has more than doubled from Rs. 64

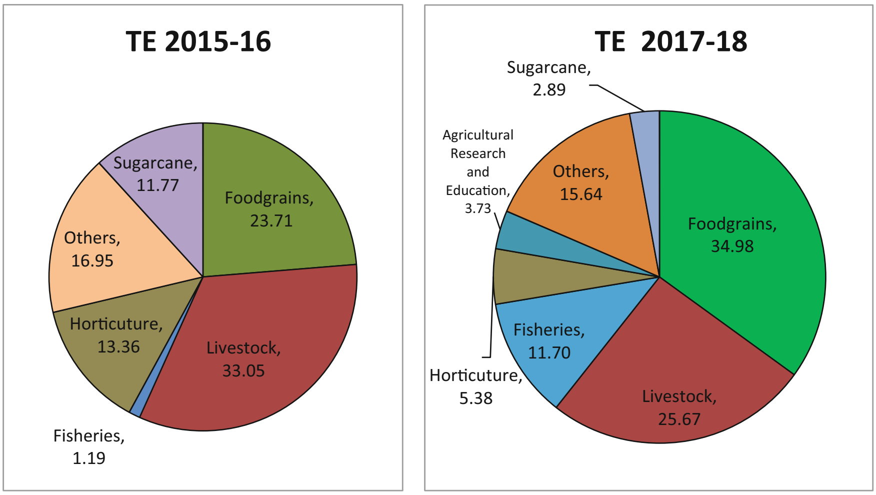

Fig. 7.19 Alignment of agricultural budget with GVO in agriculture and allied activities. *Source* Agriculture Department, Uttar Pradesh

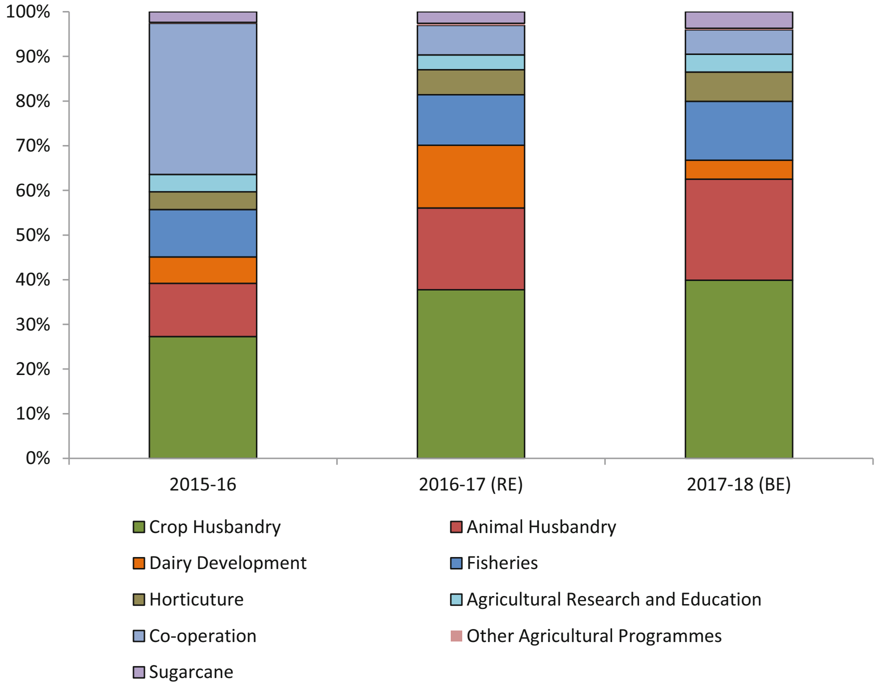

Fig. 7.20 Allocation to broad heads as a share of total allocation to agriculture and allied activities. *Source* Agriculture Department, Uttar Pradesh

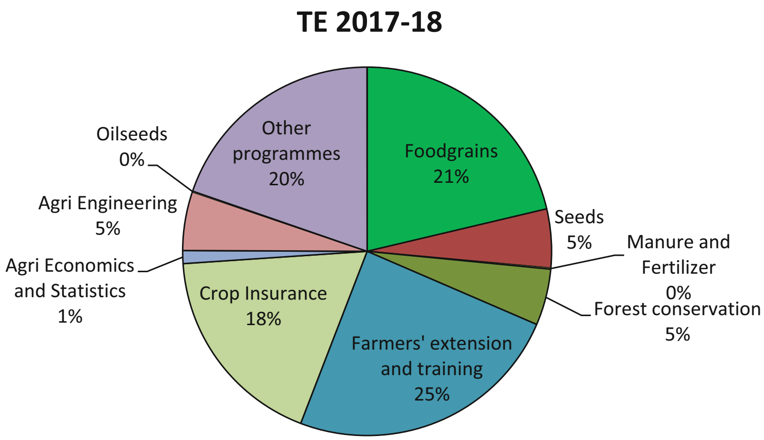

Fig. 7.21 Allocation to broad heads as a share of total allocation to crop husbandry in TE 2018–19. *Source* Agriculture Department, Uttar Pradesh

crore in 2015–16 to Rs. 143 crore in 2017–18. The government has also promised to set up one processing plant in every four districts of the state.

The food grains sector makes up 23.7% of the value of output from agriculture and allied activities and accounts for 34.5% of the total budgetary allocation (Fig. 7.19).

Fruits and vegetables contribute 13.4% in the GVOA but expenditure on the sub-sector is only 5.4% of the total expenditure incurred on agriculture and allied activities. Taking into account the importance of horticulture in augmenting farmers' income, the state government has taken steps like expansion of area, rejuvenation of old mango, guava and *amla* orchards, production of quality planting material, post-harvest management, etc. Various schemes such as the Integrated Mission for Development of Horticulture, establishment of drip/sprinkler irrigation system, National Mission on Medicinal Plants, development of horticulture in schedule caste/tribe areas, *Rashtriya Krishi Vikas Yojana* and *Sampada* scheme of Ministry of Food Processing are also being implemented by the state government. Despite the emphasis on the development of horticulture, the share of total expenditure on horticulture is less than 10% of the total budgetary outlay. Thus, given the huge opportunity and benefits that farmers could reap from the horticulture sector, there is a need to increase the budgetary allocation under this head.

Sugarcane contributes 11.8% of the GVOA in agriculture whereas the budgetary allocation for sugarcane farmers is just about 3%. The state government provides resources for sugarcane development for farmers as well as for roads and bridges for the transportation of sugarcane from farms to millers. It also provides resources for farmers' research and education, crop development and loans for reviving the sugarcane industry. The state government needs to further invest in cane development by promoting sustainable practices and efficient transportation of sugar cane to sugar mills. Expansion of area under drip irrigation is necessary to ensure the sustainability of the crop in western UP.

Expenditure on fisheries is 11.7% of total budget outlay as compared to its contribution of 1.2% in GVOA. Given the vast water resources in the state, the fisheries sector must be explored by dedicating resources to procure good quality seeds and better farming practices.

UP has one of the highest irrigation ratios (80%) in the country and it stands next to only Punjab and Haryana. Expenditure on major, medium, minor irrigation and flood control accounted for Rs. 11,990 crore in FY 2017–18. Four projects in UP have been identified under AIBP and they have the potential to bring up to 814,000 hectares of additional area under irrigation.

7.7 Conclusion and Policy Recommendations

Uttar Pradesh (UP) is largely an agrarian economy, dominated by small and marginal farmers and engaging about 47% of the population in agriculture. It is largest in terms of size and one of the largest states in terms of area. It has nine agro-climatic zones. There is a wide variation in the value of output from agriculture and allied activities from the various regions of the state. The western zone contributed 49.6% of the total value of output from agriculture and allied activities, followed by the eastern region (27.7%), central region (17.2%) and Bundelkhand (5.5%) in TE 2015–16. The cropping pattern is dominated by foodgrains, although its share in the value of production is decreasing. Livestock is a major contributor to the growth in agriculture experienced by UP over the years. UP is a major producer of horticultural produce such as potato, pea, mango, watermelon, *amla*, etc. Although it accounts for a large proportion of food grain production, the state lags behind in terms of agricultural productivity. Besides, farmers end up receiving low prices for their produce and this implies low income from farming activities.

The regression analysis conducted for UP shows that agricultural growth is positively and significantly associated with the irrigation ratio, road density and terms of trade between agriculture and industry. UP has performed well both in irrigation coverage as well as roads.

Agriculture remains at the forefront of any discussion on the economic scene in UP but there are only a few policy interventions actively promoted by the state government. For most of the last ten years, the state government has implemented centrally sponsored schemes, be it the National Food Security Mission or the *Rashtriya Krishi Vikas Yojana* or the National Horticulture Mission.

Food Grains

One of the perennial problems confronting farmers has been their inability to realise the minimum support prices even for wheat and paddy. The procurement of wheat and rice has fluctuated widely over the years. In 2012–13, 50.62 lakh tonnes of wheat was procured but the very next year, procurement fell to 6.82 lakh tonnes. In 2018–19, 50.87 lakh tonnes of wheat has been procured but it is still to be seen whether this level will endure in the future years. One of the major reasons for such fluctuation is that the arrivals are not meticulously recorded in *mandis*. For instance, the arrival of paddy in *mandis* was 32.37 lakh tonnes between October 2015 and January 2016. It fell the next year to 25.99 lakh tonnes. In 2016–17, it rose to 45.20 lakh tonnes. There are large variations across districts. It means that a substantial quantity of agricultural produce is sold outside the *mandis*. It is possible that small and marginal farmers prefer to sell their produce in the village itself since the cost involved in transporting produce to the *mandis* may make it less remunerative.

Madhya Pradesh has successfully erected an elaborate system for procurement by using information technology in the last ten years. For procurement operations in MP, the crop sown area and production of each farmer are registered. Their mobile numbers are also taken. At the time of procurement, farmers are sent advisories through SMS and they are asked to bring their produce to *mandis* on specified dates. It prevents crowding in *mandis* and enables small farmers to hire tractors for taking their produce to the market.

In 2017–18, UP also started online registration of farmers in the portal set up by the Food Commissioner. After registration, farmers are required to take a copy of the land record (*khatauni*), Aadhar card, the first page of their bank passbook and latest passport size photograph to the procurement centre.

The guidelines for procurement also provide that any farmer can sell his produce at the procurement centre situated in *mandis*, but in the centre located outside *mandis,* farmers of only the village tagged to that centre can offer their produce for procurement. Such a complex procurement system is not conducive for delivering MSP to small and marginal farmers, who would rather sell to village traders than bring their produce to *mandis*.

In any case, farmers growing crops other than wheat and paddy have no recourse to MSP operations. Under the price support scheme and price stabilisation fund, the National Agricultural Cooperative Marketing Federation of India Ltd (NAFED), the Small Farmers' Agri-Business Consortium (SFAC) and the Food Corporation of India (FCI) have been procuring pulses and oilseeds at MSP in various states. Under the price support scheme (PSS), 48.68 lakh tonnes of pulses have been procured in the country in 2016–17 and 2017–18 (up to July 23, 2018). Under the price stabilisation fund, 16.70 lakh tonnes of pulses have been procured. Most of the procurement was in Maharashtra, Karnataka and Madhya Pradesh but UP farmers, especially in Bundelkhand where pulses are predominantly grown, have not benefitted as UP's procurement agencies have not been proactive in undertaking these operations. The marketing infrastructure has been created in Bundelkhand out of the funds received by the state under the Bundelkhand package but actual procurement has not seen much of an upward trend.

e-NAM

Since its launch by the GoI on April 14, 2016, e-NAM has provided an opportunity to farmers to sell their produce in any *mandi* in states that are integrated under eNAM. UP already meets the three conditions for joining eNAM platform, i.e. provision for e-trading in *mandi* regulations, single-point levy of market fee and unified licence for trading in the state. Out of 1.1 crore farmers registered across India, about 29 lakh farmers are from UP alone. Out of the 585 markets linked to the platform, 100 are from UP alone. The actual progress of auctions through eNAM and the benefit flowing to farmers in the form of better prices, however, is not known. Auctioning through the eNAM platform can bring transparency to *mandi* operations as the bids quoted by commission agents will then be known to the farmer, who will decide what price is acceptable to him. It can address the problems of collusion in *mandi* operations.

Milk

India is the largest producer of milk in the world. In 2016–17, India produced 165.4 million tonnes of milk, of which UP contributed 27 million tonnes, which is the highest in the country. However, the milk trade in UP is dominated by the unorganised sector and only 12% of milk is processed by the organised sector.

UP has a poor reputation for the quality of milk and the media carries reports of adulteration from time to time. The FSSAI conducted a national milk quality survey in 2018 under which 6432 samples were analysed in the whole country. About 10%

of the samples were found adulterated with contaminants that made milk unsafe for human consumption. This could be due to deliberate adulteration as well as poor quality of feed, unregulated use of antibiotics and poor farm practices. The FSSAI has not released state-wise data of adulteration and safety but in the public mind, milk supplied in UP is associated with deliberate adulteration. The major task for the UP government is to organise regular analysis of samples and take strict action against adulteration. Adulteration of milk with pesticides, antibiotics and veterinary drugs shakes the confidence of public in the use of an important commodity like milk, which is consumed largely by children. A number of such events of failure to meet the safety norms of the FSSAI could be due to lack of knowledge among farmers, who may be using unsafe practices resulting in adulteration. Procurement of milk by the organised sector can improve these practices and testing of milk at collection centres needs to substantially improve.

In the last two years, due to a slump in the global prices of SMP, milk prices have fallen in India too and UP farmers have also been adversely affected. They get just about Rs. 18–20 per litre of milk while in Gujarat and Maharashtra, farmers are being paid Rs. 25 per litre, which includes a subsidy of Rs. 5 per litre promised by the state government. Banas Dairy, a member of Gujarat Co-operative Milk Marketing Federation that owns the Amul brand, has set up two processing units of 5 lakh tonnes/day at Kanpur and Lucknow, and is likely to provide a fillip to milk processing in the state. By raising the standard of processing and providing better prices to farmers, the private sector may find UP an attractive destination for investment in milk processing. NABARD has sanctioned a project of Rs. 1225.01 crore to PCDF to set up eight new diary plants and refurbish four others in the state. UP has taken a loan of Rs. 983.22 crore from NABARD under Rural Infrastructure Development Fund (RIDF). The new processing plants under this project will add a daily capacity of 16 lakh litres. Timely implementation of this project will add to the milk processing capacity in the co-operative sector. The state government must provide stable leadership to the PCDF by appointing a professional as its chief executive officer.

Fisheries

The development of inland fisheries can provide additional rural employment through aquaculture. As fish is a source of high-quality protein, the government would do well to promote the development of fisheries to address the challenge of malnutrition in the state. This can be achieved by leasing all major rural ponds to fishermen communities. For the production of quality fish seed, it may be appropriate for the government to incentivise the private sector. There is a case for privatisation of government-run fish seed farms as they have not been able to run optimally and 48 of them have been closed.

The state government already has a scheme of providing 30% grant to mobile fish parlours but the budget allocation is very meagre (Rs. 16.50 lakh in 2016–17 for ten such parlours). The main objective of the scheme is to provide hygienically prepared fish in large urban centres in UP. The demand for inland fish can easily be given a fillip by aggressively promoting the consumption of fish and fish products in cities and towns.

Horticulture

With its varied climate and large population, UP is both the source of production and market for horticulture crops. The state government has actively participated in the national horticulture mission and the production of fruits and vegetables has increased substantially in the last ten years. The state came out with a potato policy in 2014 and a food processing policy in 2013 and 2017.

The state government provides 25% subsidy of up to Rs. 25 lakh on plant and machinery and civil works for the expansion and modernisation of food processing units. Under the *Pradhan Mantri Kisan Sampada Yojana* of the MoFPI, an additional capital subsidy of 10% is also available for fruit and vegetable processing. An interest subsidy of up to Rs. 2.50 crore in a five-year period is also available. If the promises made in the policy are actually fulfilled and the food processing industry is invited to UP to invest in processing, the level of processing can increase and the horticulture sector can get a boost.

Pricing of Sugarcane

Payment of sugarcane price remains an important issue in the agricultural economy in UP. Every few years, sugar prices collapse and sugar mills start defaulting on payments to farmers. On October 29, 2018, the farmers were yet to be paid Rs. 7649 crore of cane dues, which was 21.57% of the total SAP of Rs. 35,463 crore. Cane price for 2018–19 is yet to be declared and the UP Sugar Mills Association has gone to the high court against any increase in SAP.

The Rangarajan Committee on Sugar (2012) made several recommendations to address the problem of sugarcane dues. First, it recommended that over a period of time, states should encourage contractual arrangements between mills and farmers for sugarcane. It will result in phasing out of cane reservation area[4] and bonding of farmers with sugar mills. Farmers would then be able to decide the mill to which they want to sell their sugarcane. The second recommendation of the committee was that the current norm of a minimum radial distance of 15 km between two sugar mills should be abolished. It was expected that this would ensure a better price for farmers and the mills would be forced to pay cane dues on time. The third recommendation was the sharing of revenue created in the sugarcane production chain in the ratio of 70:30 between cane growers and sugar mills. This ratio was also to apply to primary by-products of sugar. Mills would pay FRP to farmers in the first instalment and the balance of cane dues will depend on the final price of sugar realised by sugar mills. The fourth recommendation was the abolition of levy sugar quota and the system of monthly quota release by the Ministry of Food and Public Distribution, GoI. Lastly, the committee recommended that all restrictions on the sale of by-products and prices may be removed.

If the recommendation on payment of cane dues was accepted by GoUP, the situation in UP would have been as follows (see Table 7.4).

[4]The government has specified a cane reservation area under which farmers have to sell their produce to particular sugar mill and the mill has to buy sugarcane from these farmers only.

Table 7.4 Recommended sugarcane prices in comparison with SAP and FRP (Rangarajan Committee)

			(Price in Rs. per tonne)	
Year	Average sugar price	FRP@ 9.5% recovery	75% of sugar price	SAP in UP
2013–14	3001	2100	2251	2800
2014–15	2564	2200	1923	2800
2015–16	3174	2300	2380	2800
2016–17	3364	2300	2523	3050
2017–18	3076	2550	2307	3150

Source Calculated by authors' from ISMA; CACP Sugarcane Reports

It may be observed that in years of low sugar prices, even the FRP cannot be paid by sugar mills as it will be higher than 75% of sugar prices. For meeting such situations, the sugar development fund has to be augmented in years of high prices of sugar. Since the recovery of sugar cane has increased in UP, the farmers would have to be paid a higher price if the Rangarajan formula had been accepted. In certain years (2017–18 for example), the payment by sugar mills under this formula would be lower than FRP. In such a situation, the state government would have to come forward and pay the difference between FRP and price derived from the Rangarajan formula.

Molasses

In the new molasses policy of 2017–18 notified on January 27, 2018, the reservation of molasses for liquor has been reduced from 25% to 12% and mills are now required to maintain a ratio of 1:7.3 for the sale of molasses to the liquor industry and in the open market. Due to record-high production of sugar, the price of molasses crashed from Rs. 800 per tonne in October 2017 to about Rs. 1 per tonne in June 2018. The sale of molasses by sugar mills outside the state of UP is also tightly regulated by state governments and sugar mills are required to seek permission for the sale of molasses from excise commissioner on a case-to-case basis. The state government must take action soon and reduce these restrictions so that fair prices could be realised by both farmers and millers.

Ethanol

In May 2018, the GoI announced a national policy on biofuels. The policy permits manufacture of ethanol from sugarcane, corn, bagasse, etc. The sugar industry has also been permitted to manufacture ethanol directly from sugarcane juice.

Oil marketing companies have already started blending gasoline with up to 5% ethanol in twenty notified states and four union territories. For the sugar year 2017–18, 313 crore litres of ethanol was required to blend petrol with 10% of ethanol. To meet the target of 20% blending by 2030, India needs 1000 crore litres of ethanol. UP is in a position to take the lead in producing ethanol to meet this requirement. Now that the GoI has permitted direct manufacturing of ethanol from sugarcane juice, it is necessary to promote the establishment of ethanol manufacturing units by sugar mills that do not yet have the facility.

Improving Irrigation facilities
There is wide regional variation in the irrigation coverage among various regions of the state. While the western, central and eastern zones have made satisfactory progress in irrigation, Bundelkhand lags behind with less than half (48%) coverage under irrigation. Farmers in water-scarce regions like Bundelkhand and western UP should be encouraged to adopt drip irrigation and watershed-based programmes to ensure better utilisation of available water.

Annexure

Sugar sector was delicensed in 1989 and wide-ranging economic reforms were initiated by the central government in 1991. However, control over the sector continues. The condition of a minimum radial distance of 15 km between sugar mills continues to this day. The decontrol of levy sugar has come down in instalments from 45% in 1990s to 10% by March 2002. It was abolished by the UPA Government for two years in December 2014.

To attract investment in the sugar sector, the Government of UP announced the Sugar Industry Promotion Policy on August 24, 2004. The following attractive incentives were extended for fresh investment in sugar mills:

(a) Ten per cent capital subsidy.
(b) Reimbursement of transportation charges from factory up to 600 km from the UP border.
(c) Reimbursement of additional cost of transporting cane from collection centres to sugar mills.
(d) Waiver of stamp duty and registration charges on purchase of land.
(e) Reimbursement of cane society commission.
(f) Exemption of entry tax on sugar.
(g) Reimbursement of trade tax on molasses
(h) Reimbursement of administrative charges on molasses

These incentives were available for five years for any sugar mill having an investment of up to Rs. 350 crore. For investment up to Rs. 500 crore, the incentives were to be made available for ten years. Sugar mills were supposed to start production by March 2007. This period was later extended until March 31, 2008 vide an order dated November 14, 2006.

The policy was subsequently amended by an order dated December 17, 2004, through which it was clarified that the total amount of rebate/remission would not exceed the investment made during the period for which the benefit was granted. Therefore, the rebate or remission was only made to help entrepreneurs recoup their investment.

Table 7.5 Number of sugar mills in different regions of UP

Region	Private sector	Public sector	Co-operative sector	Total
East UP	33		5	38
West UP	24	1	6	31
Central UP	35		13	48

Source Handbook of sugar statistics, 2015–16, ISMA

Until the 1980s, UP had just 34 sugar mills—27 co-operatives, 6 state-owned and just one in the private sector (Palia Kalan of Bajaj Hindustan). As a result of the policy, by March 2016, UP had 117 sugar mills—48 in central UP, 38 in east UP and 31 in west UP (Table 7.5). The installed capacity in UP increased to 84.52 lakh tonnes in the private sector, 2.38 lakh tonnes in the public sector and 7.78 lakh tonnes in the co-operative sector. UP's total capacity reached 94.68 lakh tonnes but that still is lower than Maharashtra's capacity of 109.65 lakh tonnes.

As a result of the implementation of Sugar Industry Promotion Policy, 2004, 38 new sugar mills were set up in UP. Of these, 12 were in the backward region of east UP, 17 were in central UP and only 9 were in western UP.

Molasses

A number of by-products are obtained from the processing of sugarcane. From every 100 tonnes of sugarcane, a mill produces 10 tonnes of sugar, 30 tonnes of bagasse and 4.5 tonnes of molasses. Bagasse is used by mills to generate steam while molasses can be sold to the liquor or chemical industry or they can be used to manufacture ethanol.

The Government of UP exercises a great deal of control over molasses and there are frequent changes in the policy on molasses. Table 7.6 shows the changes in the

Table 7.6 Reservation of molasses for country liquor

Year	Reservation of molasses for country liquor (per cent)	Ratio of dispatch (reserved: free)
2013–14	20	1:9
2014–15	15	1:5.66
2015–16	25	1:3
2016–17	20	1:4
2017–18	12	1:7.3

Source Handbook of Sugar Statistics, ISMA
Note The ratio of dispatch (reserved: free) is a ratio that is mandated under the year's Molasses Policy. A ratio of 1:7.3 for example means that for every unit of reserved (for liquor) molasses, a mill can sell 7.3 units in the free market

last five years:

In the 2014–15 excise policy, notified on January 16, 2015, 15% of molasses was reserved for the production of liquor. On an annual basis, the mills were required to maintain a ratio of 1:5.66 so that about 20% of molasses could be sold to the liquor industry. At that time, sugar mills were realising just about 16% of the open market price of molasses from sales to the liquor industry. The support to the liquor industry was justified by the state government on account of its large contribution to revenues from excise duty. In 2018–19, the state projected an income of Rs. 9738.81 crore from country liquor, license fee for manufacturing country liquor, etc.

Ethanol

Ethanol contains oxygen, enables more efficient combustion of gasoline and causes lower emissions. The Ethanol Blending Programme was launched by the GoI in January 2003 to supply 5% ethanol-blended petrol. UP is the largest producer of ethanol. One crore litres of E10 ethanol saves Rs. 28 crore of foreign exchange at current market rates (May 2018, USD 1 equals Rs. 67.435). The government had fixed an indicative target of 20% blending of biofuels when it was made mandatory in October 2008. In May 2018, the GoI announced a national policy on biofuels. The policy permits the manufacture of ethanol from sugarcane, corn, bagasse, etc. The sugar industry has also been permitted to manufacture ethanol directly from sugarcane juice.

Oil marketing companies have already started blending gasoline with up to 5% ethanol in all twenty notified states and four union territories. For the sugar year 2017–18, 313 crore litres of ethanol is required to blend petrol with 10% ethanol. In the 2017–18 season (December to November), sugar companies and ethanol manufacturers offered approximately 160–165 crore litres of ethanol to oil marketing companies (OMCs) of which OMCs have finalised the purchase of 158.7 crore litres at a basic price of Rs. 40.85 per litre of ethanol. Of this, UP will supply 44.3 crore litre followed by Maharashtra, which will supply 40.3 crore litre. Thus, UP is likely to achieve around 9.6% of ethanol blending with petrol while Maharashtra will achieve approximately 8.6% ethanol blending by November 2018.

References

Agriculture Census. (2010–11). *All India report on number and area of operational holdings.* Department of Agriculture, Co-Operation & Farmers Welfare Ministry of Agriculture & Farmers Welfare, Government of India.

Agricultural Statistics at a Glance. (2015). New Delhi: Ministry of Agriculture and Farmers' Welfare.

CACP. (2016). *Price Policy for Rabi Crops - The Marketing Season 2017–18* . Ministry of Agriculture and Farmers' Welfare, Department of Agriculture, Cooperation and Farmers' Welfare. New Delhi: Commission for Agricultural Costs and Prices.

CAG. (2016). *Report of the comptroller and auditor general of India on performance audit of Pradhan Mantri Gram Sadak Yojna*. Union Government (Civil), Ministry of Rural Development, Indian Audit and Accounts Department, New Delhi.

Census. (2011). *Census of India*. Retrieved May 2019, from Registrar General of India, Ministry of Home Affairs, Government of India.

Dairy India. (2017). New Delhi: Dairy India Yearbook.

DESA, U. (2015). *World population prospects: key findings and advance tables* . United Nations, Department of Economic and Social Affairs, Population Division. New York: United Nations.

Fan, S., Gulati, A., & Thorat, S. (2008). Investment, subsidies, and pro-poor growth in rural India. *The Journal of the International Association of Agricultural Economists*, *39*(2), 163–170.

Government of Uttar Pradesh (GoUP). (Various years). *District development indicators* . Lucknow: Economics and Statistics Division, State Planning Institute Planning Department.

Ground-Water Yearbook. (2013–14). Faridabad: Central Ground-Water Board, Ministry of Water Resources.

Gulati, A., & Hussain, S. (2017, February 13). Can UP farmers expect a better deal? *The Financial Express*.

Gulati, A., Manchanda, S., & Kacker, R. (2016, September). *Harvesting solar power in India*. ZEF Working Paper 152. Bonn, Germany: ZEF Centre for Development Research.

Gulati, A., & Terway, P. (Upcoming Paper). *Investment and subsidies and their impact on agricultural growth and poverty reduction*. ICRIER.

Gulati, A., & Verma, S. (2017, March 27). Cow, culture and agriculture in UP. *The Financial Express*.

Horticultural Statistics at a Glance. (2015). New Delhi: Ministry of Agriculture and Farmers' Welfare.

Labour Bureau. (2016). *Report on fifth annual employment-unemployment survey 2015–16 volume I*. Ministry of Labour and Employment, Government of India. Chandigarh: Labour Bureau.

NABARD. (2018). *NABARD All India Rural Financial Inclusion Survey (NAFIS) 2016–17* . Mumbai: National Bank for Agriculture and Rural Development.

Water and Related Statistics. (2015). New Delhi: Central Water Commission.

World Development Report - Agriculture for Development. (2008). Washington, DC: The World Bank

Websites

http://agcensus.nic.in/
http://www.agricoop.nic.in/
http://eands.dacnet.nic.in/
http://mospi.nic.in/
http://morth.nic.in/
http://www.censusindia.gov.in/
http://www.eaindustry.nic.in/
http://agmarknet.gov.in/
http://animalhusb.up.nic.in/
http://planning.up.nic.in/
http://www.nddb.org/
http://nhb.gov.in/Default.aspx
http://dahd.nic.in/
http://agriculture.up.nic.in/
http://www.worldbank.org/
http://paragmilkup.in/index.aspx
http://www.cwc.nic.in/

Chapter 8
Sources and Drivers of Agricultural Growth in Bihar

Anwarul Hoda, Ashok Gulati, Shyma Jose, and Pallavi Rajkhowa

8.1 Introduction

Agriculture dominates Bihar's economy, providing employment to 53.6% of the total workforce, higher than the national average of 46.9% (Labour Bureau 2015–16). A high proportion of the population (88.5%) lives in rural areas. The share of agriculture and allied activities in gross state domestic product has declined from 34.9% in the triennium ending (TE) 2003–04 to 20.0% in TE 2017–18 (at constant prices 2011–12). The gross state domestic product (GSDP) of Bihar grew at 3.1% for the period from 2001–02 to 2017–18. The growth even at this modest rate has reduced poverty, which declined from 54.4% in 2004–05 to 33.7% in 2011–12. However, the state still has a high prevalence of poverty. In 2015–16, the average income of a farming household in the state was Rs. 7175 per month against the national average of Rs. 8931 per month, indicating the dismal agricultural scenario in the state (NABARD 2018). Small and marginal farmers account for 96.9% of the landholdings and 75.9% of Bihar's cultivated area (Agriculture Census 2015–16).

Bihar has three agro-climatic zones, north-west, north-east and south, and all three are suitable for agricultural diversification. The state is endowed with abundant natural resources, fertile soil and groundwater. The distinct agro-climatic zones give the state a congenial environment for the cultivation of a variety of commercial crops, vegetables and fruits. The state has also started growing flowers on a large scale for both the domestic and export markets. The state was awarded the *Krishi*

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Karman Award for rice production in the year 2013 and for maize production in 2016. However, constraints like the high density of rural population and year-to-year variation in rainfall have increased the volatility in agricultural growth and proved to be an obstacle to agricultural diversification. Against this background, this study examines the sources and drivers of agricultural growth and recommends policy initiatives to enhance agricultural growth as well as farm income.

In this chapter, we focus on the performance of the agricultural sector in the state of Bihar by identifying the sources of growth as well as the role of existing policies. Section 8.2 discusses the overview of agriculture in the state of Bihar. Section 8.3 discusses the composition and the sources of growth of agriculture. Section 8.4 presents the drivers of agricultural growth. Section 8.5 presents an assessment of the budgetary allocations to agricultural and allied activities. Section 8.6 draws the conclusion and policy recommendations.

8.2 Overview and Composition of the Agriculture Sector

Bihar has a geographical area of 93.60 lakh ha, which is divided by the river Ganges into two parts, north Bihar and south Bihar. The gross sown area in Bihar was around 75.72 lakh ha and the gross irrigated area was around 52.68 lakh ha in 2015–16. The cropping intensity in the state has increased from 1.37 in 2009–10 to 1.45 in 2014–15. Bihar has around 122.2 million (2019) people, accounting for about 8.8% of India's population. Based on the soil characteristics, rainfall, temperature and terrain, the state has been divided into three distinct agro-climatic zones: north–west (agro-climatic zone I), north-east (agro-climatic zone II) and south (agro-climatic zone III) (see Fig. 8.1). In the north-west zone (13 districts), the soil type is mostly sandy loam; in the north-east zone (8 districts), it is loam or clay loam and in the South Zone (17 districts) it is mostly sandy loam, loam, clay or clay loam.

There are wide climatic variations in the three zones in Bihar. The north-east zone receives the highest rainfall ranging between 1200 and 1700 mm, the southern part the least, ranging between 900 and 1300 mm and the north-west an average of 1040–1450 mm. Although the annual rainfall appears sufficient on the average for agricultural operations, the year-to-year variations result in both floods and droughts in different years (Fig. 8.2a, b). The state experienced floods in 2001, 2002, 2003, 2004, 2007, 2008, 2013, 2016 and 2017, but it was declared drought-affected in the years 2005, 2007, 2009, 2010 and 2012, with more than 20% deficiency in rainfall. According to the Water Resource Department, around 76% of the population in northern Bihar is subject to floods whereas southern Bihar is prone to severe drought.

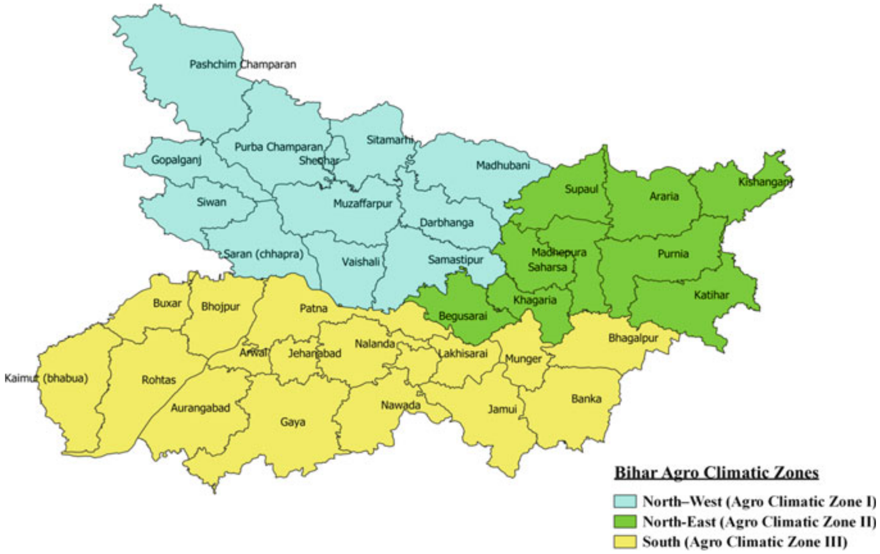


Fig. 8.1 Agro-climatic zones in Bihar. *Source* Created using QGIS from Government of Bihar's Data

8.2.1 Agricultural Growth Trend in Bihar

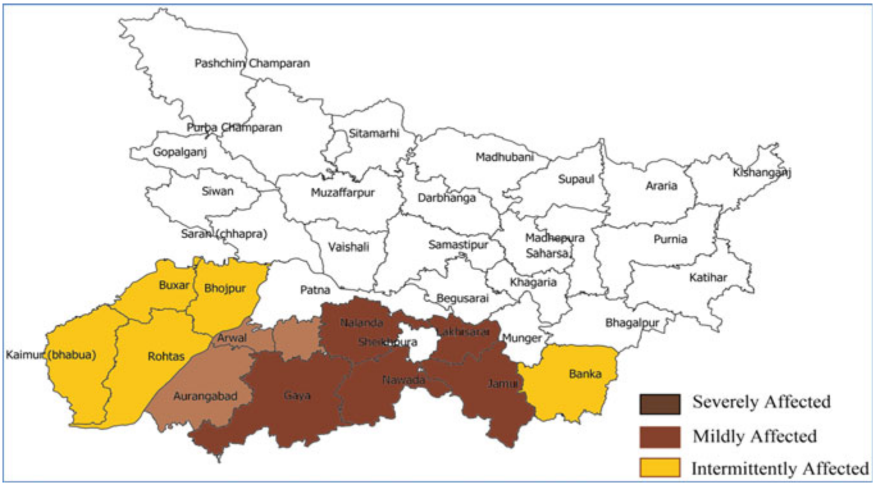
The agricultural growth rate in Bihar was 3.1%, slightly lower than the all-India agricultural growth rate of 3.4% during the period from 2001–02 to 2017–18 (at constant 2011–12 prices). Agricultural growth in Bihar has been very volatile in these years as can been seen in Fig. 8.3. The volatility is the result of recurring floods alternating with droughts. The years in which contraction has occurred are those in which the state experienced either floods or droughts.

8.2.2 Land Utilisation in Bihar

The agricultural sector in the state is dominated by small and marginal farmers. According to the Agricultural Census (2015–16), marginal farmers (those with land-holding size of less than 1 ha) accounted for 91.21% of the holdings and 57.73% of the area. Small farmers (with 1–2 ha) constituted 5.75% of the holding and cultivated 18.25% of the area. As Table 8.1 shows, the trend towards fragmentation seems to have slowed down in the last five years.

The high density of rural population is the major factor leading to fragmentation of holdings in the state. Arable land is scarce in Bihar with the gross cropped area per 100 persons only at 7.4 ha as compared to 32.6 ha in Madhya Pradesh, 28.3 ha in Punjab and 20.9 ha in Gujarat in TE 2014–15 (see Fig. 8.4).

a. Drought-prone regions



b. Flood-prone regions

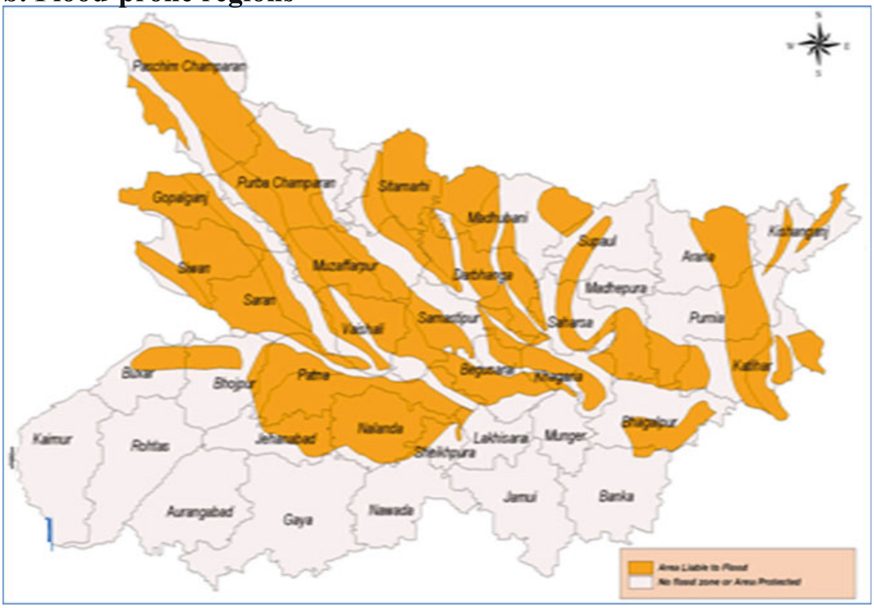


Fig. 8.2 Drought and Flood prone regions in Bihar. **a** Drought-prone regions. *Source* Created using QGIS from NIDM and UNDP. **b** Flood-prone regions. *Source* NIDM and UNDP

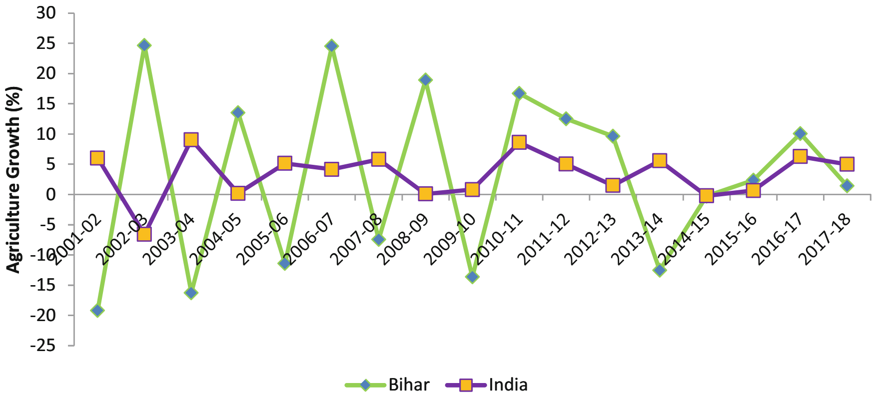


Fig. 8.3 Agricultural growth in Bihar (2001–02 to 2017–18). *Source* Government of India, Central Statistical Organisation

8.2.3 Cropping Pattern in Bihar

Cereals dominate the state's agriculture. In TE 2015–16, the cereal production accounted for as much as 79.8% of the gross cropped area as compared to national average 50.8%. Rice is the dominant *kharif* crop and wheat, the most important *rabi* crop. Maize has been rising in importance, with acreage under it increasing. From Fig. 8.5, it can be seen that the share of acreage under rice has declined while that under wheat and maize has increased. Both the decline in the acreage under rice and the increase in acreage under wheat and maize are more pronounced in the state than at the national level. Other features of the changing cropping pattern in Bihar are an expansion of acreage under maize, a decline in the acreage under pulses and an increase in the acreage under sugarcane.

8.2.4 Determinants of Agriculture Growth

Apart from good infrastructure, agriculture needs timely supply of adequate quantities and quality of agricultural inputs, crop insurance, price incentives, agricultural marketing and storage facilities to promote agricultural productivity and growth.

Agricultural Inputs in Crop Production

Seeds

During the past ten years, Bihar has implemented an ambitious seed programme comprising a subsidy for the production and purchase of certified seeds, a revival of previously dormant Bihar *Rajya Beej Nigam* (BRBM), strengthening of Bihar's seed certification agency and multiplication of foundation and breeder seeds by state

Table 8.1 Distribution of operational holdings in Bihar, 2000–01, 2010–11 and 2015–16

Land holding	2000–01			2010–11			2015–16		
	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)
Marginal	43.09	84.18	0.3	57.44	91.06	0.25	57.73	91.21	0.25
Small	19.20	9.23	1.21	18.56	5.86	1.25	18.25	5.75	1.25
Semi Medium	22.88	5.09	2.62	16.80	2.56	2.59	16.66	2.52	2.60
Medium	12.76	1.42	5.24	6.50	0.50	5.09	6.67	0.50	5.29
Large	2.07	0.08	15.5	0.71	0.02	14.45	0.69	0.02	14.48
All	100	100	0.58	100.00	100.00	0.39	100.00	100.00	0.39

Source Agricultural census 2000–01, 2010–11 and 2015–16

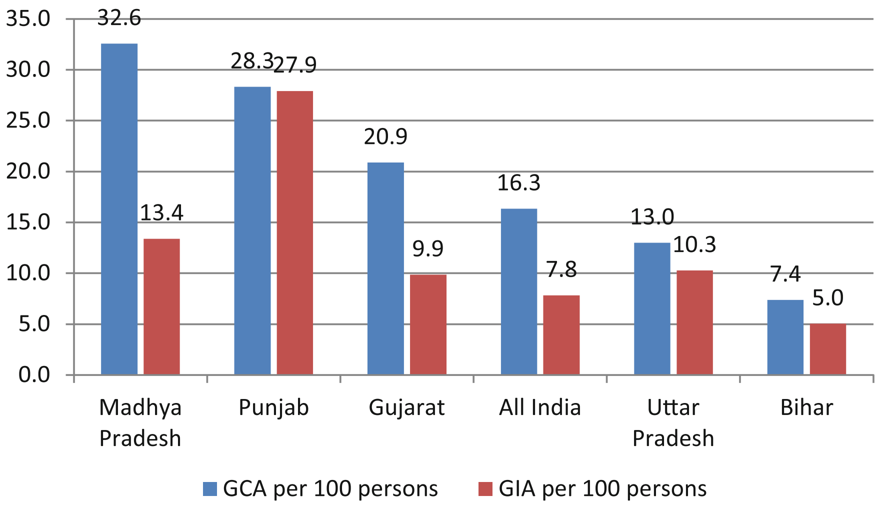


Fig. 8.4 GCA and GIA per 100 persons (in ha) TE 2014–15. *Source* Directorate of Economic and Statistics, GoI

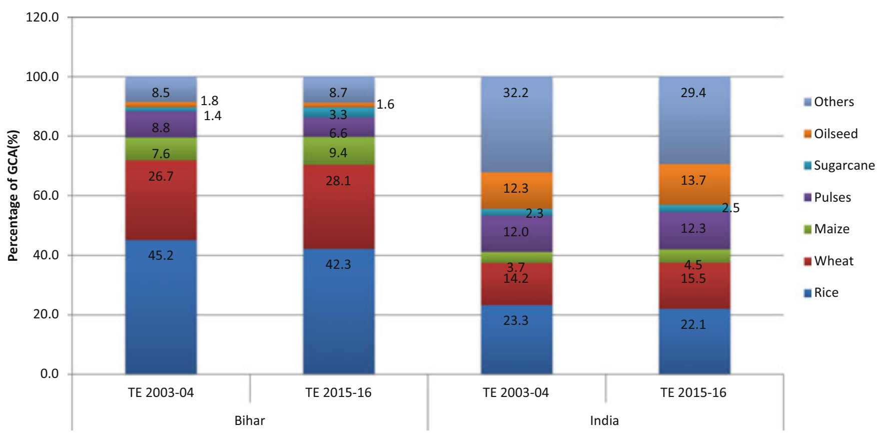


Fig. 8.5 Area under major crops in Bihar (percentage of gross cropped area). *Source* Directorate of Economic and Statistics, GoI

farms. In the early 2000s, the productivity of major crops was depressed by low seed replacement rates (SRR) in major crops like paddy and wheat. Due to a sustained effort by the state government, the SRR has registered considerable improvement over the last 15 years or so. The SRR for paddy has increased from 10.0% in 2004–05 to 42.8% in 2016–17 and for wheat, from 9.0 to 20.3% over the same period (Fig. 8.6). The most impressive improvement has been in the case of winter maize,

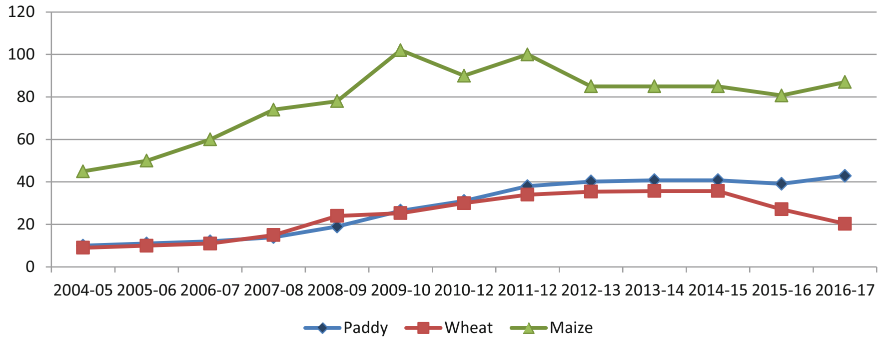


Fig. 8.6 Seed Replacement Rate Wheat, Paddy and Maize in Bihar (%). *Source* Department of agriculture, GOB. *Note* Data for maize includes only *rabi* maize

where the SRR has risen from 45.0 to 87.0% over this period. In fact, Bihar's SRR for maize is now far higher than the all-India average of 64.7%.

Fertiliser

Data available from the state government show that the consumption of fertilisers per hectare in the state has been consistently above the national average during the last ten years (Fig. 8.7). In 2015–16, the consumption in Bihar was around 201 kg/ha while the national average was 130.7 kg/ha. However, the data provided by the Directorate of Economics and Statistics (DES) shows that wheat cultivation in

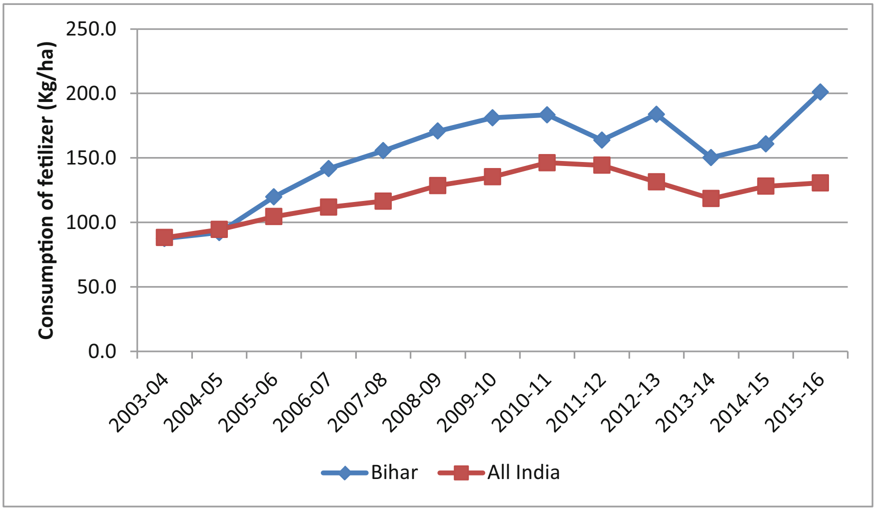


Fig. 8.7 Consumption of fertilisers in Bihar. *Source* Department of Agriculture Bihar, several issues of the Economic Survey of Bihar and Agriculture Statistics at a Glance, several issues

Bihar required 125 kg/ha while paddy required 97 kg/ha in 2012–13. This discrepancy in fertiliser consumption data provided by DES raises the question of whether subsidised fertilisers are being diverted to neighbouring countries (Gulati 2016).

The discussion above highlights how low productivity in Bihar is not due to low utilisation of productivity augmenting inputs. In fact, the state's farmers have been investing heavily in assets such as quality seeds, fertilisers and farm machines. This increasing investment in agricultural inputs has taken place even though the state lags behind the national average in the disbursement of agricultural credit from institutional sources. What is impeding the disbursement of institutional credit is the slow pace of implementation of the *Kisan* Credit Card (KCC), which leaves a large number of farmers dependent on high-cost, non-institutional lending sources. The total number of KCCs issued by banks in Bihar (scheduled commercial banks, regional rural banks and central co-operative banks) has been declining over the last few years. The achievement percentage against total targets for all banks was 71.6% in 2013–14, which declined to 35.5% in 2017–18. The absence of updated records of applicants could be a reason for the lower achievement against a reduced target in 2017–18.

As land records have not been updated, and the land ownership act as collateral security to avail of institutional credit, the scheduled commercial banks, regional rural banks and central co-operative banks recorded slow growth of agricultural credit. However, the state is seized of the problem and is taking action to update its records. As soon as progress is made on this front, it will be possible for farmers to access more agriculture credit for purposes such as mechanisation and the expansion of crop and livestock production.

Crop Insurance

The world over, governments are increasingly relying on crop insurance to support agriculture. In India, the *Pradhan Mantri Fasal Bima Yojana* (PMFBY) was implemented in 2016. Dissatisfied with its experience after the PMFBY was implemented, Bihar introduced its own crop insurance scheme—Bihar State Crop Assistance Scheme (*Bihar Rajya Fasal Sahayata Yojana*). In the *Pradhan Mantri Fasal Bima Yojana*, the centre and state each had to pay 49% of the premium amount while the farmer had to pay only 2% of the premium amount. Under the state's crop assistance scheme, the registered farmer will not be charged any premium but can avail of the benefits when they suffer crop damage due to natural calamities. Under this scheme, the state government will provide Rs. 7500 per ha as assistance for up to two hectares to registered farmers if their crop is less than 20% of a threshold production limit (Vajpayee 2018). This scheme will increase the fiscal burden on the state government as a large proportion of the financial resources devoted to the agricultural sector may have to be transferred to this scheme.

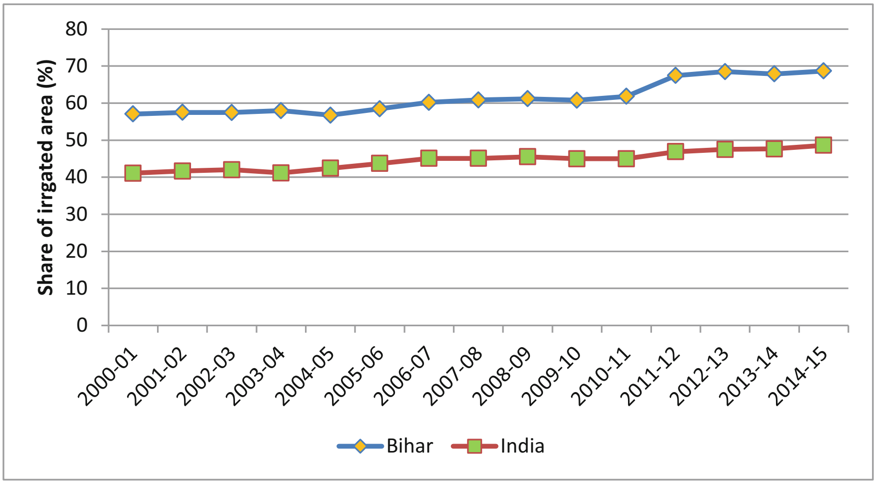


Fig. 8.8 Gross irrigated area as a percentage of gross cropped area. *Source* Directorate of Economics & Statistics, GoI

Infrastructure for Agriculture

Irrigation

We have alluded earlier to the fact that while normal rainfall received by Bihar is sufficient to sustain agriculture, there are spatial and temporal uncertainties surrounding rainfall. As a result, farming in Bihar remains substantially dependent on irrigation. The irrigation ratio (the gross irrigated area as a proportion of the gross cropped area) in Bihar was more favourable (68.7%) as compared to the country as a whole (48.6%) during the period 2001–02 to 2014–15 (Fig. 8.8).

The source wise picture of the evolution of irrigation during the period under consideration in the state is given in Fig. 8.9. Tube wells and canals are the main sources of irrigation in Bihar, contributing around 65.3 and 28.9% of the GIA respectively and there was modest expansion in the number of tube wells and canals during the period between TE 2003–04 and TE 2016–17. However, irrigation from tanks has been shrinking in Bihar as can be seen in Fig. 8.9.

Bihar's ultimate irrigation potential (UIP) stands at 117.54 lakh ha, of which 53.53 lakh ha can be irrigated through major and medium projects and 64.01 lakh ha through minor irrigation (including both flow and lift irrigation) (Fig. 8.10). If this potential is exploited fully, Bihar can more than cover its total cultivable area (62.9 lakh ha in TE 2014–15). As per Central Water Commission (CWC), Bihar had achieved 53.7% of its total irrigation potential from major and medium projects and 59.4% from minor irrigation projects by 2006–07. If we compare these figures to the latest figures given by the Economic Survey of Bihar 2017–18, it appears that the irrigation potential created through major and medium projects up to March 2017 has improved to 55.4%, and through minor irrigation projects to 63.7%. There is

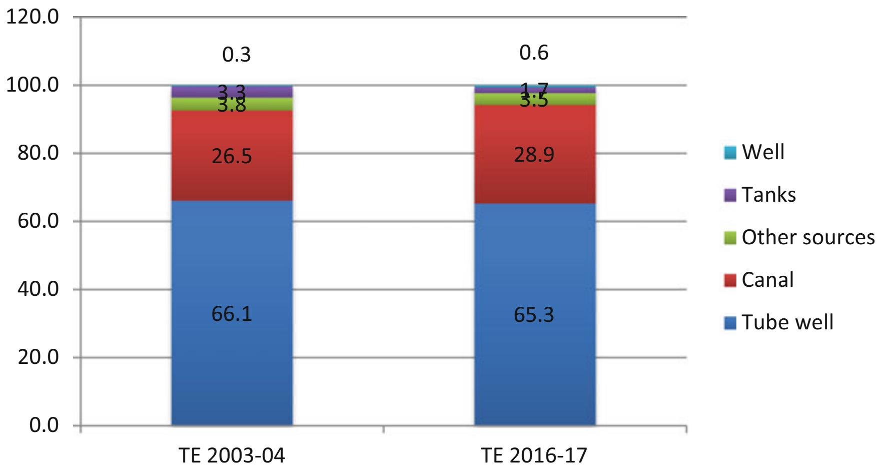


Fig. 8.9 Source-wise Irrigation (per cent of gross irrigated area). *Source* Directorate of Economics and Statistics, GoI

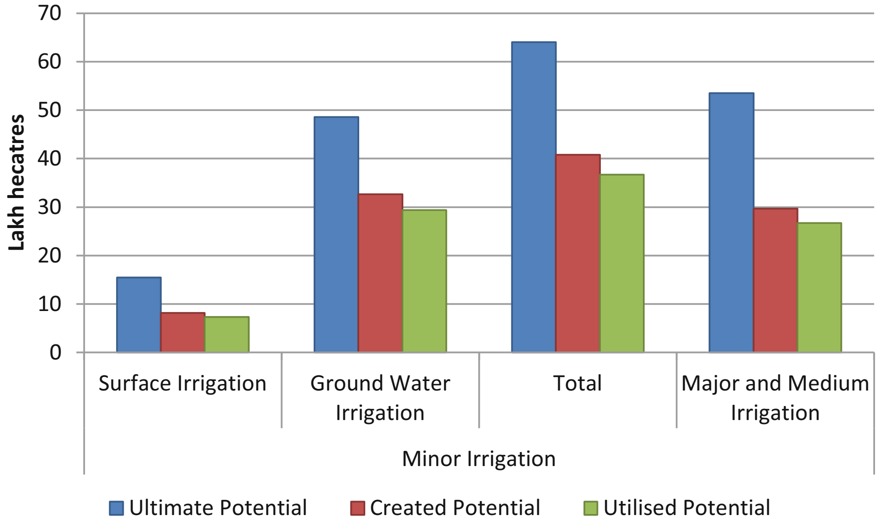


Fig. 8.10 Status of water resources in Bihar (in lakh ha). *Source* Department of Minor Water Resources, GOB. *Note* Potential in lakh ha; created and utilised potential is up to March 2017

still substantial scope to expand surface water irrigation in the state through a major, medium as well as minor flow projects. There is also scope for restoring the irrigation potential, which has been lost due to heavy sedimentation and breaches in irrigation canals (Economic Survey 2014–15). Further, the irrigation potential lost due to the fall in the water table because of prolonged spells of deficient rains needs to be restored by rejuvenating aquifers through watershed projects.

Flood protection

We have already been seen how critically agriculture has been affected by variation in water availability. Construction of embankments has been the main strategy adopted by the state government to contain damage from floods. Up to 2017, a cumulative length of 3789.96 km of embankments had been constructed, protecting an area of 3.6 million ha from floods, which constitutes 52.8% of the flood-affected areas. The Economic Survey 2017–18 mentions that there is a plan for the protection of a further 3.43 lakh ha from flood by the construction of new embankments. There are indications, however, that the state government may be moving away from reliance only on building embankments. The new strategy for flood management adopted by the state government puts more emphasis on rehabilitating pre-existing natural drainage systems to give enough room to rivers to flow.

The limitations of building embankments are well-known. The areas outside the embankments are denied the benefit of the rich alluvial sediments that the river flows bring. Besides, the silt brought by the rivers raises riverbeds. Rainwater gets stuck outside the embankments and river water seeps through the embankments into the countryside. Additionally, embankments restrict the flow of waters from tributaries to the main river. Although sluice gates facilitate the process of directing water from tributaries to the main river during the offseason, during the peak flood season, the sluice gates cannot be opened because of the risk of the main river flowing back into the tributaries.

Further, there is also the risk of breach of embankments, which can create havoc for populations residing close to embankments (Mishra 1999). For these reasons, experts and planners have been looking beyond embankments for a permanent solution to the problem of flooding. In the past, the thinking has been that there is substantial potential for upstream reservoir storage in the Himalayan headwaters, which could be harnessed through large multipurpose dams to provide three benefits, viz., regulate river flows to contain floods, deliver irrigation water and produce hydropower. A recent evaluation of the Ganges Strategic Basin Assessment (SBA) undertaken by the World Bank (Sadoff et al. 2012) in co-operation with several leading research institutions has come to some sobering conclusions. The potential to control floods by providing for upstream storage is limited. There could be benefits from irrigation in the dry season but in Bihar, where the water table is high even in the dry season, such irrigation could cause harm by increasing waterlogging. The SBA confirms the existence of considerable hydropower potential—as much as 40,000 megawatts of economically feasible hydropower potential is believed to exist. But the development of power would be capital intensive and would take several years to implement. The SBA report does not touch upon the environmental aspects, which, according to some authors, make the proposal for the construction of multipurpose dams in the Himalayas a nonstarter because "in the Himalayas, we confront one of the most fragile ecosystems in the world" (Shah 2016).

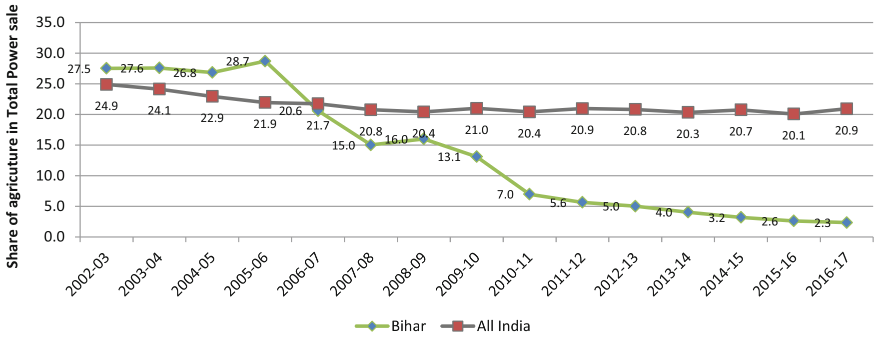


Fig. 8.11 Agriculture share in total power sales. *Source* Central Electricity Authority, various years

Power for Agriculture

An important determinant of development is the availability of adequate, reliable and quality power at a competitive rate but the state is chronically deficient in this regard. In 2013–14, the state generated only 94 MW from its own sources and imported around 2241 MW from other sources. Per capita power consumption in the state is only 256.3 kWh, much lower than the all-India average of 978.1 kWh. Bihar is almost entirely dependent on central sector allocations to meet its energy demand. The availability of ample power supplies from the central grid in recent months has reduced the pressure to increase domestic generation and enabled the government to focus on improving transmission and distribution. However, Bihar has recently made good progress in the renovation of existing units and the construction of new ones and it is expected that, in about a year or two, it will be able to meet from its own generation close to 50% of the power needs of about 3500 MW.

The share of agriculture in total power sales was higher in the state than the all-India average from 2002–03 to 2005–06. But it has fallen sharply since then as can been seen in Fig. 8.11.

The data on power intensity, i.e. the ratio of electricity used per hectare, underscores the extremely low use of electricity by the agricultural sector in Bihar (Fig. 8.12). Total power sales to agriculture per hectare of gross cropped area for TE 2014–15 were 42.7 kWh/ha for Bihar against the all-India level of 790.3 kWh/ha.

The relative position of Bihar as compared to the national average in the rural electrification infrastructure and rural power supply is also mirrored in the progress made over the last decade or so in the energisation of pump sets, whether for tube wells or wells. The number of energised pump sets in Bihar was 34.8 per 1000 ha of gross cropped area in 2000–01; it had only marginally increased to 38.7 per 1000 ha in 2017–18. At the all-India level, the number of energised pump sets increased from 68.2 per 1000 ha in 2000–01 to 108.0 per 1000 ha in 2017–18.

The progressive decline in the quantity and quality of power supplied by power utilities has increased the dependence of farmers in Bihar on diesel tube wells. Further, the increase in diesel prices have increased the cost of irrigation and reduced

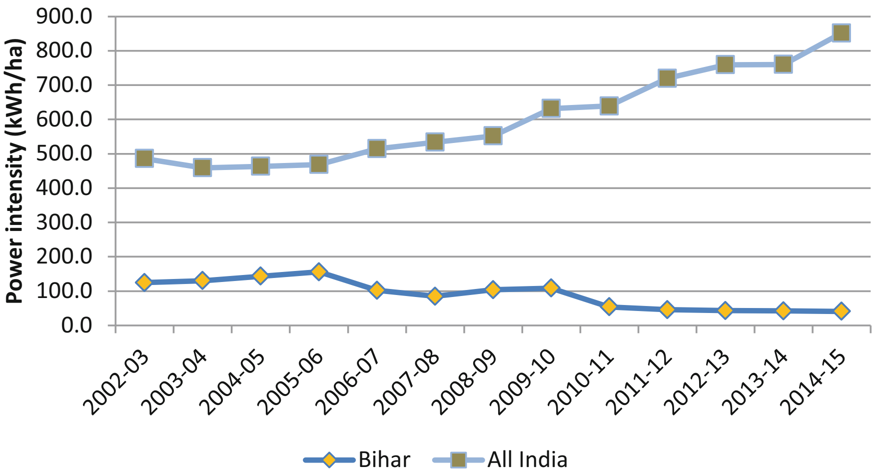


Fig. 8.12 Power intensity (power sales/GCA (KWh/ha), 2002–03 to 2014–15. *Source* Central Electricity Authority and DES, various years

the profitability of farming in Bihar. The poor state of power supplies for irrigation is one of the main reasons for the plentiful supplies of groundwater in the state's aquifers not being fully exploited. Against the ultimate lift irrigation potential of 4.9 million ha, an irrigation potential of only 3.1 million ha has been created. In order to expand coverage and bring down the cost of cultivation, the government has to provide assured supply of power for agriculture by increasing the expenditure on transmission and distribution to rural areas. The low and dwindling use of power in agriculture can be attributed to the weak distribution and transmission infrastructure, which results in interruptions as well as poor quality of supply.

However, with the recent initiatives of the central and state governments, the situation is expected to change dramatically in the next two years. Under the *Deen Dayal Upadhaya Gram Jyoti Yojana*, the Government of India has sanctioned 38 projects valued at Rs. 5856.35 crore. Seventy per cent of the allocation of Rs. 4439.69 crore has been earmarked for feeder segregation of power supplies for irrigation and the remaining for system strengthening. The entire work on feeder segregation has been bid out and implementation has already begun. In addition, the state government has taken a loan of Rs. 800 crore from the Asian Development Bank (ADB) to undertake the work of strengthening the transmission system. The latest data on the implementation of DDUGJY in Bihar shows impressive progress in strengthening of the distribution and transmission infrastructure in the state. Up to August 31, 2019, the state had received an advance of Rs. 6500.71 crore of which Rs. 4630.23 crore was for feeder separation and the physical achievement was already 75%.

After the launch of the solar pumping programme for irrigation and drinking water by the Ministry of New and Renewable Energy (MNRE), the state has made a good start in solar pumping. Bihar supplemented the Government of India subsidy of 30% with a 45% subsidy of its own. According to the Economic Survey of Bihar

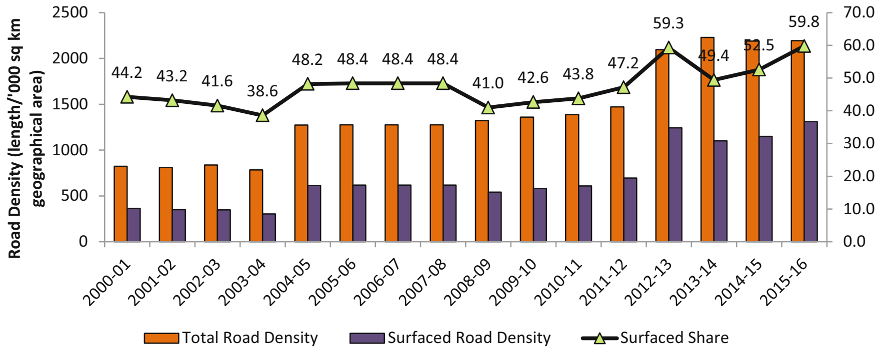


Fig. 8.13 Total and surfaced road density in Bihar. *Source* Basic Road Statistics, Ministry of Road, Transport and Highways

(2018–19), the state government has installed 995 solar water pumping sets under the *Mukhyamantri Naveen* and *Naveenkarniya* irrigation scheme and 521 solar water pumping sets under the Bihar *Saur Kranti* irrigation scheme up to October 2016. It, however, has not been possible to make arrangements to enable farmers to sell surplus power back to the grid.

Roads

The roadways infrastructure is critical for agricultural growth as roads facilitate trade, connect input and output markets, promote the development of backward regions and improve farm income. The investment in roads and bridges has tripled in the state during the last decade, the total public expenditure increasing from Rs. 2.6 thousand crores in 2007–08 to Rs. 7.5 thousand crores in 2017–18, which was around 4.7% of the total budget in that year. The state government invested 14.7% of public investment on road and bridges, which amounted to 1.5% of GSDP in 2017–18.

Figure 8.13 shows the progress in the state in total road density, surfaced road density and share of surfaced roads to total roads during the period from 2000–01 to 2015–16. In the latest year for which data are available (2015–16), the total road density in Bihar (2193 km per 1000 km^2) and surfaced road density (1311 km per 1000 km^2) is slightly higher than the all-India average (1430 km per 1000 km^2 and 1009.5 km per 1000 km^2 respectively) but what is more crucial is that the surfaced road share in total roads (59.8%) is much lower than the national average (70.6%).

Agricultural Marketing and Food Storage

Bihar took the unique step of repealing the APMC Act in 2006 and, at present, there is no legislation regulating agricultural marketing. Kishore et al. (2014) in their study highlight that the post-APMC era in Bihar seems to have been a mixed experience for different stakeholders.

Post APMC reform, the liberal market environment favours processing industries as they now have increased sourcing options without paying *mandi* taxes. Given that the food processing industry is at a very nascent stage in Bihar, these benefits are limited. As at the national level, only two to three per cent of total fruits and vegetables go through any kind of processing. However, for Bihar, food processing is much more important as the high value segment dominates agricultural output.

The state has not been active in the procurement of wheat and paddy at the minimum support price (MSP) with the result that the farm harvest price (FHP) has been in most years lower than the MSP (Fig. 8.14). One of the main reasons for the lack of initiative in procurement is the deficit in storage facilities in the state. Bihar produces around 8.4% of total vegetables in the country and around 4.8% of fruits but only four per cent of total cold storages in India are in Bihar. The shortcomings in the quality and quantity of power supply in the state have also contributed to the closure of cold storages. In order to bolster cold storage construction, the Bihar Government has initiated a cold storage scheme under which cold storages with a capacity of 5–10 thousand tonnes can avail of a subsidy of 30% on capital expenditure.

The state has ambitious plans to expand the storage of food-grains, the lack of capacity in which has been identified as one of the main impediments in increasing procurement. The estimated capacity needed is 12.61 lakh metric tonnes against which it had a storage capacity of 6.98 lakh metric tonnes at the beginning of the year 2016–17. The plan was to make good the shortfall of 5.63 lakh metric tonnes during 2016–17 and to add further capacity of 60,000 metric tonnes every year up to 2020–21.

8.3 Sources of Agriculture Growth in Bihar

In order to study the sources of agriculture growth in Bihar, we calculate the share of the value of output from different segments as a percentage of the total value of output from agriculture and allied activities (GVOA) (at current prices). Further, to analyse the sources of agricultural growth, we have decomposed the year-on-year growth in GVOA by taking the absolute year-on-year difference in GVOA from each segment as a proportion of the previous year's GVOA. Additionally, we look at production trends and growth rates reflecting sectoral performance. Given the high volatility in Bihar's agricultural growth, this exercise is important to throw light on the sub-sectors that are driving agricultural growth.

The share of value of output from different segments as a percentage of the total value of output from agriculture and allied activities (GVOA) (at current prices) has been shown in Fig. 8.15. The figure highlights how the sectoral composition of Bihar's agrarian economy has changed between TE 2002–03 and TE 2015–16. The shares of livestock, fishery and sugar have made gains while those of cereals and

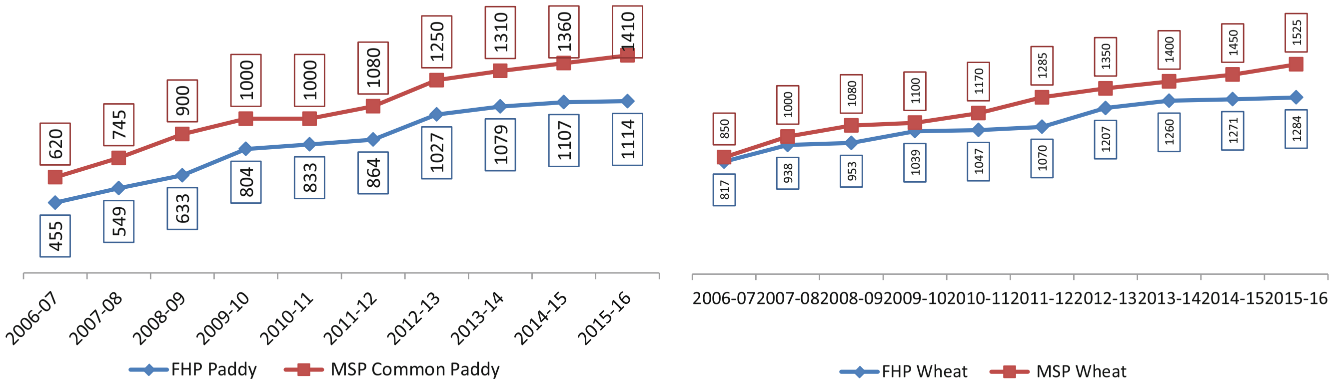


Fig. 8.14 Farm harvest price of paddy and wheat as compared to MSP (crop year) in Bihar (Rs. per Quintal). *Source* Directorate of Economics and Statistics, GoI and CACP. *Note* MSP is inclusive of the bonus

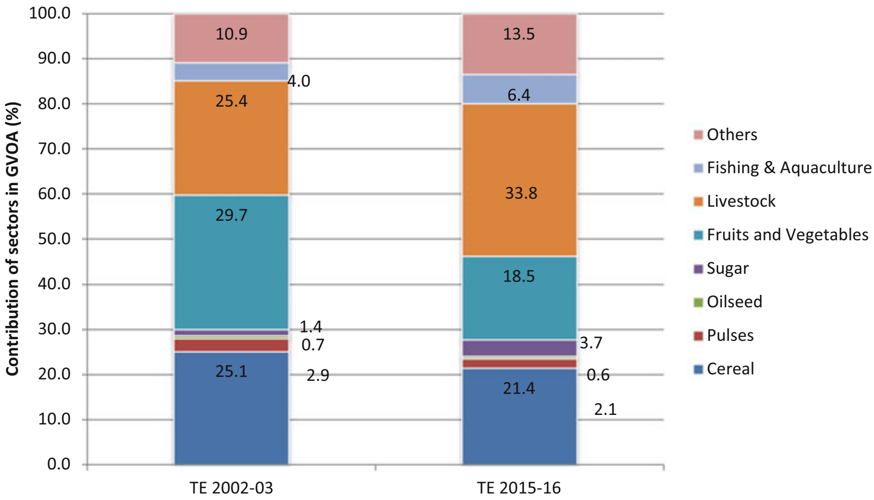


Fig. 8.15 Sector-wise shares in total value of output from agriculture and allied activities (at current prices). *Source* Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities, various years. *Note* Others include drugs and narcotics, condiments and spices, other crops, kitchen garden, by-products, forestry and logging

fruits and vegetables have lost somewhat, although they remain important. The share of pulses, already low at 3% at the beginning of the period, has also declined to 2%.

The GVOA grew annually at average 5.8% in the period from 2000–01 to 2015–16. Livestock accounted for the highest contribution (37%), followed by fruits and vegetables (20%), cereals (15%) fishing and aquaculture (8%) and forestry and logging (8%) (Fig. 8.16).

Figure 8.17 shows the changes in the sectoral composition of the GVOA for the period between 1999–00 and 2015–16. The share of livestock in GVOA has been increasing rapidly since 2003–04, affecting the shares of fruits and vegetables as well as of food grains.

Production and productivity of major crops

Bihar is endowed with abundant groundwater resources and fertile soil, which help farmers produce a variety of cereal and non-cereal crops, including fruits and vegetables. Table 8.2 shows the production and productivity of major crops from TE 2003–04 to TE 2017–18. The production and productivity of rice, maize and sugarcane have risen substantially. Wheat has lagged behind with lower growth, while the production of pulses has registered negative growth. One of the main reasons for the lower productivity of wheat is the delayed sowing time in Bihar.

The acreage and production under sugarcane have increased, underlining the suitability of the climate and soil in this state for the crop. However, the yield of sugarcane at 68.4 mt/ha, which is lower than the national average of 73.3 mt/ha in TE 2017–18, has been a problem. In an effort to increase the yield, the state government has

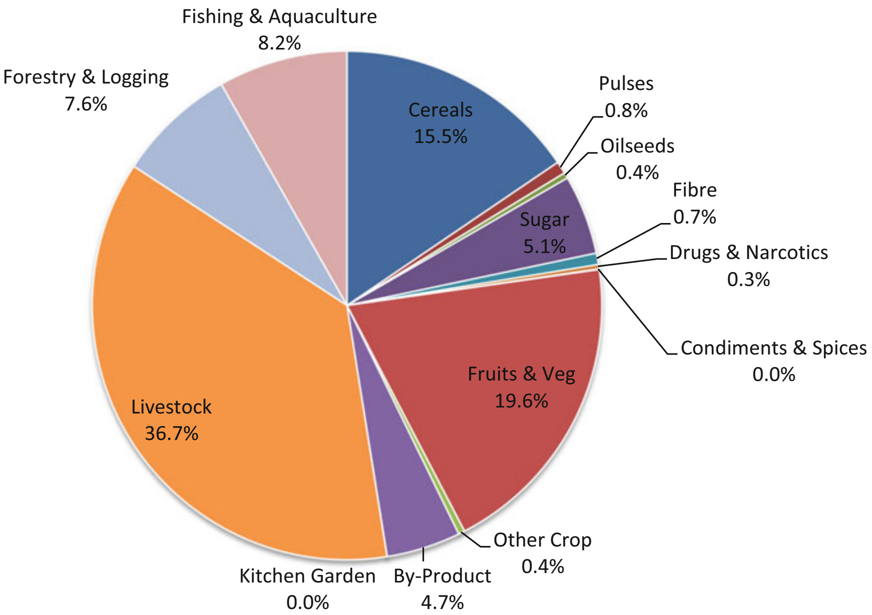


Fig. 8.16 Growth of value of output coming from each segment (2000–01 to 2015–16). *Source* Calculated by authors

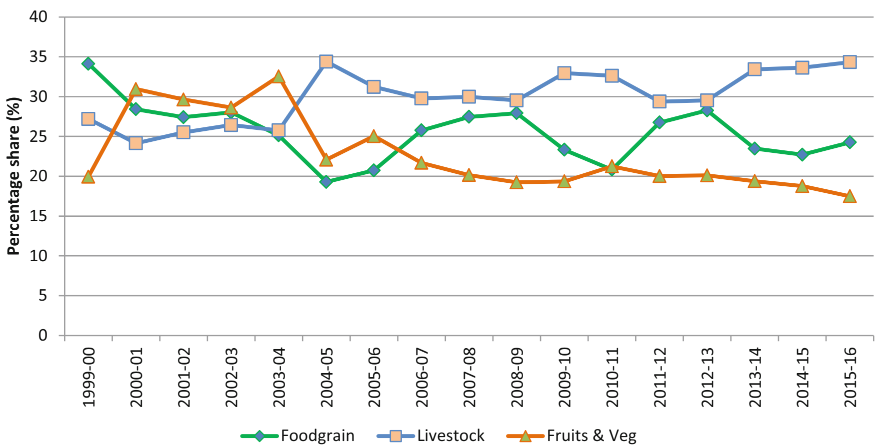


Fig. 8.17 Sectoral composition of agricultural and allied activities in GVOA from 2001–02 to 2015–16 (%). *Source* Government of India, State-wise estimates of value of output from agriculture and allied activities, various years

Table 8.2 Production and productivity of major crops

Crop	Production (million tonnes)			Productivity metric tonnes (mt)/ha		
	TE 2003–04	TE 2017–18	CAGR (%)	TE 2003–04	TE 2017–18	CAGR (%)
Total cereal	10.7	16.5	2.9	1.7	2.5	2.7
Rice	5.3	7.7	2.6	1.5	2.4	3.2
Wheat	4.0	5.6	2.2	1.9	2.3	1.1
Maize	1.4	3.2	5.7	2.3	4.1	3.9
Other coarse cereals	0.1	0.0	−3.3	0.9	1.1	1.0
Pulses	0.6	0.5	−1.3	0.8	0.9	0.6
Oilseeds	0.1	0.1	0.5	0.8	1.1	1.9
Sugarcane	4.7	18.0	9.4	43.2	68.4	3.1

Source Directorate of Economics and Statistics, GOB

supported sugarcane farmers by giving them a subsidy of Rs. 135 per quintal on the purchase of certified seeds and an incentive amount for inter-cropping with sugarcane under the National Food Security Mission (NFSM) programme. The state government has also taken the initiative to provide training to farmers to use improved varieties of seeds. The state provides a subsidy in terms of the distribution of plant protection chemicals at the rate of 50% of the total cost or a maximum of Rs. 200 per ha to sugarcane producers. The government has also provided Rs. 25,000 per ha for the production of foundation seeds (Economic Survey of Bihar, 2017).

Fruits and Vegetables

The production of a variety of fruits and vegetables in the state provides a strong base for high-value agriculture and the food processing industry. This industry can flourish only if there is efficient supply of power. Within the fruits and vegetable segment, vegetables constitute a larger share. In terms of acreage, the state devotes around 11% of its gross cropped area to vegetable production, which is way above the national average of 5.0%. In TE 2017–18, Bihar was the fourth largest vegetable producer (8.4%), after West Bengal, Uttar Pradesh and Madhya Pradesh. Potato is the most important vegetable grown in the state with around 38% of vegetable area dedicated to the crop. Apart from potato, the other main vegetables grown in Bihar are cauliflower, okra, brinjal, onion, tomato and cabbage.

The trend of production and productivity of the full range of major vegetables grown in the state is given in Table 8.3. The state was the third-largest producer of potato in TE 2017–18 with 31.4% of the cropped area under vegetables accounted for by potato. In TE 2017–18, potato yield in Bihar was around 21.3 mt per ha as compared to the all-India average of 23.3 mt per ha.

As Table 8.3 shows, Bihar's productivity in okra, brinjal and onion as well as in vegetables as a group are higher than the national average. However, it is lower in cauliflower, tomato and cabbage, apart from potatoes to which we have already

Table 8.3 Production and productivity of vegetables

Crop	Bihar			India		
	TE 2007–08	TE 2017–18	CAGR (%)	TE 2007–08	TE 2017–18	CAGR (%)
Production (million tonnes)						
Potato	5.8	6.8	1.5	30.7	47.8	4.1
Cauliflower	1.0	1.0	0.0	5.6	8.4	3.8
Cabbage	0.6	0.7	1.4	8.7	8.8	0.1
Onion	1.0	1.2	1.7	19.8	22.2	1.0
Tomato	0.9	1.0	1.0	10.0	19.7	6.4
Brinjal	1.1	1.2	0.8	9.5	12.6	2.6
Okra *(Bhindi)*	0.7	0.7	0.0	4.1	5.9	3.4
All vegetables	13.7	14.9	0.8	117.4	177.2	3.8
Productivity metric tonnes/ha						
Potato	18.5	21.3	1.3	18.1	22.3	1.9
Cauliflower	16.5	15.2	−0.7	18.6	19.0	0.2
Cabbage	16.5	17.7	0.6	21.9	22.4	0.2
Onion	19.8	23.1	1.4	14.2	17.0	1.6
Tomato	18.5	21.5	1.4	19.2	25.1	2.5
Brinjal	20.4	20.3	0.0	17.3	17.9	0.3
Okra (*Bhindi*)	12.6	13.4	0.6	10.8	11.8	0.8
All vegetables	16.7	17.9	0.6	16.7	17.4	0.4

Source National Horticulture Database, several issues

referred. Even in these three vegetables, Bihar seems to be closing the gap with the national average. Clearly, vegetable cultivation is an area of promise in Bihar.

Around 4% of its GCA is dedicated to fruit cultivation as compared to the national average of 3.2%. Mango, banana, litchi and guava are the main fruits grown in Bihar. In TE 2017–18, around 51.0% of the area under fruit cultivation was devoted to mango orchards, 11.9% to banana, 10.9% to litchi and 10.1% to guava. Bihar's productivity in fruit cultivation is around 14.9 mt per ha, which is slightly higher than the national average of 14.6 mt per ha. Of the fruits grown in the state, there has been robust growth in the production of banana and guava in recent years (Table 8.4). Bihar is the top litchi producing state in the country and the state contributes around 42.7% of total production. In terms of mango production, Bihar ranks fifth contributing around 8.9% of the total production.

Table 8.4 Production and productivity of fruits

Fruits	Bihar			India		
	TE 2007–08	TE 2017–18	CAGR (%)	TE 2007–08	TE 2017–18	CAGR (%)
Production (million tonnes)						
Banana	1.1	1.5	2.9	21.0	30.1	3.3
Guava	0.2	0.4	6.5	1.8	3.9	7.3
Litchi	0.2	0.2	0.0	0.4	0.6	3.8
Mango	1.1	1.8	4.6	13.4	20.0	3.7
Fruits	3.3	4.5	2.9	59.5	93.4	4.2
Productivity metric tonnes/ha						
Banana	38.9	44.2	1.2	34.6	35	0.1
Guava	8.3	13.6	4.6	10.6	15.3	3.4
Litchi	7.3	6.5	−1.0	7.3	6.6	−0.9
Mango	8.0	12.0	3.8	8.0	9.0	1.1
Fruits	11.4	14.9	2.5	11.6	14.6	2.1

Source National Horticulture Database, several issues

Livestock

Animal husbandry plays an important role in Bihar's economy by providing employment and income opportunities apart from crop cultivation. The state is endowed with vast resources of livestock and poultry. As discussed above, it is evident that the livestock sector contributed 33% to GVOA in TE 2015–16. Figure 8.18 shows

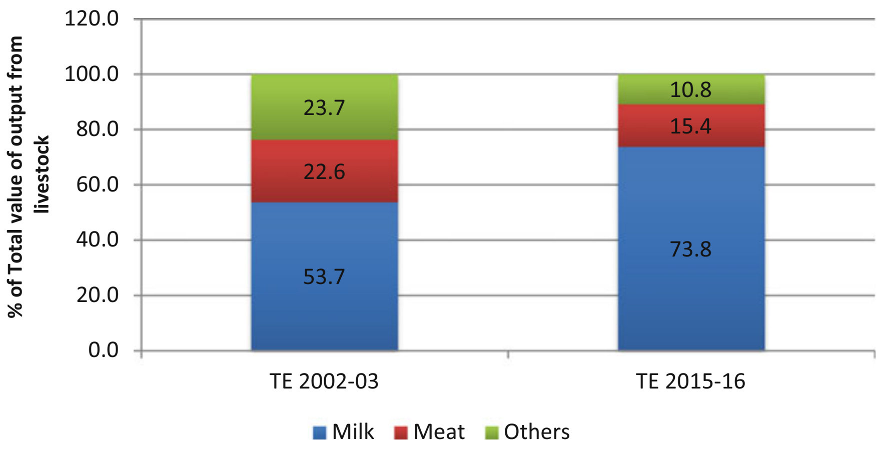


Fig. 8.18 Composition of livestock segment (percentage of total value of output from livestock sector). *Source* Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities, various years

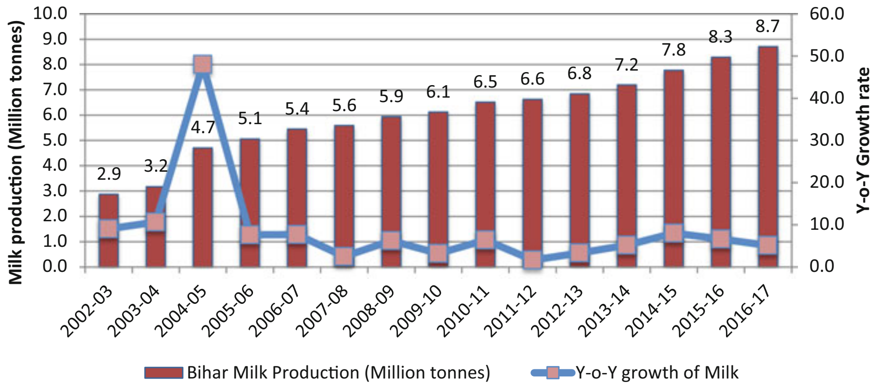


Fig. 8.19 Production of milk in Bihar (Million Tonnes). *Source* Economic Survey of Bihar, various years

the changing composition of livestock in Bihar from TE 2002–02 to TE 2015–16. The share of milk in livestock increased from 53.7% in TE 2002–03 to 73.8% in TE 2015–16.

Milk and Meat

As evident from the earlier discussion, milk is an important segment of the livestock sector and has also led to the changing composition of livestock. The production of milk has increased from 2.9 million tonnes in 2002–03 to 8.7 million tonnes in 2016–17. Looking at the growth rate of milk, there is a significant sharp rise in the production of milk in the year 2004–05 (Fig. 8.19). This apparent sharp rise was due to the fact that the livestock census was conducted in 2003 in the state, which estimated that the number of livestock was much higher than earlier projections had suggested. It is evident that the value of output from livestock was underestimated earlier. However, the state has low productivity in milk, which was about 0.8 mt per lactating animal in TE 2016–17. Despite high growth in milk production, the state has a low proportion of genetically superior cattle, which is a pre-requisite for higher milk productivity.

Exotic/cross-bred cows have superior genetic potential to yield proportionately higher productivity compared to native breeds. On average, a cross-bred cow yields 7.4 L a day nationally, but in Punjab, a typical cross-bred cow yields about 12.0 L a day while in Bihar, it is only 6.5 L a day. This means that cross-bred yield in Bihar is almost half the yield in Punjab (Table 8.5). The production trait of milk-producing cattle in Punjab is better than in Bihar because of the use of germplasm from superior breeds in cross-breeding in the former.

The state-run Bihar State Milk Co-operative Federation (COMFED) works on a similar three-tier model as Anand in Gujarat. COMFED has played a significant role in the growth of the dairy industry (Economic Survey of Bihar 2017–18). There were 20.7 thousand milk co-operative societies in 2016–17. In 2016–17, milk procurement

Table 8.5 Species wise yield of in-milk animals (Ltr/day) in select states

State	2004–05			2016–17		
	Crossbred	Local cow	Buffalo	Crossbred	Local cow	Buffalo
Bihar	5.5	1.7	3.4	6.5	3.3	4.3
Punjab	8.7	3.1	6.8	12.0	7.0	9.5
India	6.3	1.9	4.3	7.4	3.5	5.9

Source Basic Animal Husbandry Statistics, DAD&F, GoI

per functional dairy declined to 108.6 kilolitres as compared to 124.2 kilolitres in 2015–16. COMFED processes only 9–10% of the milk produced and another 2–3% is processed in the organised private sector. There is still a need to improve procurement and processing of milk in the state. The state government has several schemes like medical treatment of animals, artificial insemination, sterilisation and free distribution of fodder to encourage the growth of this sector. Under "*Samagra Gavya Vikash Yojana*", the state government has sanctioned an amount of Rs. 80 crore to establish dairy units.

The changing composition of the livestock sector highlights the declining share of meat over time. Figure 8.18 shows that the share of meat in GVOA has declined from 22.6% in TE 2002–03 to 15.3% in TE 2015–16. The CAGR of meat production for the period from 2007–08 to 2016–17 was around 6.7%. Figure 8.20 shows meat production in Bihar from 2007–08 to 2016–17. Within total meat production, mutton and pork account for the two largest shares followed by buffalo meat and poultry. The lack of modern abattoirs with processing facilities having due forward and backward linkages has slowed the growth of value-added products in this sector.

Poultry's share in total meat production is only 16.3% (2016–17). However, between 2008–09 and 2012–13, poultry has grown at the fastest rate as compared to other animal meats in Bihar due to the robust expansion of poultry farms and hatcheries. As per the 19th Livestock Census (2012), Bihar's backyard poultry shrank at a CAGR of 1.7% in the period 2007 and 2012. This is analogous to the national

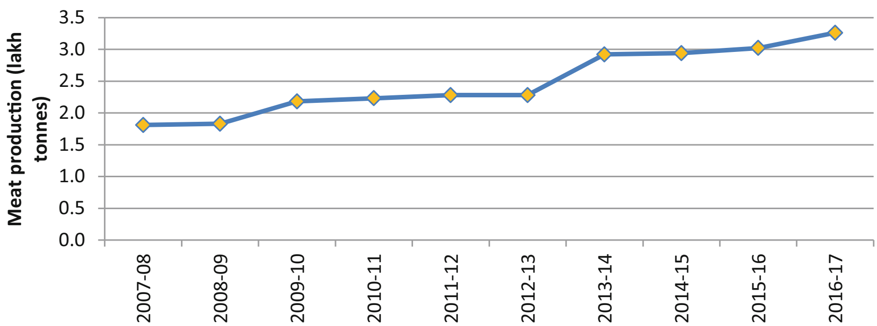


Fig. 8.20 Production of meat in Bihar. *Source* Department of Animal husbandry, GOB

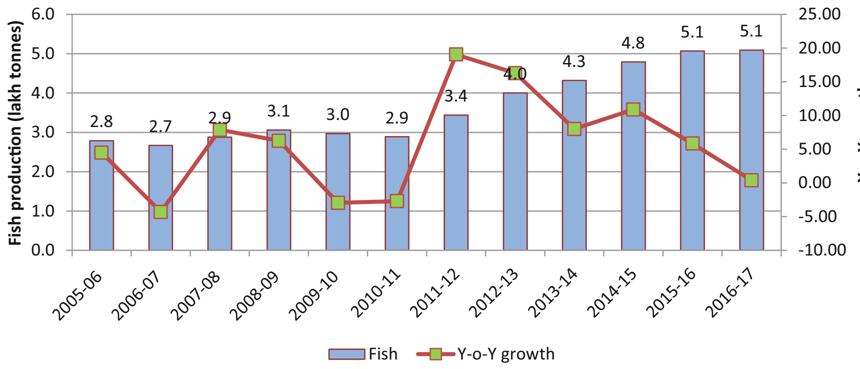


Fig. 8.21 Fish production in Bihar. *Source* Department of Animal husbandry, GOB

trend, which shows a fall in backyard poultry, and an increase in farms and hatcheries. In Bihar, the number of poultry birds in broiler farms increased from 3.1 million to 5.1 million in this period, a CAGR of 7.8%, as compared to the national average of 6.3%. Bihar has also recorded a robust expansion in duck population in duck farms.

Fisheries

Bihar is endowed with 273.3 thousand ha of area underwater and 3200 km of river length. This gives the state an advantage in fish production. Fish production has gradually increased from 2.8 lakh tonnes in 2005–06 to 5.1 lakh tonnes in 2016–17 (see Fig. 8.21). In terms of GVOA, the share of fish increased from 4.0% in TE 2002–03 to 6.4% in TE 2015-16. However, the per capita availability of fish in the state stands at 7.7 kg against the national average of 10.0 kg. In view of the fact that the fisheries sector has huge potential in providing gainful employment, the state has provided subsidies for the establishment of fish feed mills, construction of fish seed hatcheries, renovation of ponds and distribution of vehicles for fish marketing. About 121 fish seed farms and 10 private hatcheries by the government are working to meet the growing demand for fish seeds.

8.4 Drivers of Agricultural Growth: Econometric Analysis

The literature emphasises that the drivers of agricultural growth are factor inputs such as HYV adoption ratio, irrigation, fertiliser consumption, farm mechanisation and agricultural extension. The other factors that affect agricultural growth, apart from factor inputs, are price incentives and rural infrastructure. The study analyses the impact of different factor inputs in agriculture, rural infrastructure and incentives on GSDPA (at 2004–05 prices) for the period from 2001–02 to 2015–16 using ordinary least squares. The correlation matrix and description of the variables are shown in Tables 8.8 and 8.9 in the Annexure.

In this study, we have used irrigation as a representative of inputs used in agriculture, terms of trade between agriculture and industry, diversification towards milk and total road density, which is used as representative of infrastructure. The correlation matrix shows that GSDPA has a significant and positive correlation with irrigation, total road density, terms of trade and diversification towards milk.

The function is defined as follows:

$$Y_t = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \cdots \tag{1}$$

where X_1 is irrigation ratio (IRR); X_2 is total road density; X_3 is terms of trade (ToT) between agriculture and industry and X_4 is diversification towards milk production measured as the share of milk in GVOA.

The log value of GSDPA at 2004–05 prices is the dependent variable. However, due to the high correlation among the explanatory variables, we have specified three different double-log models to gauge the relationship between agricultural gross domestic product (GDP) and drivers of agricultural growth (Table 8.6). We have run the model with different variables and have presented only those variables that have a significant effect on agricultural GDP.

In Model 1, irrigation has a positive and significant impact on agricultural GDP; every one per cent increase in the share of irrigated area increases agricultural GDP by 1.8%. However, the ToT between agriculture and industry shows no relationship with agricultural GDP. In Model 2, total road density has a positive and significant impact on agricultural GDP; every one per cent increase in road density increases agricultural GDP by 0.44% and ToT shows no significant relationship. Model 3 indicates that a one per cent increase in ToT increases agricultural GDP by 0.6% and diversification towards milk impacts agricultural GDP by 0.53%.

Table 8.6 Model estimation: ordinary least squares (2001–02 to 2015–16)

Dependent variable: GSDPA	Model 1	Model 2	Model 3
IRR (share of irrigates area in GCA)	1.88**		
Total road density (km/100 km sq of area)	0.11	0.44***	
Milk (share in GVOA)			0.53**
ToT (Agricultural deflator/industry deflator)		0.14	0.60*
Constant	2.8***	5.4***	5.7***
R-sq	0.8	0.7	0.5
Observation	15	15	15

Source Calculated by authors
Note ***significant at 1% level (p-value < 0.01); **significant at 5% level (p-value < 0.05); *significant at 10% level (p-value < 0.1)

8.5 Assessment of Budgetary Allocation to Agriculture and Allied Activities

The present section will evaluate the budgetary expenditure for the last three financial years—FY 2016–17 (actual), FY 2017–18 (RE) and FY 2018–19 (BE) to assess if there has been a correction in the historically overwhelming budgetary support to crop production and, within crops, to grain production. Changing dietary patterns towards the consumption of non-staples and the potential that other sub-sectors of agriculture hold in terms of both catering to changing tastes and to augment farm incomes indicate the need to reverse the historical trend and to increase budgetary allocations to the horticulture (F&V) and livestock sectors.

The broad budgetary allocation on agriculture and allied activities is shown in Fig. 8.22. The graph shows that crop husbandry constitutes the largest share of budgetary allocations (51.7%) followed by animal husbandry and dairy development (10.9%) and agricultural research and education (7.8%) for the FY 2018–19 (BE).

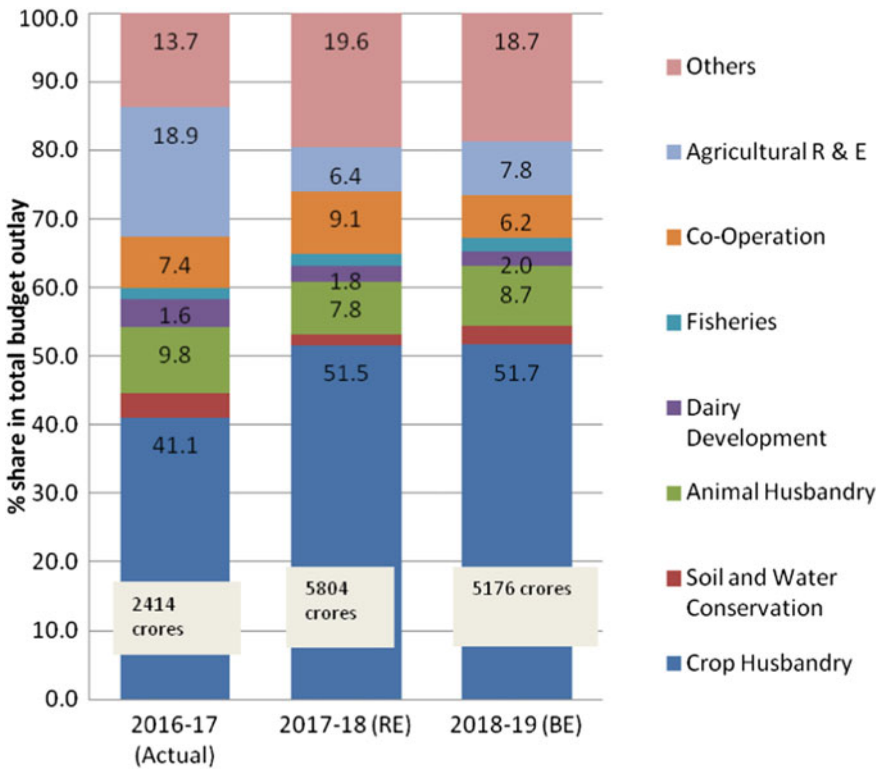


Fig. 8.22 Allocation to broad heads as a share of the total allocation to agriculture and allied activities. *Source* Finance Department, Government of Bihar

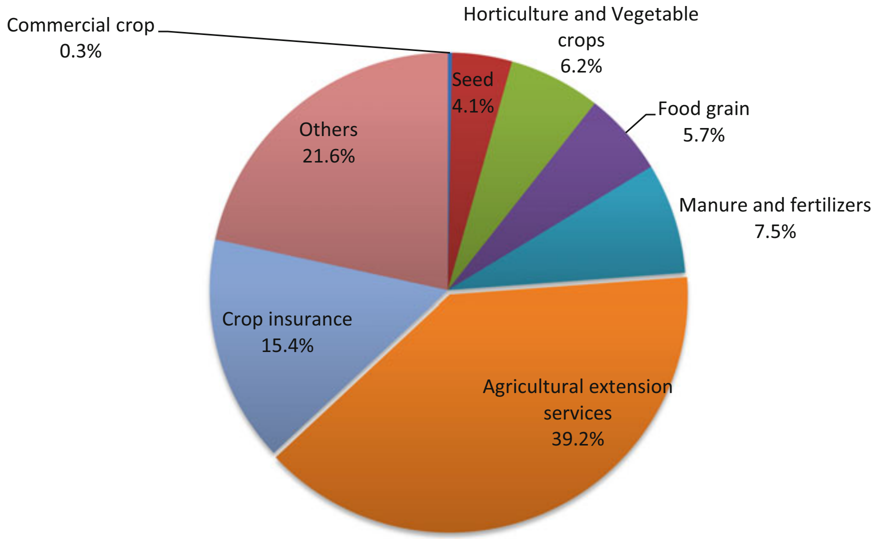


Fig. 8.23 Allocation to broad heads as a share of the total allocation to crop husbandry in TE 2018–19. *Source* Finance Department, Government of Bihar

Crop husbandry comprises food grains, horticulture and vegetables and commercial crops. It also includes expenditure on support services that apply to all segments such as agricultural extension services, crop insurance, seeds, manure and fertilisers, etc. The major allocations under crop husbandry are made for agriculture extension services (39%) as well as crop insurance (15.4%) followed by manure and fertilisers (7.5%) in TE 2018–19 (Fig. 8.23).

Figure 8.24 provides the budgetary allocation for different sub-sectors in the agriculture and allied activities sector.

Of course, it cannot be expected that the share of budgetary expenditure on various segments will correspond to the share of the segment in GVOA. Even so, when we compare the two shares, we find that the budgetary expenditure on livestock is well below the share of this segment in the GVOA. Similarly, there is a large gap between the share of horticulture and vegetables in GVOA (18.5%) and the budgetary allocation (2.8%) in TE 2018–19. The same is the case with commercial crops (oilseeds, sugar and jute fibre) where the share in GVOA is 5% while the budgetary allocation is 0.1%. Also, while the fisheries sector contributes 6.4% in GVOA, the budgetary allocation is only 1.8%. Here, we would like to note only that there would seem to be scope for introducing support schemes with respect to those segments in which the budgetary allocation is relatively lower than the contribution to the GVOA.

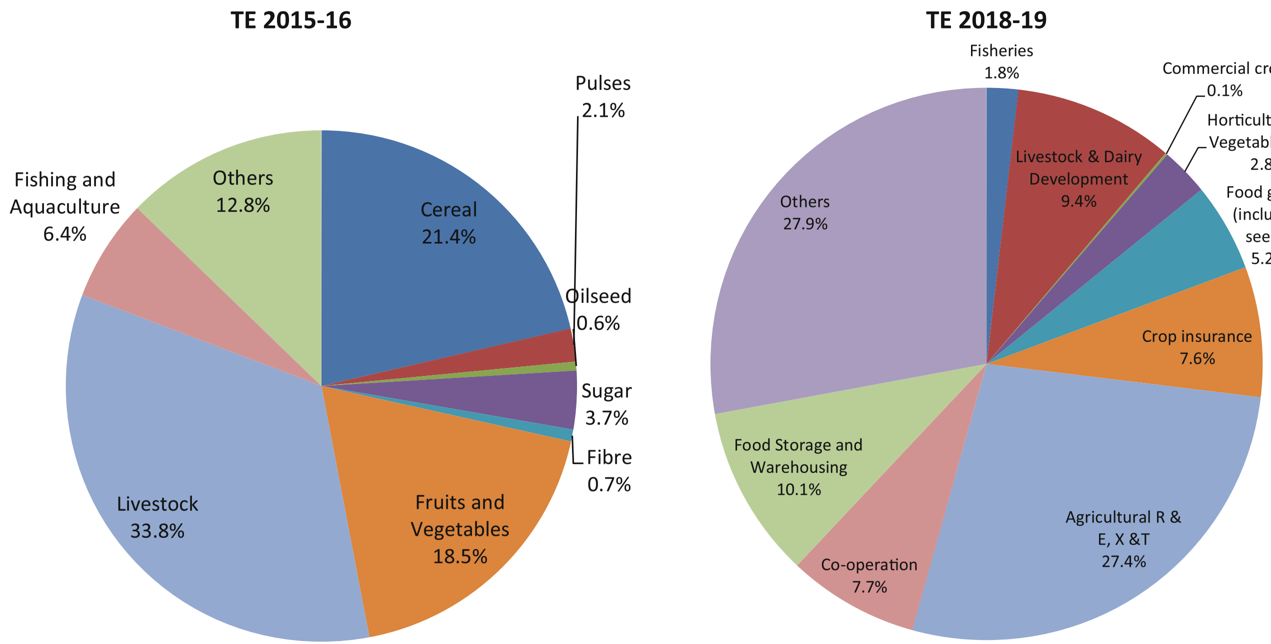


Fig. 8.24 Aligning agriculture budget with GVO in agriculture and allied activities. *Source* Finance Department, Government of Bihar and State-wise Estimates of Value of Output from Agriculture and Allied Activities, Government of India, various years. *Note* Others include budgetary allocations to soil and water conservation, manure and fertilisers and other agricultural programmes

Table 8.7 Budgetary allocation (capital outlay) for infrastructure (in crore)

Budget allocation	2016–17 (Actual)	2017–18 (Revised estimate)	2018–19 (Budget estimate)
Irrigation (including major, medium and minor irrigation)	896.2	1605	1107.7
Flood control	899.5	1288.6	1502.6
Irrigation and flood control	1795.7	2893.6	2610.3
Power projects	5738.6	6958.6	5424.8
Road and bridges	5325.5	5876.0	5473.2

Source Finance Department, Government of Bihar

We cannot expect the expenditure by the state on food grains to match the share of cereals in the GVOA. The production of cereals is supported heavily by the central government through input subsidies (fertilisers and credit); further, the state subsidies on irrigation and power do not get reflected in the budgetary allocation. Low procurement ratio in the state is due to lack of storage facilities which the state is endeavouring to build by allocating 10% of the agricultural budget to food storage and warehousing.

Equally important to the budgetary allocation for the agricultural programmes is the capital outlay on infrastructure, irrigation, power and roads. Table 8.7 gives details of budgetary allocations under these heads. More than 65% of irrigation is provided by tube wells, which are dependent on power supplies. We have seen that, in the past, there was acute difficulty in terms of the quality and quantity of power supplies to agriculture and that the state has been active in recent years in improving the power infrastructure. This has been fully reflected in the budgetary allocation to this sector.

In surface irrigation, the maximum capital outlay has been provided to major irrigation projects. It is observed that flood control projects take away a large proportion of the total funds available under irrigation and flood control.

The state has not lagged behind in the budgetary allocation for roadways including rural roads. The centrally sponsored *Pradhan Mantri Gram Sadak Yojana* (PMGSY) has been supplemented by state schemes. We do not have figures of the share of surfaced roads for the last three years to be able to confirm the physical achievement in these years. However, we have seen that the share of surfaced to total road had already increased from 47.2% in 2011–12 to 59.8% in 2015–16.

8.6 Policy Recommendations

The study recommends the following policies required to increase agricultural growth as well as farm income in the state.

1. **Volatility in the Agricultural Sector: Flood and Drought Protection**

Agricultural growth in Bihar has been volatile which affects agricultural productivity. The huge endowment of water resources makes the state flood-prone, especially in the northern part. Nearly 73% of the northern part is affected by floods whereas the southern part of the state is drought-prone. This requires increased public investment in flood protection in the northern part and watershed management and rainwater harvesting in drought-prone areas. Given the criticism of constructing embankments as a flood protection measure, the state government has advocated a move towards the rehabilitation of natural drainage systems. The new strategy requires planning and investment by the state government along with social mobilisation and participation of civil society organisations.

2. **Utilisation of Ultimate Irrigation Potential**

Bihar has so far actualised 55.4% of the ultimate irrigation potential of major and medium irrigation projects and 63.7% of minor irrigation potential. The government needs to increase investment in both surface water and groundwater irrigation. The current irrigation ratio of 68.7% (TE 2014–15) is relatively high compared to most other states but we have to remember that there are huge population pressure and a high level of rural poverty in the state. The state needs to expand agricultural production substantially in order to provide a livelihood to the rural population. In order to achieve higher agricultural production, the state needs more irrigation. A higher irrigation ratio will facilitate higher crop intensity and will increase production.

3. **Increase Power Intensity in the Agriculture Sector**

More than 65% of irrigation is provided by groundwater through tube wells, which have to use diesel because of the poor quality and quantity of power available for agriculture. The state has already undertaken an extensive programme to bolster infrastructure for the transmission and distribution of power and there has been good progress in the last two to three years. Funds have been made available by the Government of India under DDUGJY and the state has separately availed a loan from the ADB. The implementation of these programmes will play a critical road in Bihar's agricultural development. Availability of power will also provide a stimulus also to the food processing industry.

4. **Popularise the Use of Solar Pumping Sets**

The state needs to popularise the use of solar pumping as an alternative to dependence on power supply from the grid especially in North Bihar, which has higher water tables and the bulk of shallow private tube wells. The Government of India has provided financial assistance of 30% of the project cost from the Ministry of New and Renewable Energy (MNRE) for the solar pumping programme for drinking water and irrigation. The state government has already installed 1000 solar pumps in 2015–16 under this scheme.

5. **Expansion of Dairy Co-operative Societies**

Milk contributed around 25% of the value of output from agriculture and allied activities in TE 201–16 and production increased at a CAGR of 7.6% between 2002–03 and 2016–17. However, only 10% of the milk produced is being processed by COMFED and another 2–3% by other private players. There is considerable scope for expansion of dairy co-operative societies to increase the collection, processing and marketing of the milk produced in the state.

6. **Increase Milk Productivity**

Milk productivity in the state is lower than in states like Punjab. Health and reproduction management is crucial to increase productivity. Bihar needs to increase the proportion of cross-bred bovines and to use germplasm from superior breeds in cross-breeding. Furthermore, the state needs to make use of recent developments in technology and reduce the number of births of male calves to increase the share of milch animals in the herd. Additionally, the government should focus on utilising degraded and wasteland for quality fodder production, encourage short duration fodder crops in the periods between main crops and encourage efficient utilisation of available resources such as crop residue.

7. **Increase Investment in Surface Road Length**

The surface road density in Bihar is lower than in many states. The share of surfaced roads in total road length is only 59.8%, lower than the national average as discussed in the chapter. The state government needs to increase investment in surface and all-weather roads to improve connectivity and the movement of inputs and agricultural produce.

8. **Develop Marketing facilities**

Poor marketing facilities have led to the FCI procuring only a small proportion of food grains from Bihar. There is a need to expedite the construction of marketing infrastructure at designated locations to ensure that farmers benefit from the government's price policies. Markets also need to be connected with surfaced roads. Besides, farmers in Bihar need to integrate with the National Agriculture Markets—e-nam—an initiative launched by the GOI under which agricultural producers can fully participate in agricultural markets nationwide for better price discovery without intermediaries.

9. **Scope for Poultry Development**

Poultry development in Bihar is in poor shape because of the lack of contract farming. Given the advantage that Bihar enjoys in the winter maize market, integrators should find it attractive to move into the state. In fact, if integrators expand their activities, there will also be scope for the establishment of maize processing units, which is currently insignificant, to reap the benefit of vertical integration in the maize value chain, and give a fillip to the poultry industry in Bihar. In the light of this, the state government needs to be pro-active in inviting well-known integrators to establish units in Bihar.

10. **Expansion of Fish Production**

The availability of a large number of fresh water bodies in the state provides a good basis for the development of fishery and the state government has taken a number of promotional measures to accelerate it. But the water bodies (*sairats*) are auctioned every year to private players, including fishermen's co-operatives. Yearly leases do not allow the lessees to invest in the water body and work for the long-term development of fisheries. If the water bodies are leased out for longer periods, say three to five years, this shortcoming can be overcome. The state government also plans to set up fish feed mills and construction of fish seed hatcheries at subsided rates. The government has initiated several schemes for fish farmers, which include the distribution of subsidised fish seed, loan for maintenance and renovation of private ponds at low-interest rates and provided free homes for fishermen.

11. **Facilitation of Agricultural Credit**

To facilitate the advancement of agricultural credit by commercial banks to farmers, it is critical that land surveys are completed quickly to revise and update land records to reflect current ownership.

Annexure

See Tables 8.8 and 8.9.

Table 8.8 Correlation matrix

Correlation matrix at level 2001–02 to 2015–16	GSDPA	Irrigation	ToT	Milk	Fertiliser	Share of surface road to total road	Surface road density	Total road density	Livestock
GSDPA	1.00								
Irrigation (share of irrigates area in GCA)	0.92***	1.00							
ToT (agricultural deflator/industry deflator)	0.45*	0.63***	1.00						
Milk (share in GVOA)	0.66***	0.60**	0.16	1.00					
Fertiliser (kg/ha)	0.82***	0.81***	0.42	0.79***	1.00				
Share of surface road to total road	0.61**	0.72***	0.45**	0.62**	0.55**	1.00			
Surface Road Density(km/100 km^2)	0.82***	0.87***	0.47**	0.84***	0.79***	0.89***	1.00		
Total Road Density (km/100 km^2)	0.85***	0.88***	0.45*	0.87***	0.83***	0.80***	0.99**	1.00	
Livestock (share in GVOA)	0.49*	0.46*	0.16	0.95***	0.62**	0.54**	0.74**	0.77**	1.00

Source Calculated by authors
Note ***significant at 1% level (p-value < 0.01); **significant at 5% level (p-value < 0.05); *significant at 10% level (p-value < 0.1)

Table 8.9 Description of variables

IRR	Log of share of irrigated area as a share of gross cropped area	Directorate of economics and statistics (DES)
GSDPA	Log of gross state domestic product in agriculture and allied activities	CSO
Total road density	Log of total road length (km) per 100 km^2 of the geographical area	Ministry of roads, transports and highway
ToT	Term of trade measured as log of agricultural deflator/industry deflator	CSO
Milk	Log of value of output from milk as a share of value of output from agriculture and allied activities	CSO

References

Agriculture Census. (2015–16). *All India report on number and area of operational holdings*. Retrieved May 2019, from Agricultural Census: http://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf.

Gulati, A. (2016). *From plate to plough*: Twenty-five years of tinkering. Indian Express, July 4, 2016. http://indianexpress.com/article/opinion/columns/india-economic-reformsindian-farmers-fertiliser-subsidy-union-budget-modi-govt-organic-farming-2892089/.

Kishore, A., Sharma, B., & Joshi, P. K. (2014). *Putting agriculture on the takeoff trajectory: Nurturing the seeds of growth in Bihar, India*. New Delhi, India: International Food Policy Research Institute (IFPRI) and International Water Management Institute (IWMI).

Livestock Census. (2012). *19th livestock census-2012 all India report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Mishra, K. D. (1999). Flood protection that never was: Case of Mahananda Basin of North Bihar. *Economic Political Weekly*, *33*(29).

NABARD. (2018). *NABARD All India Rural Financial Inclusion Survey 2016–17* . Mumbai: NABARD

Sadoff, C., Rao, H., Blackmore, D., Wu, X., McDonnell, A., Jeuland, M., et al. (2012). Ten fundamental questions for water resources development in the Ganges: myths and realities. *Water Policy, 15*(S1), 147–164.

Shah, M. (2016). Eliminating poverty in Bihar: Paradoxes, bottlenecks and solutions. *Economic Political Weekly, LI*(6).

Vajpayee. (2018, February 24). *Bihar Fasal Sahayata Yojana: Less than 3 lakh farmers applied*. Retrieved from https://www.mygovernmentschemes.com/bihar-fasal-sahayata-yojana/.

Chapter 9
Drivers of Agricultural Growth in Odisha

Anwarul Hoda, Ashok Gulati, Harsh Wardhan, and Pallavi Rajkhowa

9.1 Introduction

Odisha is the ninth largest state in India with a share of 4.7% of India's total landmass. In terms of population, it is the eleventh largest comprising 3.47% of India's total population, of which more than 83% is rural (Census 2011). Odisha is a mainly agrarian economy with a GSDP value of Rs. 3.74 trillion at current prices. Over the years, the share of agriculture in the gross state domestic product has declined from around 37% in TE1992–93 to 21% in TE2017–18 and that of industry and services increased correspondingly (CSO 2019). Even though the share of agriculture in GSDP is declining, the number of persons engaged in agriculture remains high. According to NSS reports, more than 55.7% of Odisha's population is engaged in agriculture and related sectors (NSS 68th round 2014) (45% according to the Labour Bureau, 2015–16). Agricultural policy can have a direct impact on a large proportion of the population.

Odisha is one of the poorest states in India, with a large section of its rural population living below the poverty line, lagging behind other states in terms of agricultural growth during the last couple of decades. Its agricultural GDP grew at an average three per cent between 1991–92 and 2017–18. Political stability in the state in the last decade contributed to progress in agriculture, arising from enhanced budgetary allocations towards agriculture, infrastructural development and new beneficial government policies and initiatives. The KALIA scheme of income support for farmers and agricultural labour in Odisha was much talked about and led other state governments,

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central governments and even opposition parties to announce similar schemes in the run-up to the general elections in early 2019.

Predominantly with red soil, Odisha produces a wide variety of commodities, the most notable being paddy, mangoes, tomatoes, brinjal, sugarcane, jute and poultry. Even though paddy is the most cultivated crop with a share of almost 48% in gross cropped area, farming in the state has diversified towards high-value agriculture including fruits and vegetables and livestock. However, the frequent occurrence of extreme natural calamities like floods, cyclones and droughts is a major constraint that agriculture in the state faces. In 2019, a devastating cyclonic storm, "FANI", caused large-scale destruction in the state. Dealing with natural calamities has necessitated the allocation of a sizeable portion of government's funds, which could have been used for agricultural and other developmental activities, towards reconstruction and rehabilitation. These events have impeded agriculture growth, lowered farmers' income and hampered the overall development of the state.

This chapter will examine the sources and drivers of agricultural growth in the coastal state. The chapter is organised into six sections as follows. The introduction is followed by a detailed overview of agriculture in the state in Sect. 9.2. Section 9.3 analyses the composition and sources of agricultural growth in Odisha. Section 9.4 gives the econometric analysis used to derive the drivers of agriculture growth in the state. In Sect. 9.5, Odisha's agricultural budget has been discussed. Section 9.6 concludes, providing policy prescriptions to achieve and sustain high agricultural growth in Odisha.

9.2 Overview of Odisha's Agriculture

Based on climate, soil, rainfall and cropping pattern, Odisha is divided into ten agro-climatic zones: north-western plateau, north-central plateau, north-eastern coastal plain, east and south-eastern coastal plain, north-eastern *ghat*, eastern *ghat* high land, south-eastern *ghat*, western undulating zone, western central table land and mid-central table land (Fig. 9.1). Located on the eastern side of peninsular India, Odisha is prone to natural calamities such as cyclones, floods and even droughts. Between 2000 and 2019, Odisha has been affected by floods in 15 out of the 19 years and by droughts in 8 (GoO 2017; PIB 2018).

9.2.1 Agricultural Growth

During the last two decades, Odisha has not achieved the growth in agriculture that other states have. Gross state domestic product in agriculture (gross value added at

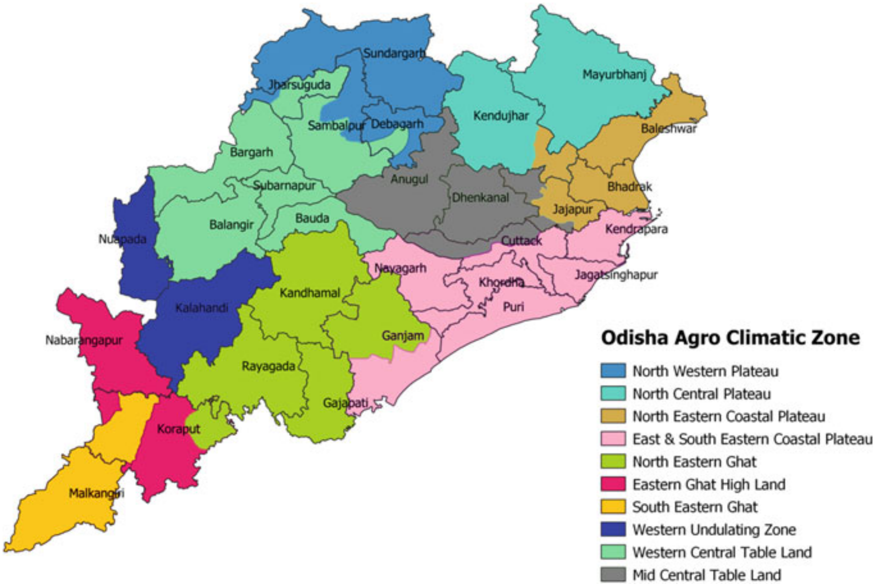

Fig. 9.1 Agro climatic zones—Odisha. *Source* Created using QGIS from Government of Odisha's data

basic prices [1]after 2011–12) grew at an average rate of 3.9% since 2001–02 and 3% since 1991–92. Even though Odisha's agriculture GDP grew at the same average rate as the all-India growth rate, the state's growth rate has been more volatile, with a coefficient of variation (CV) at 355% compared to India's CV of 84% (Fig. 9.2). Agricultural growth declined five times during the 1990s due to natural calamities.

During the 2000s, Odisha recorded positive growth rates. However, the present decade (2011–12 to 2017–18) has already seen negative growth rates in four of seven years, making Odisha one of the poorest performing states in terms of agricultural growth.

9.2.2 Agricultural Livelihood in Odisha

Like other states in India, Odisha too is dominated by small and marginal farm holdings. Of the total 48.7 lakh farm holdings in Odisha, 93% are in the small and marginal category with less than 2 ha of land accounting for around 75% of the total land. The number of small and marginal farmers has increased by 5.6% between 2010–11 and 2015–16 (Fig. 9.3). Large farmers (landholding size >4 ha), on the

[1]Gross value added at basic prices is defined as output valued at basic prices less intermediate consumption valued at purchasers' prices.

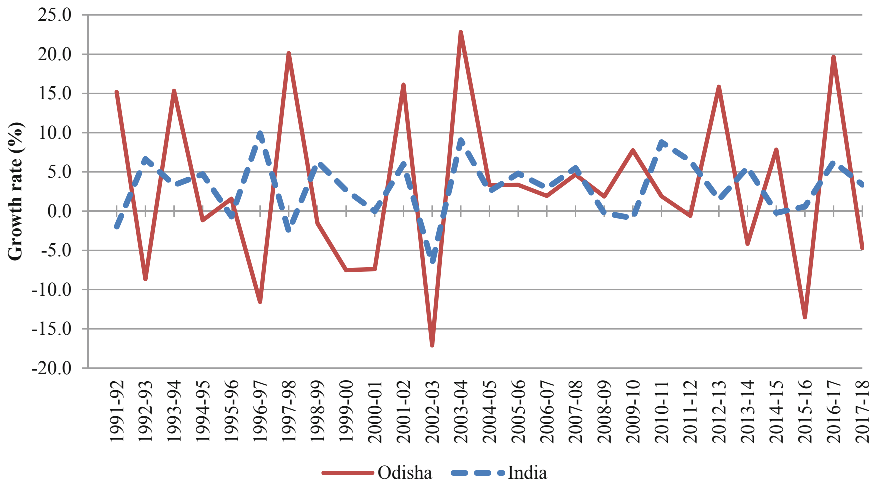

Fig. 9.2 Growth rate in agriculture and allied sectors in India and Odisha. *Source* (CSO, Various Issues)

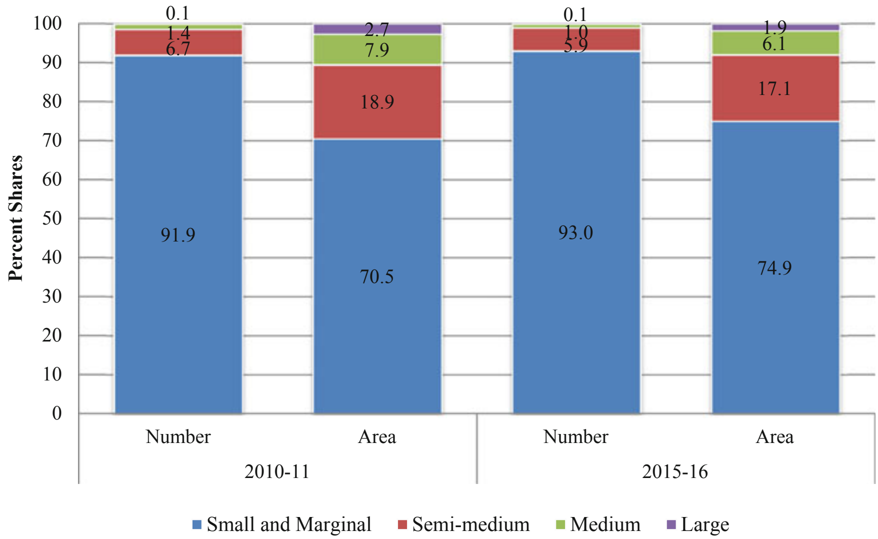

Fig. 9.3 Share of operational holding (%). *Source* (Agriculture Census 2015–16)

other hand, are a mere 0.1%, with around 2% of the total land (Agriculture Census, 2015–16).

Odisha has 32.6% of the population below the poverty line (Tendulakar Committe 2011). The state's per capita income in 2017–18 was Rs. 80,991 compared to the national average of Rs 126,043. However, Odisha has achieved the fastest reduction in poverty rates from 61% in 2004–05 to 36% in 2011–12. The important contributory factor for this has been rising incomes from the livestock sector (Hoda et al. 2017).

In 2015–16, the average monthly income per agriculture household was Rs. 7731 compared to Rs. 8931 at the all-India level according to NABARD's Financial Inclusion Survey for 2015–16, which is among the lowest in India, but is better than the average monthly income in Andhra Pradesh (Rs. 6920), UP (Rs. 6668) and Bihar (Rs. 7175) (NABARD 2018).

9.2.3 Land Utilisation and Cropping Pattern

Land utilisation pattern[2] in Odisha has undergone considerable change over the last two decades. While land available for agriculture has declined, there is a substantial increase in fallow lands. Gross cropped area (GCA) decreased from 9.6 m ha during TE1992–93 to 8.5 m ha during TE2016–17 and the net sown area (NSA) fell from 41 to 36% of the total geographical area of 15.6 m ha during the same period. This decline in cultivable land can be attributed to increased salinity in soil due to frequent flooding, soil erosion and inadequate irrigation during the *rabi* season.

Fallow land other than current fallows and current fallows together accounted for 5.3% of the total geographical area during TE2016–17 against 2.3% during TE1992–93. During TE2012–13, fallow land had touched 1.1 million hectares, about 7% of the total geographical area, due to irregular rainfall, frequent natural calamities, lack of irrigation facilities and poor soil quality in the state. There have also been large conversions of agricultural land to non-agricultural land for use in industrial and domestic constructions.

Odisha is predominantly a rice-producing state but the cropping pattern has been evolving as can be seen in Fig. 9.4. The most notable change since TE 2001–03 has been that the share of rice in the GCA has fallen while that of pulses has increased.

9.2.4 Determinants of Agriculture Growth

We analyse below the status of physical infrastructure such as irrigation, power and road and other factors like diversification that have played a critical role in the growth of the agriculture sector.

Irrigation

Irrigation is by far the most important driver of agricultural growth in Odisha. Odisha is heavily dependent on rainfall and receives annual precipitation of 230.76 bcm. The normal annual rainfall in Odisha is 115 cm of which the South-West monsoon

[2]There is discrepancy in LUS data of DES, GoI; hence, data from Odisha Agriculture Statistics have been used

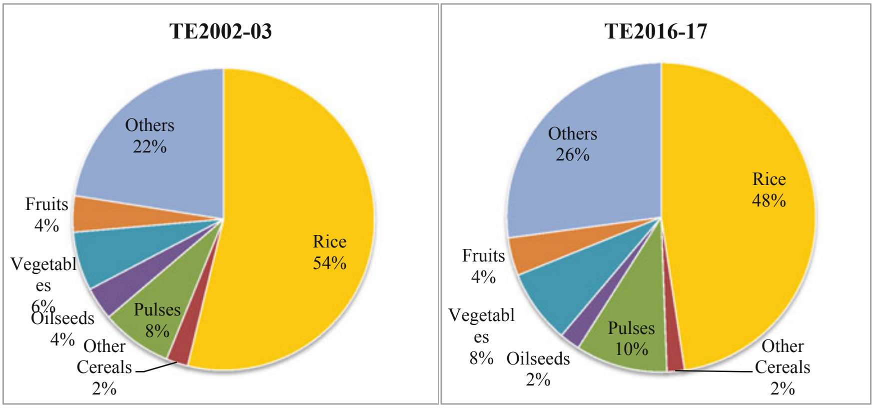

Fig. 9.4 Area under crops as % of gross cropped area (GCA). *Source* DES

months contribute 79% in the months of June to September (IMD 2016). There is also spatial variation and the northern plateau gets higher rainfall than the southern coastal plains. Because of temporal and spatial variations in rainfall, exacerbated by the frequent occurrences of floods and drought, the development of irrigation infrastructure assumes importance for agriculture.

The irrigation ratio (gross irrigated area as a proportion of gross cropped area) in Odisha has consistently remained below the all-India level. While the irrigation ratio in 2014–15 was 38.4 in Odisha, it was 48.6 at the all-India level (Fig. 9.5).

Against the ultimate irrigation potential (UIP) of 8.8 m ha in Odisha, 3.6 million hectares can be created using major and medium projects, 1 million hectares using

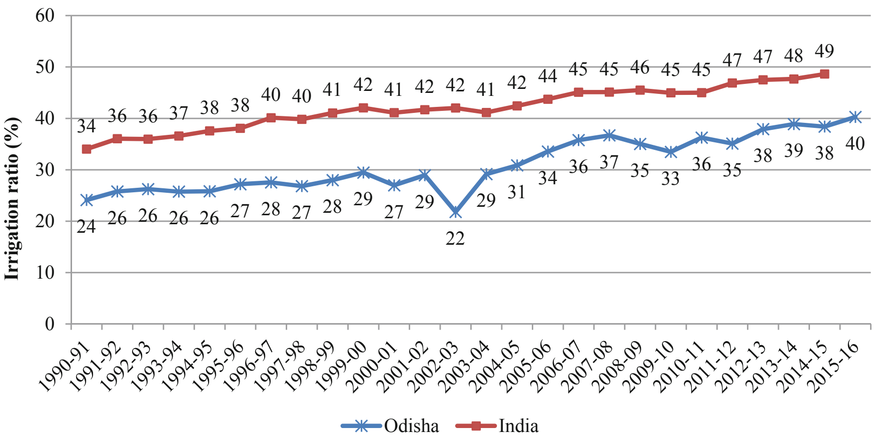

Fig. 9.5 Irrigation Ratio (Odisha and India). *Source* (Odisha DES, Various Issues) and (Land Use Statistics, DES 2018)

minor flow and 4.2 million hectares using minor lift irrigation projects. As of 2018–19, 81% of minor flow had been exploited as against 44% in minor lift and 59% in major and medium projects (Fig. 9.6).

Until 2016–17, the potential of 5.6 m ha or 64% had been created out of the UIP of 8.8 million hectares. However, only 3.6 m ha or 64% of irrigation potential created (IPC) has been utilised so far. In fact, the share of utilisation in IPC (share of irrigation potential utilised over-irrigation potential created) has been declining since 2007–08 after it peaked at 81% (Fig. 9.7). In major and medium irrigation projects, the main reason for the shortfall in utilisation is the lack of field channels

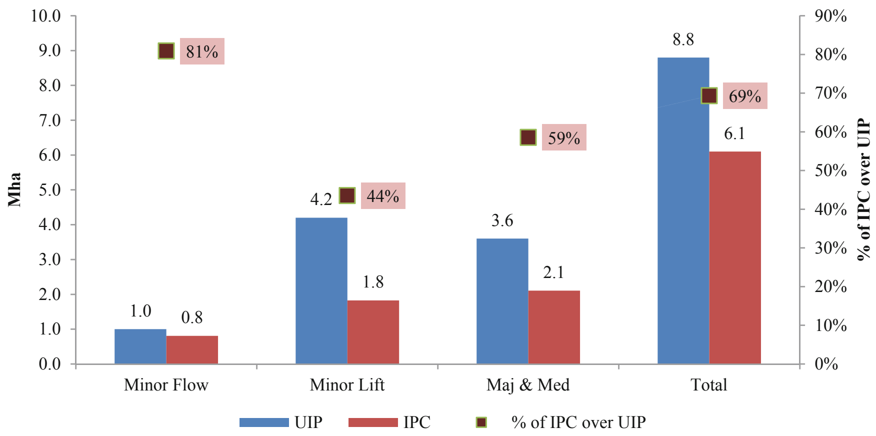

Fig. 9.6 Ultimate Irrigation Potential (UIP) and Irrigation Potential Created (IPC) in Odisha (2018–19). *Source* DoWR, Odisha

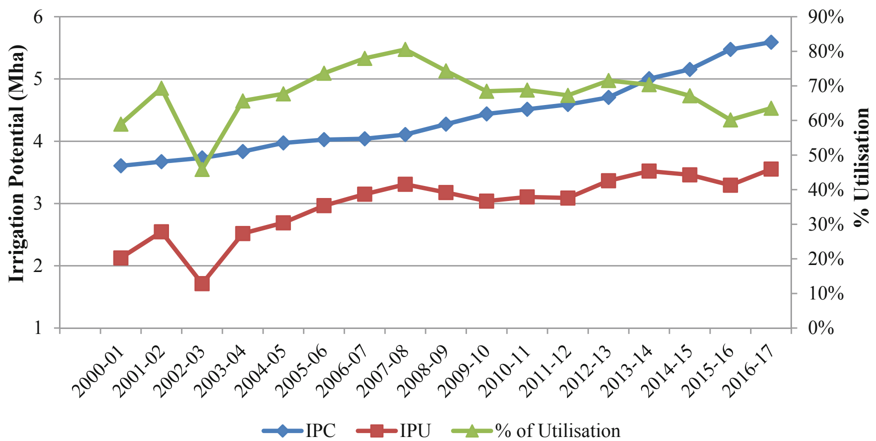

Fig. 9.7 Gap between irrigation potential created and irrigation potential utilised in Odisha. *Source* (DoWR, Odisha)

in the command area, and poor maintenance of distribution infrastructure. In minor irrigation schemes, it is the siltation of channels and tanks.

Odisha has abundant groundwater resources—about 16.69 lakh bcm. However, the state lags behind in the development of these resources as only 5.02 lakh bcm or 30% of the total potential has been used so far for different purposes, especially for irrigation (DoWR Annual Report 2016–17). Deficiencies in the transmission and distribution infrastructure of power are the main reasons for the low level of utilisation of groundwater.

Due to frequent droughts, there is a decline in the groundwater level, particularly in the southern plains. To tackle this problem, the Odisha government has signed an agreement with NABARD to develop infrastructure for groundwater recharge and solar micro-irrigation to ensure food security and enhance resilience in 15 districts with financial assistance from the South Korea-based Green Climate Fund (NABARD 2018). The project is expected not only to improve the water table in the state but also to enhance the water quality for the health and well-being of about 52 lakh vulnerable communities in these districts who are prone to food and water insecurity.

Out of the ninety-nine (99) ongoing major/medium irrigation projects under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY)—Accelerated Irrigation Benefits Programme (AIBP)—due to be completed by December 2019, eight are in Odisha with a targeted potential of 371,500 ha to be created. According to the AIBP dashboard, three of these had already been completed by September 2019 (PMKSY-AIBP 2019).

Power

Electricity is an important input for agriculture for use in irrigation and operating agricultural machinery and equipment and is considered as an indicator of an economy's development. However, Odisha's situation in power sales/consumption is poor, especially when it comes to the agricultural sector, resulting in under-utilisation of groundwater resources in Odisha.

The per hectare power consumption in agriculture or power intensity in Odisha is among the lowest in the country. While Odisha recorded a power intensity of 24 KWh/ha during 2014–15, states like Tamil Nadu with 2070 KWh/ha, Haryana with 1477 KWh/ha and Karnataka with 1469 KWh/ha were the highest-ranked states in terms of power intensity. Punjab and Gujarat had higher power intensities whereas Madhya Pradesh (633 KWh/ha) and Uttar Pradesh (450 KWh/ha) had lower power intensities than at the all-India level. Apart from Odisha, only Bihar had a low power intensity at 41 KWh/ha. In recent years, however, there has been a substantial increase in power intensity, which reached 41 KWh/ha in 2016–17. This is the result of increasing power sales to the agriculture sector in recent years (2014–15 to 2016–17) (Fig. 9.8).

However, Odisha has the lowest agricultural power sales to total power sales ratio in the country. As shown in Fig. 9.9, the share of the agricultural sector in total power sales declined from 3.2% during 2000–01 to 1.9% during 2016–17 as compared to all-India's share from 26.8% that declined to 20.9% during the same period. In states like

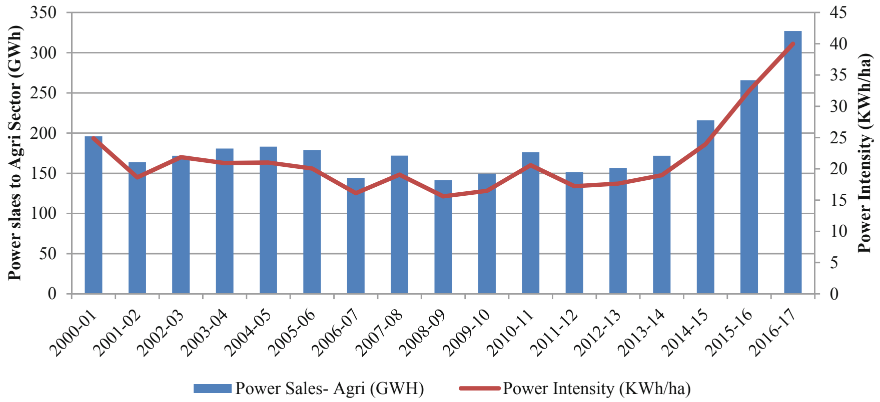

Fig. 9.8 Power sales and power intensity in Odisha (agricultural sector). *Source* Authors own calculation using data from Central Electricity Authority (CEA), Various Issues and (Odisha DES, Various Issues)

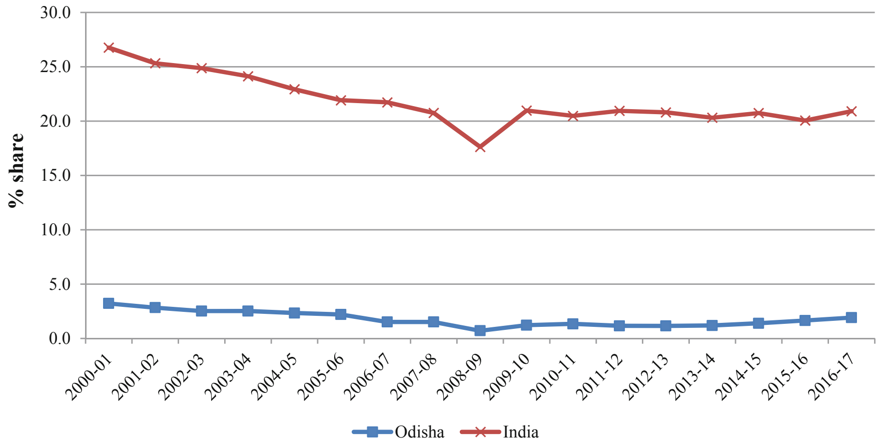

Fig. 9.9 Share of agriculture in total power sales. *Source* (CEA, Various Issues)

Uttar Pradesh (19.3%), Gujarat (19.6%), Punjab (27.7%), Madhya Pradesh (37.9%) and Rajasthan (41.9%), power sales to agriculture shares were way higher than in Odisha during 2016–17. While power sector reforms took place in Odisha during the 1990s when generation, transmission and distribution activities of the Orissa State Electricity Board (OSEB) were unbundled and an independent and transparent regulatory regime was established, the consumption of power in the agricultural sector remained low. In 1999, power distribution was privatised to bring efficiency. This resulted in decrease in the aggregate technical and commercial (AT&C) losses in the state from 57% in 1999–00 to 38% during 2014–15. However, it is still way higher than the national average of 21.4%.

Although Odisha has surplus power, the state faces extreme deficit in supply during peak demand, apart from high voltage fluctuations and frequent load shedding especially in rural areas. This poor quality of power situation in Odisha explains the reasons for lack of a supply chain infrastructure including cold storages and milk processing in the state. The Government of India's scheme of *Deen Dayal Upadhaya Gram Jyoti Yojana* (DDUGJY) for rural areas was launched to resolve issues related to the quality and quantity of power to agriculture. The major aim of the scheme was to separate agriculture and non-agriculture feeders, facilitating judicious supply to agricultural and non-agricultural consumers, to strength transmission and distribution infrastructure and for rural electrification. However, Odisha does not seem to be taking full advantage of the funds available under the *Gram Jyoti Yojana*. About four years ago, 31 projects were sanctioned for a sum of Rs. 1654 crore, but as on August 31, 2019, only Rs. 670.51 crore had been drawn by the state (DDUGJY Portal 2019).

According to the Government of India, complete rural electrification has been achieved in Odisha with 100% of its villages electrified under the *Saubhagya Yojana*. As of 31 April 2019, all 47,677 villages in Odisha stand electrified. However, inadequate and unreliable power supply remains one of the pressing problems in rural Odisha. In a joint initiative with all state governments, the Government of India launched "24 × 7 Power for All (24 × 7 PFA)" to provide reliable power to consumers apart from adequate power supply to the agriculture sector (MoP 2016). While the *Saubhagya* scheme provided access to all, 24 × 7 PFA will provide sustainable and 24 × 7 power to all.

To boost solar energy power generation, the Odisha government plans a total of 2378 MW of solar energy to be established by the Green Energy Development Corporation Limited (GEDCOL) in co-ordination with the Odisha Renewable Energy Development Agency (OREDA) by 2022. The state government is also promoting the use of 0.5 hp solar photo voltaic pump sets in areas with no or inadequate electricity supply. The government provided 90% subsidy for solar power pumps to around 5000 farmers during 2017–18 and 2018–19 to increase irrigation potential and cropping intensity in the state (GoO 2019).

Roads

Odisha has a road network of 2.9 lakh km with 77% being rural roads. Odisha's total road density in 2015–16 stands at 185 km per 100 km^2, much higher than the all-India average of 143 km per 100 km^2. Odisha's total road density was constant between 2001–02 and 2007–08 when the average road density in India was rising. Since 2008–09, Odisha's total road density has increased at the same pace as India's (Fig. 9.10). However, in terms of surfaced road density, Odisha is behind the average for the country as a whole, and in fact, the gap has been widening since 2001–02, as can be observed in the figure. In 2011–12, only 23.9% of the total roads in Odisha were surfaced as compared to 89% in Gujarat and Punjab, 77% in Uttar Pradesh, 61.5% in Madhya Pradesh and 47.2% in Bihar.

Due to inconsistent data for surfaced roads in Odisha after 2011–12 in Basic Road Statistics, we have limited our analysis from 2000–01 to 2011–12.

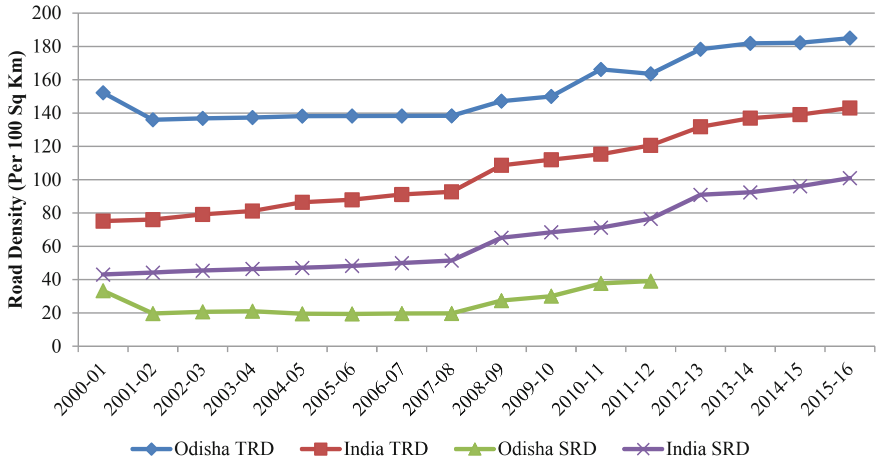

Fig. 9.10 Total road density and surfaced road density for Odisha and India. *Source* (Basic Road Statistics of India (Various Issues))

Diversification

With increasing demand for high-value agricultural commodities like milk, meat, fruits and vegetables, there is pressure for change in the cereal centric policies of the government. The increasing value of livestock and horticultural output as compared to food grains testifies to the process of diversification in Odisha's agriculture and highlights the need for government to take supportive action to foster the development of value chains.

Horticulture

Horticulture in Odisha suffers not only from the lack of organised marketing but also from a shortage of cold storage facilities for perishable fruits and vegetables. As of 2017, Odisha had 171 cold storages, which represented a mere 2.2% of the total cold storage capacity in India. Most of these cold storages are used for keeping potatoes. More cold storages are needed for potatoes as well as other fruits and vegetables. Solar-powered cold storages are another option, which also has lower operational costs compared to traditional cold storages. Processing facilities for fruits and vegetables, which the state lacks, is another area of concern.

Dairy

The dairy sector faces a different set of issues. Odisha's dairy sector suffers from low animal productivity, poor marketing and low levels of milk processing. Odisha had 1.4 million artificial inseminations (AIs) performed in 2017–18, which was just 2% of total AI performed in India. As shown in Fig. 9.11, UP (12.7 m) had the highest number of AIs performed followed by Gujarat (7.4 m), Tamil Nadu (7 m) and Karnataka (6.7 m). To strengthen the dairy industry in Odisha, there is a need to set up more dairy co-operative societies, collection centres and processing facilities.

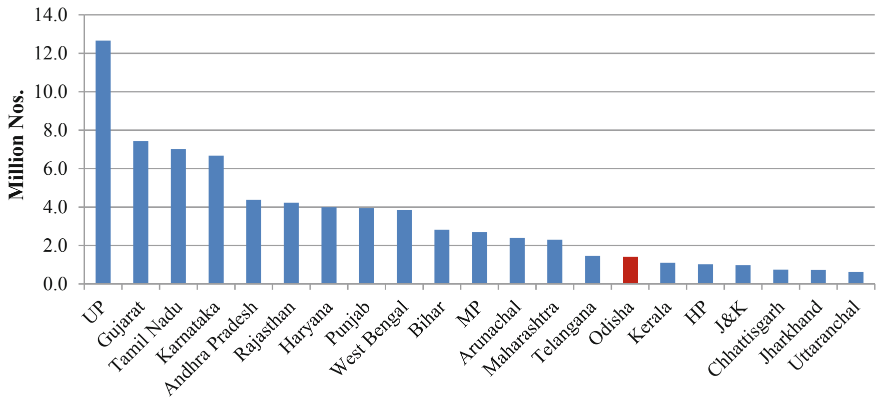

Fig. 9.11 State-wise artificial inseminations performed (2017–18). *Source* Basic Animal Husbandry Statistics

Linking farmers with the organised milk processing sector through producer-owned dairy co-operatives will make dairy farming more sustainable for Odisha farmers.

The low productivity of milch animals in the state is despite the fact that the best germplasm is being used in the state for artificial insemination and cross-breeding. The low productivity is ascribed by state officials to the diet of milch animals. Farmers do not have the incentive to improve their diet to increase production because market expansion has been too slow to enable the off-take of increased output. In this situation, in order to increase productivity, farmers need to reduce the herd size, so that milch animals constitute a higher proportion. To achieve this, the state needs to adopt cutting edge reproduction management technologies, such as semen-sexing (Hoda et al. 2017).

9.3 Composition and Sources of Agricultural Growth

Even as the cropping pattern of Odisha is dominated by foodgrains especially rice, it is fruits and vegetables that have a higher share in gross value of output from agriculture and allied activities. Cereals had a 20% share in gross value of output during TE2015–16, down from 21% in TE2002–03 (Fig. 9.12). Rice contributed 98% of the total value of cereal output. While fruits and vegetables still dominate GVO, its share declined from 34% in TE2002–03 to 30% during TE2015–16. Livestock is an emerging sector in Odisha, with the value of output increasing from 12.9 to 18.4% during the same period. The livestock sector is dominated by meat (49%) and milk (39%).

Let us now decompose the sources of agricultural growth in Odisha. In order to do this, we will use gross value of output (GVO) at current prices for different segments and total gross value of output from agricultural and allied activities. To analyse the

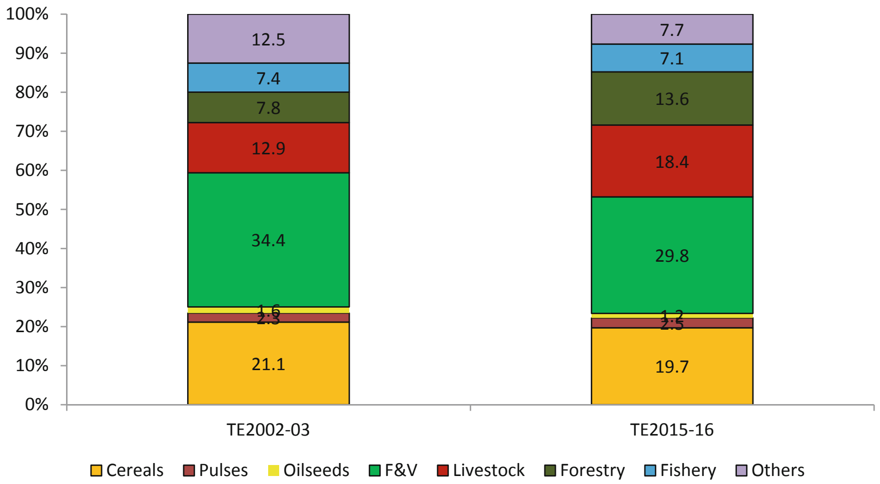

Fig. 9.12 Sector-wise shares in gross value of output from agriculture and allied activities. *Source* (MoSPI, State wise estimates of Value of Output from Agriculture and Allied Activities, Various Issues)

composition of agriculture, we have computed the share of value of output from different segments as a percentage of the total value of output from agriculture and allied activities. To determine the sources of growth, we have deflated the current series of each segment by the WPI at 2011–12 prices. Then, decomposed year-on-year growth in GVO from agriculture and allied activities is calculated by estimating the absolute year-on-year difference in GVO from each segment and estimating its ratio as a proportion of the previous year's gross value of output from agriculture and allied activities (GVOA).

Using the above methodology, the average growth of GVO for the agricultural and allied sector in Odisha was computed to be 6.54% annually between 2000–01 and 2015–16. Decomposing this growth into various sectors shows that high-value agriculture commodities like fruits and vegetables, and livestock had the maximum shares. While fruits and vegetables contributed 31.5% share to this growth, livestock accounted for 23%. Coming in third position, cereals had a 15% share in the growth. Pulses contributed a mere 3%, while oilseeds had a 0.8% share in the growth. Forestry and fisheries contributed 17.8 and 8.6% shares, respectively (Fig. 9.13).

Let us now discuss each of these segments briefly in terms of production and productivity growth, government policies and the overall success and failure of the sector.

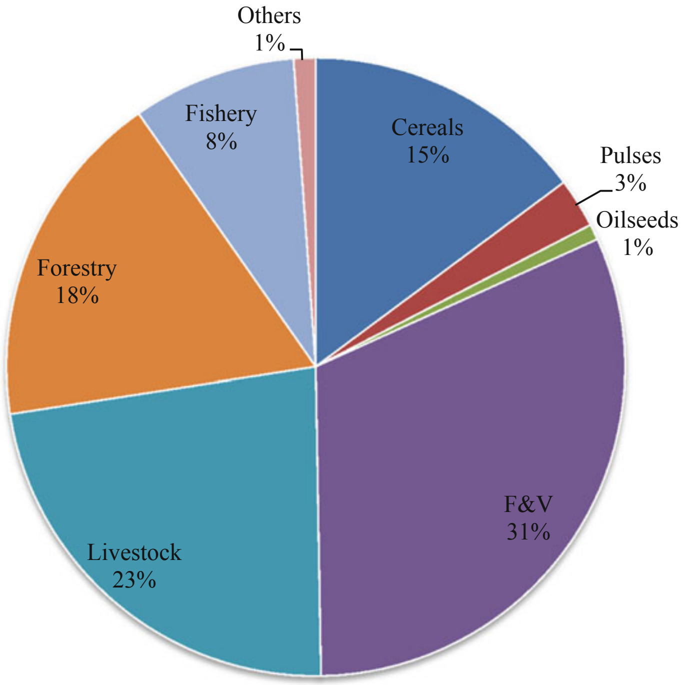

Fig. 9.13 Sources of growth in GVOA of Odisha. *Source* Authors own calculation using data from MoSPI

9.3.1 Foodgrains

Cereals

Rice is the dominant crop within cereals, accounting for 48% of the gross cropped area in Odisha (and accounting for 96% of the area under cereals) and 19.3% of GVOA (98% of the total value of output of cereals). The state ranks third for rice acreage and sixth for rice production among all Indian states. Rice production increased from 5.8 MMT during TE1992–93 to 6.9 MMT during TE2017–18. However, there was a substantial decline in rice production from 8.3 MMT in 2016–17 to 6.6 MMT in the following year, affecting overall foodgrains production in the state (Fig. 9.14). This decline lowered Odisha's rank from fourth to sixth in rice production. The steep fall in production was due to drought conditions in 2017, compounded by a pest attack and unseasonal rainfall (Odisha Eco Survey 2018–19).

Even though Odisha has a share of 6.3% in India's total rice production (TE2017–18), its rice productivity is among the lowest in the country. There was an improvement in its rice productivity from 1.1 mt/ha during TE2002–03 to 1.8 mt/ha to TE2017–18, but it still lags behind the national average of 2.5 mt/ha. All major rice-producing states have higher productivity than Odisha including West Bengal (2.9 mt/ha) and Uttar Pradesh (2.2 mt/ha). Punjab had the highest productivity of

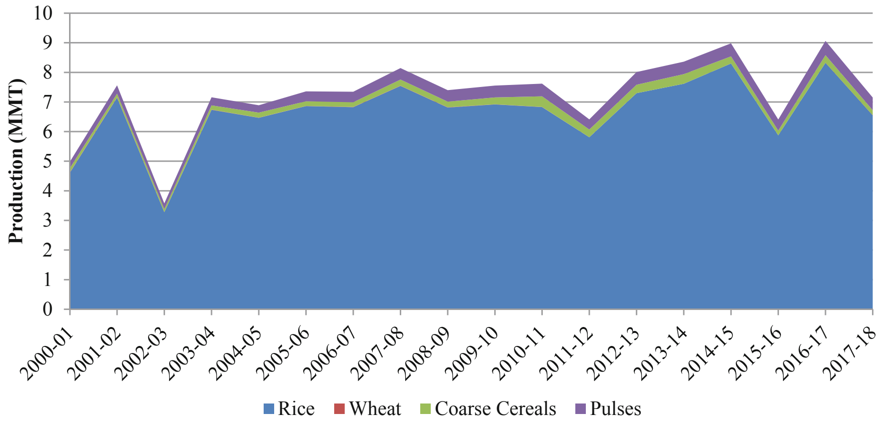

Fig. 9.14 Foodgrains Production in Odisha. *Source* DES, Government of India

4.1 mt/ha. States like Andhra, Haryana, Tamil Nadu and Telangana recorded productivity levels of more than 3 mt/ha. Maize is another cereal produced in Odisha; however, it stands nowhere compared to rice, with just a 2% share in the total value of cereal output.

Pulses

Pulses contribute just 2% to the gross value of output from agriculture and allied activities. The share has been almost constant over the last two decades. There was a steep decline in pulses production from 1.5 MMT during TE1992–93 to 0.23 MMT during TE 2002–2003, since when it has recovered to 0.43 MMT during TE2017–18. *Tur* and *moong* are the two important pulse crops cultivated in Odisha. Not among the major producers of pulses in India, the state's productivity in pulses lags behind the national average productivity levels.

9.3.2 *Oilseeds*

Odisha is not among the major players in the oilseeds economy of India as it contributes less than 0.5% to the national production of oilseeds. The share of oilseeds in GCA stands at 2%, while its share in GVOA is just 1%. Like pulses, oilseeds production too saw a substantial fall since the 1990s, declining from 0.68 MMT during TE1992–93 to 0.13 MMT during TE2016–17. Even though, the national production of oilseeds has increased in the last two decades, making India its largest producer, rice-centric Odisha has long neglected this sector.

9.3.3 *Fruits and Vegetables*

With just a 12% share in gross cropped area, fruits and vegetables have a 30% share in gross value of output from agriculture and allied activities (GVOA). While its contribution to GVOA has declined from 34% during TE2002–03 to 30% during TE2015–16, fruits and vegetables contribute the largest share to GVOA among all segments of agriculture and allied activities.

Vegetables

Odisha is the seventh-largest producer of vegetables contributing 4.9% to total vegetable production in India. Accounting for 8% of GCA, Odisha produced around 8.8 MMT of vegetables during TE2017–18 (DoAC&FW 2019). Not among the major producers of potato, which is by far the largest cultivated and produced vegetable in India, Odisha is among the largest producers of other important vegetables. Major vegetables grown in Odisha in descending order of their contribution to the value of output include brinjal (18.1%), tomatoes (11.2%), cabbage (5.9%), okra (5.6%), cauliflower (4.3%), onion (3.3%) and sweet potato (2.5%), constituting 50.8% of the total value of output of fruits and vegetables (TE2016–17). These vegetables, along with potato, represent three-fourths of the total vegetable production in the state (Fig. 9.15). In comparison to other states, Odisha is the largest producer of sweet potato and pumpkin (*sitaphal*), the second-largest producer of brinjal and cabbage, fourth-largest producer of okra, bitter gourd and cauliflower and the fifth largest producer of tomatoes in India.

We have compared the productivity of important vegetables grown in Odisha with the average productivity in the country (Table 9.1). While during the last 10 years, the productivity of vegetables has generally improved in the state, it remains below

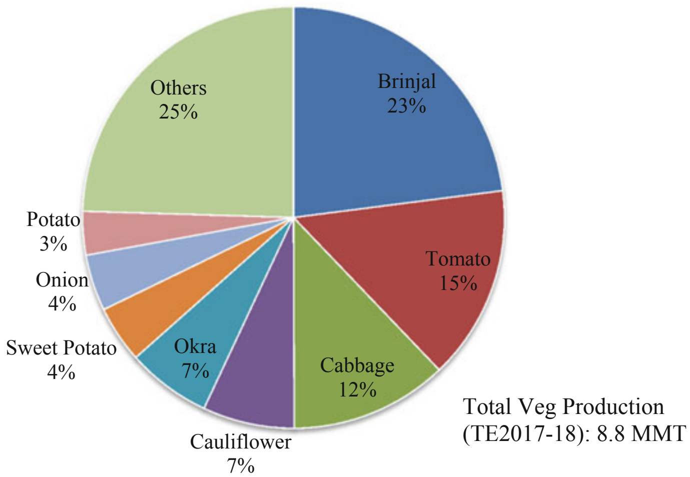

Fig. 9.15 Share of Major Vegetables Produced in Odisha (TE 2017–18). *Source* (DoAC&FW 2018)

Table 9.1 Productivity comparison of Odisha's major vegetables

Vegetables	Productivity (t/ha)			
	Odisha		India	
	TE2007–08	TE2017–18	TE2007–08	TE2017–18
Brinjal	14.8	17.1	16.8	17.9
Tomato	13.3	14.3	17.7	25.1
Cabbage	27.6	28.1	22.3	22.4
Okra	8.7	8.8	10.2	11.8
Cauliflower	14.2	15.1	18.4	19.0
Sweet Potato	8.5	9.4	8.8	11.5
Others	11.9	11.5	13.6	14.0
Total	12.4	13.6	15.7	17.4

Source National Horticultural Database 2008, 2009 and Horticulture Statistics at a Glance 2018

the all- India average, except in the case of cabbage. Like many other states in India, Odisha is also affected by the boom and bust cycles of vegetable prices. With bumper crops of tomatoes, farmers here often resort to distress sales and even dump their produce on roads in the absence of proper marketing, storage and processing facilities. On the other hand, potato consumers in Odisha face another type of crisis in the form of price rise leading to heavy dependence on other states like West Bengal and Uttar Pradesh to meet its needs. Odisha produces 3 lakh mt of potatoes, which is less than 1% of national production. The state government implemented "Potato Mission" in 2015–16 to increase potato production and achieve self-sufficiency. However, with heavy crop losses due to late sowing, Odisha could not achieve the target and the mission failed. The recently announced "Operation Green" scheme of the Government of India under the Ministry of Food Processing includes Odisha's two districts-Mayurbhanj and Keonjhar which have been selected for tomato clusters. This scheme aims to stabilise the prices of three of the most important vegetables: tomatoes, onions and potatoes (TOP) by ensuring availability of the product throughout the country round the year without price volatility. However, even though the guidelines have been issued, the scheme has not taken off as yet.

Fruits

Fruits are cultivated on 4% of Odisha's gross cropped area, making the state the twelfth largest fruit producer, ranking sixth in acreage (DoAC&FW 2019). Odisha produced 2.4 MMT of fruit crops during TE2017–18, which was 2.6% of the country's total fruit production. With poor productivity recorded for most fruits, Odisha's fruit productivity (7.1 mt/ha) is only 50% of the national average (14.6 mt/ha). Mango is the most important fruit crop produced in Odisha, contributing the largest share to production at 33%, in terms of both the value of output and acreage under fruits. Other important fruits produced in the state are banana, lime/lemon, watermelon, guava and papaya (Fig. 9.16). The area under mango has increased significantly from 53,000 ha during TE1992–93 to 19.9 lakh hectares

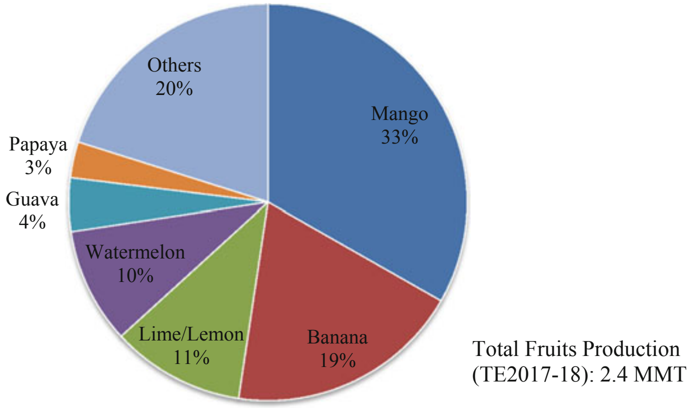

Fig. 9.16 Share of Major Fruits Produced in Odisha (TE 2017–18). *Source* (DoAC&FW 2018)

during TE2017–18. Odisha is the eighth largest mango producing state in India with a total production of 8 lakh mt during TE2017–18, contributing 4% of the country's total mango production. However, productivity is among the lowest in the country with only 4 MT per hectare during TE2017–18 compared to India's average of 9 MT per hectare. Even though the state has 10% of the total acreage under mango in the country, it contributes just 2.6% to total mango production. APEDA data for exports suggest that Odisha is the second-largest exporter of mangoes after Maharashtra, and even its low-quality mangoes get exported to neighbouring countries, Nepal and Bangladesh. Odisha has the potential to increase mango yields if it adopts ultra-high-density mango planting and micro-irrigation technologies for mango orchards. Maharashtra has already adopted these and now the state is the country's largest mango exporter to the world.

9.3.4 Livestock

The growth of the livestock sector in Odisha has been phenomenal in the last one and half decades. Its share in the gross value of output from agriculture and allied activities (GVOA) has increased from 12.9% during TE2002–03 to 18.4% during TE2015–16. Milk contributed 39% of the GVO from livestock during TE2015–16, meat 49% and eggs 6%. The dominance of meat is a recent phenomenon as milk had a 49% share in livestock GVO during TE2002–03 compared to the share of meat at 36% (Fig. 9.17).

Odisha has 4.1% of the bovine population and 2.7% of the poultry population of India (Livestock Census 2012). Cattle form the majority of the bovine population with a 95% share while buffaloes constitute a mere 5%. A comparison of different livestock censuses reveals that Odisha's livestock population declined from 24 million in 2003 to 23.1 million in 2007 and further to 20.7 million in 2012. The poultry population

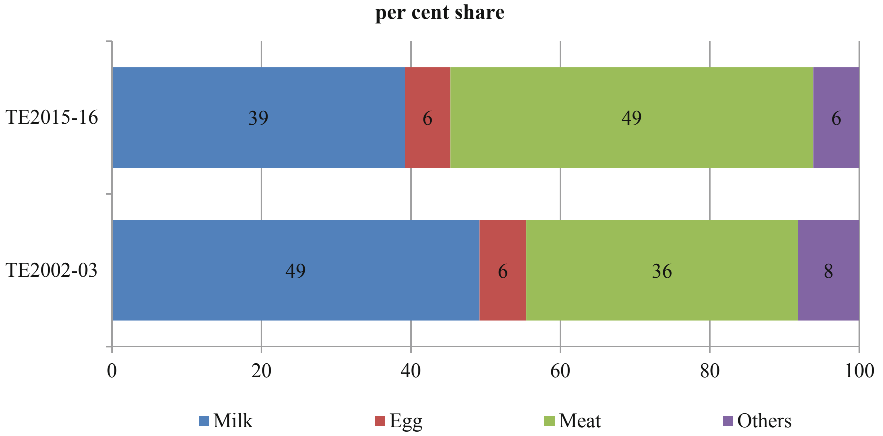

Fig. 9.17 Composition of Value of Output from Livestock. *Source* Authors own calculation using data from MoSPI

increased from 17.6 million in 2003 to 20.6 million in 2007, declining slightly to 19.9 million in 2012.

Milk

Milk production in Odisha increased from 0.92 MMT in TE2002–03 to 2 MMT in TE2017–18 (Fig. 9.18). Odisha ranks sixteenth in milk production in India with a share of 1.2%. Odisha's per capita availability of milk at 128 g/day is among the lowest in India. Out of the total milk production in Odisha during TE2017–18, 87% was cow milk, 12.8% was buffalo milk and 0.2% was goat milk. The average yield

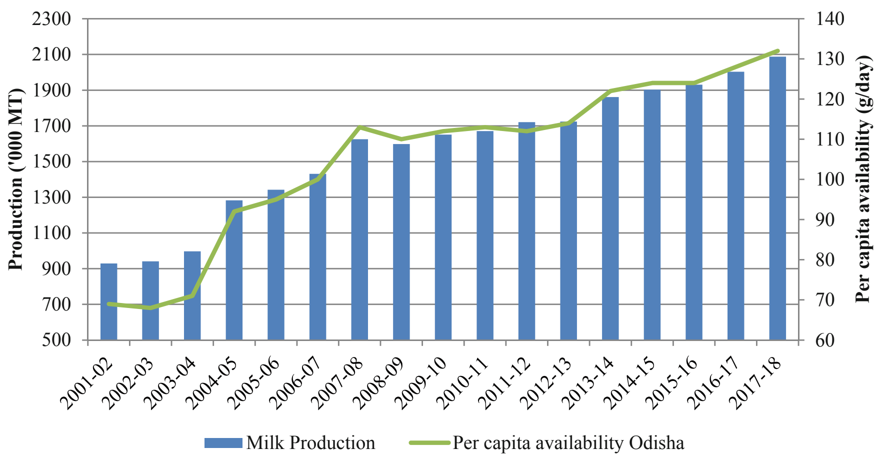

Fig. 9.18 Milk production and per capita availability in Odisha. *Source* (Basic Animal Husbandry and Fisheries Statistics, Various Issues)

for crossbred cows in Odisha was 6.2 kg/day, for indigenous cows 1.4 kg/day and for buffaloes 3.9 kg/day during TE2017–18, which are all lower than the national average.

The low productivity of milch animals in Odisha can be attributed to poor feed quality and high breeding overheads. An FAO report (Gerber et al. 2013) notes that "about 57 of the dairy herd in South Asia is composed of non-milk producing animals compared with a global average of 41% in dairy cattle mixed systems". As recommended in the report, the relative share of productive animals in the herd can be increased by improving animal health and adopting advanced reproduction management technology such as semen-sexing in artificial insemination. The report adds: "The adoption of semen-sexing technology for 25% of the dairy cows in India was estimated to reduce male calf numbers by 9%".

The Odisha State Co-operative Milk Producers' Federation Limited (OMFED) was established under Operation Flood of NDDB. It had 5852 dairy co-operative societies registered with 2.76 lakh members in 2017–18. Average procurement by OMFED was 9.3% of total milk production in the state in TE2017–18, compared to GCMMF's procurement of 53.7% of production in Gujarat. Private players operating in the milk business in Odisha include Pragati Milk Products Private Limited with a plant capacity 250 KLPD milk, and Milk Mantra, which is India's first venture capital-funded start-up in the food sector.

Meat

Meat production in Odisha has more than quadrupled from 42,000 MT during TE2002–03 to 175,000 MT during TE2017–18. This explains the increasing share of livestock in the gross value of output from agriculture and allied sectors. However, Odisha's share in the total meat production in the country has increased only marginally from 2.1 to 2.4% during the period. Even though the increase in meat production was because of both animal meat (goat, sheep, pig) and poultry meat, the composition of meat production has undergone a major shift towards poultry meat. During TE2002–03, 68% of meat production came from goats, 22% from sheep, 9% from pigs and 1% from cattle. However, during TE2017–18, poultry meat contributed to 46% share to total meat production followed by goats (40%), sheep (9%) and pigs (5%).

While 70% of total poultry in Odisha consist of backyard breeds, vertical integration of the poultry value chain by several private players is gaining prominence. Earlier dependent on neighbouring states for poultry meat, Odisha now has large broiler integrators like Venky's, Pasupati and Suguna working with small farmers. These private players have entered into contracts with small farmers and provide them day-old broiler chicks, broiler feed, medicines and vaccines and veterinary services. Once the birds are six weeks old, they are weighed and sold back to the integrator under the respective brand name. Apart from these big private companies, several poultry co-operatives are working for poultry development and providing livelihood to a large number of small farmers.

Eggs

Eggs are the third largest component of the livestock sector after milk and meat. Egg production in Odisha increased from 843 million during TE2002–03 to 2 billion during TE2017–18, constituting 2.2% of India's total egg production of 88.8 billion. The per capita egg availability in Odisha stands at 46.3 per annum compared to the all-India figure of 70 eggs per annum. Commercial poultry farms contributed 86% of the egg production and backyard poultry only 14% during TE2017–18 compared to 81% and 19%, respectively at the all-India level.

9.3.5 *Fisheries*

Fish has always been an integral part of the Odia diet given Odisha's proximity to a large coastline and lakes. The fisheries sector holds an important place in the state's economy. It not only gives employment opportunities to the large community of fishermen but also contributes significantly to the GDP of the state. The share of the fisheries sector in the gross value of output from the agriculture and allied activities sector, however, declined marginally from 7.4% during TE2002–03 to 7.1% during TE2015–16. Odisha's fish production increased from 277 thousand metric tonnes (TMT) during TE2002–03 to 607 TMT during TE2017–18. The state ranked tenth in fish production with a share of 5.3% during TE2017–18 of which 75% came from inland sources and 25% from marine sources. As shown in Fig. 9.19, there has been a rapid increase in inland fish; marine fish production has remained stable since 2000–01. This increase in inland fish is basically due to an increase in fish production from fresh water sources and brackish water. Freshwater fish from tanks and ponds account for a share of more than 84% of the production. Odisha's share in India's total fish production has hovered between 4 and 6% since 2001–02.

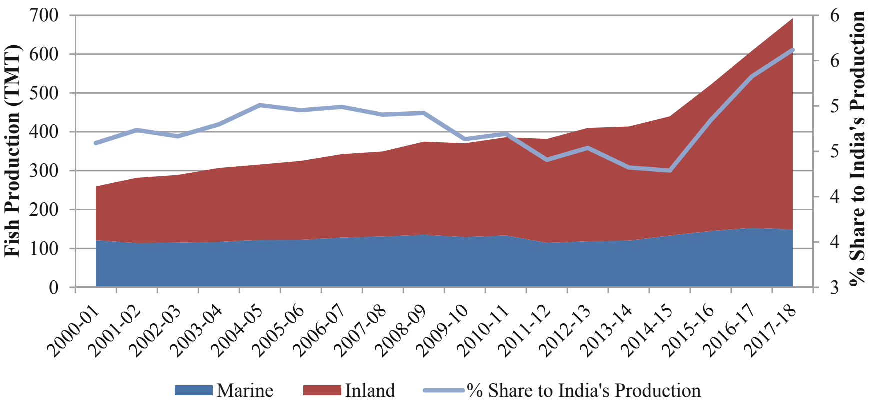

Fig. 9.19 Odisha's fish production. *Source* (Basic Animal Husbandry and Fisheries Statistics, Various Issues)

The strength of the fisheries sector in Odisha lies in its large unutilised freshwater and brackish water resources. Odisha has not been able to develop its marine fish sector; production has remained stagnant in the last two decades or so. Fish production from fresh water including tanks, ponds, swamps, lakes, reservoirs, rivers and canals can be further developed. There is huge potential for the development of freshwater fisheries in Odisha, which has 32,587 ha of cultivable brackish area, 3 lakh hectares of estuaries, brackish water and backwater areas and 93,000 ha of the Chilika Lake (Perspective Plan 2010–2020 for Fishery Development, Odisha). The government should encourage PPP models for the development of inland, fresh water and brackish water fishery. Apart from the expansion of fishery, the availability of large wet lands in Odisha offers unique opportunities for agricultural development by promoting the cultivation of *makhana*, water chestnut and lotus and the adoption of various combinations of integrated crop-fish-animal farming systems. (Hoda et al. 2017).

9.4 Drivers of Agriculture Growth: Econometric Analysis

Growth in the agricultural sector for any state is influenced by a number of supply-side factors. These can be

- inputs (irrigation, fertilisers, agriculture credit)
- technology (quality seeds, farm mechanisation, extension services)
- price incentives (terms of trade)
- infrastructural facilities (roads, electricity)

While all these factors have an impact on agricultural growth, some factors are the key drivers for achieving growth in a particular state. As different states are located in different agro-climatic zones, have varied soil, climate, rainfall and policies, a certain factor may influence agricultural growth to a much larger extent in a particular state than in others. In this section, we use econometric analysis to determine the key drivers of agricultural growth in Odisha.

First, we use representative variables for each of the factors listed above as potential drivers of agricultural growth and run a simple pairwise correlation between gross state domestic product from agriculture and allied activities for Odisha (GSDPA) and a host of other variables. The correlation matrix along with the significance values obtained has been presented in Annexure 1. The GSDPA is shown to have a positive and significant correlation to the following variables: irrigation ratio, total road density, diversification to livestock, terms of trade between agriculture and services, quality seeds and fertilisers.

Under the assumptions of a classical linear regression model, we run a simple ordinary least square regression using the natural log value of GSDPA as the explained variable and natural log values of some of the variables mentioned above (having a positive and significant correlation) as explanatory variables. We run the model with different variables and only those models have been presented here that significantly explain the changes in GSDPA. The variables that had a positive and significant

Table 9.2 Regression results

Model 1		Model 2		Model 3	
Reg lngsdpa lnir lnroad		Reg lngsdpa lntotas lnlivestock		Reg lngsdpa lnir lnlivestock	
Irrigation ratio	0.7470***	lnTOT(AS)	0.4280**	Irrigation ratio	0.7193***
Road density	0.5585***	lnLivestock	0.4729**	Livestock	0.3718***
Constant	9.6563***	Constant	13.8322***	Constant	11.5490***
R-squared	0.88	R-squared	0.77	R-squared	0.89
Adj R-squared	0.86	Adj R-squared	0.74	Adj R-squared	0.87

*** and ** corresponds to 1 and 5% level of significance respectively

correlation with GSDPA and used in our regression model are (i) irrigation ratio (IR), (ii) total road density (Road), (iii) terms of trade between agriculture and services (ToTAS) and (iv) the share of livestock in the value of output from agriculture and allied activities (Livestock). Data for these variables have been used from 2000–01 to 2015–16. The following models have been estimated:

$$\ln \ \mathrm{GSDPA} = \beta_0 + \beta_1 \ln \ \mathrm{IR} + \beta_1 \ln \ \mathrm{Road} + u_t \tag{9.1}$$

$$\ln \ \mathrm{GSDPA} = \beta_0 + \beta_1 \ln \ \mathrm{ToTAS} + \beta_1 \ln \ \mathrm{Livestock} + u_t \tag{9.2}$$

$$\ln \ \mathrm{GSDPA} = \beta_0 + \beta_1 \ln \ \mathrm{IR} + \beta_1 \ln \ \mathrm{Livestock} + u_t \tag{9.3}$$

The results from the above regression models have been presented in Table 9.2.

The results from the model show that irrigation, road density, terms of trade and diversification in agriculture have a positive and statistically significant impact on GSDPA.

Model 1 This model shows that keeping other things constant, a one per cent increase in the irrigation ratio increases GSDPA by 0.75%. Similarly, keeping other things constant, an increase of one per cent in total road density increases Odisha's GSDPA by 0.56%. Together, these two variables explain 86% of the variation in GSDPA.

Model 2 According to this model, keeping other things constant, a one per cent improvement in terms of trade between agriculture and services increases Odisha's GSDPA by 0.43%. Similarly, keeping other things constant, a one per cent increase in the share of livestock to gross value of output from agriculture and allied sectors increases Odisha's GSDPA by 0.47%. Together, these two variables explain 74% of the variation in GSDPA.

Model 3 The model shows that, ceteris paribus, a one per cent increase in the irrigation ratio increases Odisha GSDPA by 0.72%. Similarly, keeping other things constant, a one per cent increase in the share of livestock to the gross value of output of agriculture and allied sectors increases Odisha's GSDPA by 0.37%. Together, these two variables explain 87% of the variation in GSDPA.

9.5 Agriculture Budget in Odisha

Odisha is among the few states that announce an exclusive budget for agriculture and allied activities. Broad head wise allocations for agriculture and allied activities have been shown in Fig. 9.20. It is clear from the graph that crop husbandry has an almost two-thirds share in the budget estimates (BE) in the 2019–20 budget, up from 52% in the revised estimates for 2018–19. Animal husbandry and dairy development together accounted for a mere 5% in the total budget allocation although in recent years the contribution of livestock in the GVO has been in the range of 18–19%. Compared to 2017–18 and 2018–19, this year's budget had a lesser share for fisheries, with budgetary allocation declining from 2.6 to 1.8%, although the contribution of the segment to GVO in recent years has been more than 7%.

The major highlight of this year's budget was the state government's flagship scheme for direct income support to farmers, "KALIA" (*Krushak* Assistance for Livelihood and Income Augmentation), for which Rs. 5611 crores was allocated.

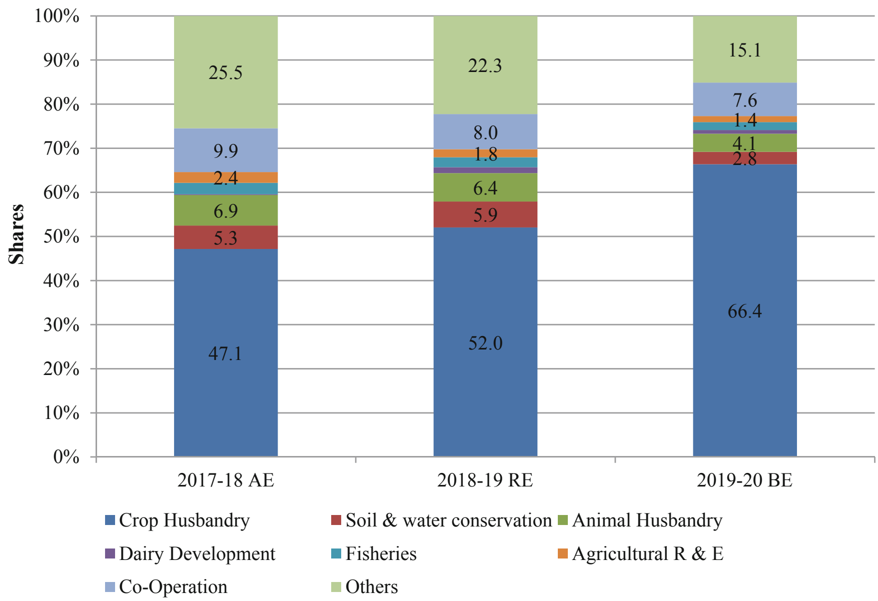

Fig. 9.20 Budget allocation to broad heads of agriculture and allied activities. *Source* (Odisha Budget 2019–2020)

The scheme was first announced during the vote on account budget in February 2019 in the run-up to the assembly elections when Rs. 4461 was allocated. The scheme has five components: (i) financial support of Rs. 25,000 to every small and marginal farmer family over 5 agricultural seasons for cultivation; (ii) livelihood support of Rs. 12,500 for each landless agricultural household over three years for activities related to rearing goats, sheep and poultry, fishery, bee-keeping and cultivation of mushrooms; (iii) financial assistance of Rs. 10,000 per family of vulnerable agricultural households (comprising persons in old age or with disabilities); (iv) life insurance premium support to cultivators and landless agricultural labour; and (v) interest-free loans to farmers up to Rs. 50,000. The scheme has been lauded by policymakers, economists and academicians alike for its inclusiveness and prompt payment (The Odisha Gazette 2018).

While a major chunk of this year's agriculture budget has been allocated for KALIA, there are other ongoing centrally sponsored and state government schemes for which allocations have been provided in this budget as shown in Fig. 9.21. First, Rs. 800 crore has been provided for interest subvention on crop loans to co-operative as well as commercial banks in order to provide credit at an effective interest rate of 1% to farmers for loans up to Rs. 50,000 and 2% for loans above Rs. 50,000. Next, Rs. 400 crore has been allocated towards premium as the state's share for the *Pradhan Mantri FasalBima Yojana* (PMFBY), which is the Government of India's crop insurance scheme that provides comprehensive risk coverage for pre-sowing to post-harvest losses due to non-preventable natural risks. Further, Rs. 250 crore has been allotted for the soil health and conservation programme to open mobile soil testing laboratories and issue soil health cards. To popularise agricultural implements and equipment, Rs. 182 crore has been allotted for farm mechanisation and to procure

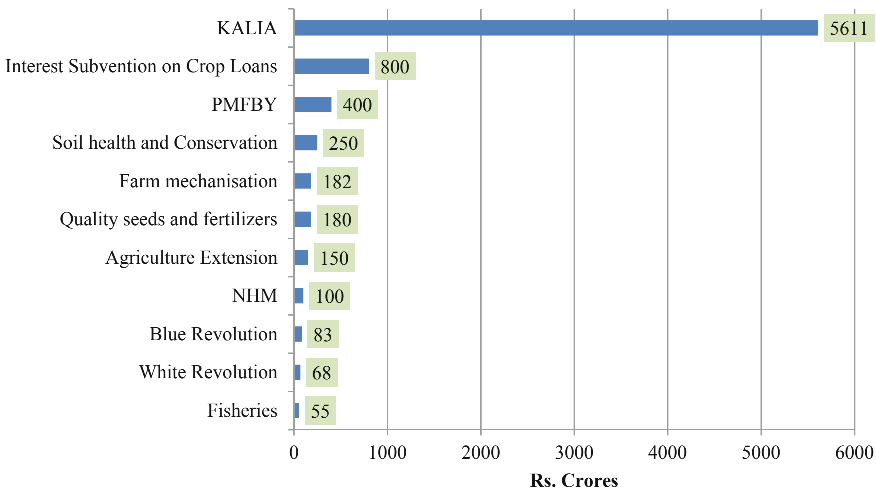

Fig. 9.21 Outlays on major agricultural schemes in Odisha's agricultural budget 2019–20. *Source* (Odisha Budget 2019–2020)

and distribute quality seeds and fertilisers to farmers. The outlay for agricultural extension has been Rs. 150 crore. This is to provide farmers with the latest technology and improved agronomic practices. Another Rs. 100 crore has been provided for National Horticulture Mission and Rs. 55 crore for the development of brackish water aquaculture, marine fisheries, intensive aquaculture and inland fisheries. For the development of the fisheries and dairy sectors, Rs. 83 crore and Rs. 68 crore respectively have been allocated under the blue and white revolutions (Odisha Budget (2019–20)).

A major food security scheme of the state, wherein the state government provides 5 kg of rice per month per beneficiary at Re. 1/kg, was introduced as many deserving households were not covered under the Government of India's National Food Security Act.

9.6 Conclusions and Policy Recommendations

Odisha is an agrarian state with 55% of its workforce (45% according to the Labour Bureau, 2015–16) directly or indirectly involved in agriculture and allied sectors for employment (NSS 68th round 2014). Frequent famines and flooding have caused havoc in the state, leading to volatile agriculture growth over the past two decades. The regression results for Odisha show that irrigation, roads and diversification play an important role in the growth of agricultural GDP. In this section, we recommend interventions in the following areas to enable Odisha to achieve stable and robust agricultural growth for the benefit of the small and marginal farming community, who are 93% of the total farming community in Odisha.

Infrastructural Development

1. *Development of Irrigation Infrastructure*: Our analysis in this chapter suggests that irrigation is the most important driver of agricultural growth in Odisha. As the state has among the lowest gross irrigated area in India, there is a need to develop irrigation facilities. Out of 8.8 m ha of ultimate irrigation potential (UIP) in Odisha, 5.6 m ha or 64% had been created until 2016–17. The state is targeting the completion of eight medium/major projects by December 2019 under the PMKSY-AIBP. However, only 3.6 m ha or 64% of IPC (irrigation potential created) has been utilised so far. In fact, the share of utilisation in IPC (share of IPU over IPC) has been declining since 2007–08. In order to bridge this gap between IPC and IPU, there is a need for comprehensive action to construct field channels in major and medium projects, restore distribution systems where they are in disrepair and rejuvenate tanks. In terms of groundwater, only 30% of the total potential of 16.7 lakh bcm has been used so far for different purposes, especially for irrigation.
2. *Enhancing Power Consumption in Agriculture*: To increase the utilisation of groundwater resources for irrigation purposes, power is an important input. Assured and uninterrupted power supply for agriculture also helps in operating

agricultural machinery and equipment. Odisha has the lowest power intensity among all major states in the country. Even though power sales to the agriculture sector have increased during recent years (2014–15 to 2016–17), it remains inadequate especially during the peak demand season; it is also characterised by high voltage fluctuations and frequent load shedding. Considering the poor power situation in Odisha in terms of power sales/consumption in the agricultural sector, the government needs to focus on improving transmission and distribution infrastructure. Efforts should be made to utilise separate feeders for power for agricultural purposes. The state should take full advantage of the funds being made available by the Government of India under the *Deen Dayal Upadhyay Gram Jyoti Yojana* (DDUGJY). Improving the power situation will also encourage the food processing sector to expand in the state. Further, solar energy as a sustainable form of energy has huge potential, especially for agricultural use in the form of solar pumps and solar-based irrigation systems.

3. *Increasing Coverage of Surfaced Roads:* The total coverage of roads in Odisha is 2.9 lakh km of which 77% consists of rural roads. While Odisha's total road density is higher than the all- India average, it lags behind in terms of surfaced road density. Odisha has one of the lowest surfaced road lengths in India. In 2011–12, only 23.9% of the total roads in Odisha were surfaced as compared to Gujarat and Punjab (89%), Uttar Pradesh (77%), Madhya Pradesh (61.5%) and Bihar (47.2%). Since Odisha is subjected to frequent floods, the state needs to increase the coverage of concrete roads that are more durable than black topped roads in regions where submergence is a frequent occurrence. Increasing the coverage of surface roads in the state will go a long way in ensuring efficient movement of agricultural inputs and products.
4. *Drought-proofing rain deficient areas* : Odisha needs to undertake a serious watershed management programme for drought-proofing areas frequently affected by deficient rains. Action is needed also in the context of adaptation to climate change, which is expected to increase the frequency and severity of events when climate extremes are experienced. Soil and water conservation practices are the main elements of the watershed management programme. Some of these practices are aimed at increasing soil moisture availability within agricultural fields by constructing contour *bunds*, graded *bunds*, field *bunds*, or by building terraces or furrows. Other practices such as the construction of check dams, farm ponds, gully control structures and excavation of pits across the stream channel are aimed at harvesting a substantial amount of runoff and for increasing groundwater recharge.

Crop Husbandry

5. *Adopting Crop Rotation/Multi-Cropping*: A large part of Odisha is mono-cropped with rice, and remains fallow after harvest during the *rabi* season. The practice of monoculture has a huge disadvantage in the form of loss of nutrients, vulnerability to diseases, soil erosion and water loss that occurs due to planting the same crop each year. Crop rotation or multi-cropping by growing a variety of crops

like pulses, coarse cereals and oilseeds on the same field will not only help in retaining micronutrients in the soil but will also help increase farmer's income from a diversified crop basket. It is imperative to reduce the dependence of farmers on a single crop, as the recurring climatic anomalies make agricultural production in the state doubly risky. A second crop of oilseeds, pulses, vegetables and fodder crops can be raised through greater use of groundwater resources including through the deployment of solar pumps.

6. *Adopting improved rice varieties*: Rice continues to be an important crop in terms of acreage and production but its productivity has not kept pace with the rest of the country. It has been particularly affected by recurring droughts and floods. To promote stress-tolerant varieties and improve productivity, drought-tolerant varieties of paddy like *Sahabhagi Dhan* in Western Odisha and submergence tolerant varieties like *Swarna* sub-1 in Coastal Odisha should be popularised through the extension network.
7. *Reforming Horticulture Sector*: Horticulture, especially fruits and vegetables, represents the largest component of the value of agricultural output in Odisha. It is also the largest source of growth in the state's GVOA. Horticultural commodities, being high-value crops, generate higher income for lakhs of small and marginal farmers. Hence, the state government should promote best practices like precision farming through extension services to enhance the productivity of fruits and vegetables.

Animal Husbandry and Fisheries

8. *Livestock and Dairy Development*: With the increase in the dominance of the livestock sector, increased attention needs to be given to enhancing the productivity of milk through health and reproduction management. The productivity of milk in the state is as low as 0.5 mt per female animal as compared to Punjab's productivity of 2.4 mt per female animal, Gujarat's 1.1 mt per female animal and Uttar Pradesh's 1.0 mt per female animal. The low productivity of milch animals in Odisha is despite the fact that the best germplasm is being used in the state for artificial insemination and cross-breeding. In this situation, in order to increase productivity, farmers need to reduce the herd size so that milch animals constitute a higher proportion. To achieve this, the state needs to adopt cutting edge reproduction management technologies, such as sex-sorted semen. With improved productivity, the state will become a more competitive supplier of milk in the country and will be able to sell the product in the domestic market. To strengthen the dairy industry in Odisha, there is a need to set up more dairy co-operative societies, collection centres and processing facilities. Linking farmers with the organised milk processing sector through producer-owned dairy co-operatives will make dairy farming more sustainable for Odisha farmers.
9. *Expansion of the Fisheries Sector*: The fisheries sector holds an important place in the state's economy due to its long coastline and the presence of lakes. For further development of inland fishery, brackish water fisheries and fresh water fisheries from tanks, ponds, swamps, lakes, reservoirs, rivers and canals, government

should encourage public-private partnerships. Government should also promote the adoption of *makhana, and* water chestnut in addition to combining other crops with fisheries and livestock farming. These can be promoted in the available large wet lands of Odisha, ensuring enhanced income generation for farmers.

Storage and Processing Infrastructure

10. *Food Processing Infrastructure:* Processing of food is a form of value addition that not only increases the shelf life of food through dehydration, but also enhances the nutritive value of food by making food more nutritious and healthy. However, Odisha lacks processing infrastructure in the food sector. The establishment of food parks with efficient physical infrastructure facilities like power, water supply and drainage can facilitate the setting up of cold storages, refrigeration plants, pulping plants, dehydration plants and food manufacturing plants with the active participation of private players. This will not only help reduce wastage, but will also help absorb surplus agricultural commodities in the market. To establish food processing industries, a pre-requisite is an improvement in the power situation in the state in terms of both quality and quantity.

Annexure

See Tables 9.3 and 9.4.

Table 9.3 Description of variables

Variable	Variable Name	Description
GSDPA	GSDP from agriculture	Gross State domestic product from agriculture and allied sectors for Odisha, gross value added at basic prices from 2011–12 onwards
TOT (AS)	Terms of trade (agri/services)	Terms of trade between agriculture & allied activities to services
TOT (AN)	Terms of trade (agri/non-agri)	Terms of trade between agriculture & allied activities to non-agricultural sector (industry + services)
IR	Irrigation ratio	Ratio of gross irrigated area to gross cropped area as %
Seed	Quality seed	Quality seed distribution
Ferti	Fertiliser consumption	Fertiliser consumption per hectare
Road	Road density	Total road density (Per 100 Km^2)
Livestock	Livestock	Share of livestock to value of output from agriculture and allied activities

Table 9.4 Correlation matrix

	Lngsdpa	Lntotai	Lntotas	Lntotan	Lnir	Lnseed	Lnferti	Lnpower	Lnroad	Lnfv	Lnlivestock
Lngsdpa	1										
Lntotas	**0.8062*****	−0.1556	1								
Lntotan	**0.4549***	0.385	0.8422***	1							
Lnir	**0.8971*****	−0.5379**	0.7211***	0.4267*	1						
Lnseed	**0.8401*****	−0.3479	0.7588***	0.4973*	0.7168***	1					
Lnferti	**0.8033*****	−0.5741**	0.5828**	0.2622	0.7322***	0.8398***	1				
Lnroad	**0.791*****	−0.3187	0.8145***	0.5442**	0.6434***	0.8333***	0.5978**	0.3449	1		
Lnlivestock	**0.8144*****	−0.5324**	0.6962***	0.3492	0.6714***	0.8753***	0.8207***	-0.035	0.8229***	−0.6596***	1

References

Agriculture Census. (2015–16). *All India Report on Number and Area of Operational Holdings*. Retrieved May 2019, from Agricultural Census: http://agcensus.nic.in/document/agcen1516/T1_ac_2015_16.pdf.

Basic Animal Husbandry and Fisheries Statistics, Various Issues. New Delhi: Department of Animal Husbandry and Dairying (AH&D), Ministry of Agriculture and Farmer's Welfare, Government of India.

Basic Road Statistics of India (Various Issues). *Basic Road Statistics of India*. New Delhi: Ministry of Road Transport and Highways, Government of India.

CEA. (Various Issues). *All India Electricity Statistics*. New Delhi: Central Electricity Authority, Ministry of Power, Government of India.

Census. (2011). *Census of India*. Retrieved May 2019, from Registrar General of India, Ministry of Home Affairs, Government of India.

Committee, T. (2011). *Expert Group on Methodology for Estimation of Poverty*. New Delhi: Planning Commission, Government of India.

CSO. (Various Issues). *State-wise Gross State Domestic Product*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

CSO. (2019). *State-wise Gross State Domestic Product*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

DoAC&FW. (2019). *Area and Production of Horticulture Crops*. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare, Government of India.

DoAC&FW. (2018). *Horticulture Statistics at a Glance*. New Delhi: Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Government of India.

DoWR, Odisha. *An Overview of Irrigation Scenari*o. Department of Water Resources, Odisha, Government of Odisha.

GoO. (2017). *Disaster Management Plan for Odisha*. Bhubaneswar: Agriculture Department, Government of Odisha.

GoO. (2019). *Sourajalanidhi*. Retrieved June 2019, from Department of Agriculture & Farmers' Empowerment, Government of Odisha: https://odishasolarpump.nic.in/.

Hoda, A., Rajkhowa, P., & Gulati, A. (2017). *Working Paper 337: Transforming Agriculture in Odisha: Sources and Drivers of Agriculture Growth*. New Delhi: Indian Council for Research on International Economic Relations.

IMD. (2016). *Rainfall Statistics of India*. New Delhi: India Meteorological Department.

Land Use Statistics, DES. (2018). *Land Use Statistics*. New Delhi: Directorate of Economics and Statistics (DES), Department of Agriculture and Cooperation, Government of India.

Livestock Census. (2012). *19th Livestock Census-2012 All India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

MoP. (2016). *24 X 7 Power for All – A Joint Initiative of Government of India and Government of Odisha*. New Delhi: Ministry of Power, Government of India.

MoSPI, State wise estimates of Value of Output from Agriculture and Allied Activities. (Various Issues). *State wise estimates of Value of Output from Agriculture and Allied Activities*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

NABARD. (2018). *NABARD All India Rural Financial Inclusion Survey (NAFIS) 2016–17* . Mumbai: National Bank for Agriculture and Rural Development.

NABARD. (2018). *NABARD Signs Project Agreement with Green Climate Fund*. Retrieved from NABARD: https://www.nabard.org/PressReleases-article.aspx?id=25&cid=554&NID=36.

NSS 68th round. (2014). *Employment and Unemployment Situation in India*. New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Odisha Budget (2019–20). (2019). *Annual Financial Statements*. Bhubaneswar: Finance Department, Government of Odisha.

Odisha DES. (Various Issues). *Odisha Agriculture Statistics*. Bhubaneswar: Directorate of Economics and Statistics of Odisha.

Odisha Eco Survey. (2018–19). *Odisha Economic Survey*. Bhubaneswar: Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha.

PIB. (2018). *Impact of changing weather patterns on agriculture*, Lok Sabha Unstarred Question No. 45. Press Information Bureau, Ministry of Agriculture & Farmers Welfare.

PMKSY-AIBP. (2019). *Accelerated Irrigation Benefits Programme* . Retrieved May 2019, from Ministry of Water Resources, River Development & Ganga Rejuvenation: http://pmksy-mowr.nic.in/aibp/.

Tendulkar Committee. (2011). *Expert Group on Methodology for Estimation of Poverty*. New Delhi: Planning Commission, Government of India.

Part IV
Taking Agri-GDP to Farmer Incomes

Chapter 10
Going Beyond Agricultural GDP to Farmers' Incomes

Ashok Gulati, Shweta Saini, and Ranjana Roy

10.1 Background and Introduction

An average Indian farm size is 1.08 ha (Agricultural Census 2015–16), and it has been shrinking over the decades (it was 2.3 ha in 1970–71). India has about 146 million landholdings, and 68.5% of these are marginal holdings, i.e. less than 1 hectare; the average landholding size is much smaller at 0.38 ha. In addition, about 17.7% of Indian landholdings are categorised as small; i.e., they are between 1 and 2 ha and have an average size of 1.41 ha. Thus, about 86% Indian landholdings are less than 2 ha and are called the country's small and marginal landholdings or farmers (SMF). They together operate on about 47% of the country's 157 million hectares of operated area.[1]

As incomes from such small farms would not be enough to sustain families, farmers diversify their sources of income to include livestock like dairy, work as labourers on others' farms or even outside farms (non-farm), operate small businesses like barber shops, etc. As the landholding size falls, one would expect a more diversified income portfolio. These diversified activities may not all be accounted

[1] As per Agricultural Census 2015–16, operated area includes both cultivated and uncultivated area, provided part of it is put to agricultural production during the reference period. This is different from the net sown area, which refers to the actual acreage under crops in that year, and gross cropped area, which includes the double cropped area.

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for as part of the country's agricultural GDP. While some may be counted towards manufacturing GDP, others may be added to the services sector's GDP.

We explore this aspect of farmer incomes in detail in this chapter. The focus will be on understanding and analysing:

1. The level of farmers' incomes in the country and inequality of incomes between states; and
2. The structure of farmers' incomes and trends

The chapter is divided into five sections. In Sect. 10.2, an analysis of farmers' incomes is presented, with some key highlights. In Sect. 10.3 , the PM's dream of doubling farmers' incomes is outlined and key learning from the Dalwai Committee Report is highlighted. In Sect. 10.4 profitability of major crops in important producing states, and major challenges that limit farmers' incomes are identified, and in the last section, recommendations are made for ways that can support PM Modi's drive to double/augment farmers' incomes.

10.2 Analysing Trends and Composition of Farmer Incomes

10.2.1 Estimates of Indian Farmers' Incomes

An estimate of farmers' incomes is not a typical macroeconomic aggregate number that is estimated on a regular basis by the Indian government. Instead, it is estimated only occasionally through sample surveys undertaken by the Ministry of Statistics and Programme Implementation (MOSPI) of the Government of India or other government agencies. Since the year 2000, estimates of farmer incomes are available for three years—2002–03, 2012–13 and 2015–16. The 2002–03 and 2012–13 surveys were conducted by the NSSO. The 2015–16 survey was conducted by the National Bank for Agriculture and Rural Development (NABARD) and estimates are available in the NABARD All India Financial Inclusion Survey (NAFIS) report.

There is some difference between the NSSO and NABARD surveys in the definition of "farmer" as well as their coverage, which is explained below in more detail.

For the 2012–13 survey, GoI's National Sample Survey Office (NSSO) surveyed about 35,200 households[2] to profile income sources of an average Indian farmer. It found that an average Indian farmer had four major sources of incomes: (i) income from cultivation (includes income from production of field crops and plantation/orchard crops); (ii) income from livestock (includes receipts from sale of milk, eggs, live animals, wool, fish, honey, hide, bones, manure, etc.); (iii) wages and salaries (includes income from working on others' farms; it also includes salaries

[2]For 2002–03 survey, 51,770 households were surveyed.

from working in construction sector, wages received under MGNREGA, etc.) and (iv) income from non-farm work (receipts from sale of prepared food, refreshment and drinks, earnings from goods and passenger traffic, communication charges receivable from customers (STD/courier, fax, etc.), receipts for educational activity (like tuition fees, examination fees, capitation fees, etc.)).

NABARD's NAFIS surveyed about 40,327 households and like the NSSO, estimated sources and levels of farmers' incomes. On two accounts, however, the estimates of farmers' incomes from the two surveys are not strictly comparable.

1. The definition of the "rural" sector: NABARD covers Tier 3 (population between 20,000 and 50,000), Tier 4 (10,000–20,000), Tier 5 (5000–10,000) and Tier 6 (less than 5000) areas whereas NSSO covers only Tier 6 areas.
2. Type of farmers studied: While NAFIS included households who earned at least Rs. 5000 from agricultural and allied activities in the year; this threshold for the NSSO was Rs. 3000.

Based on these, it may not be inaccurate to say that estimates of farmer income estimates presented by NAFIS are likely to have an upward bias as compared to NSSO's estimates. This is because (a) it studies areas with larger populations, which are likely to offer better income opportunities; and (b) because of a higher income threshold, NAFIS profiles a relatively *richer* farmer than one studied under NSSO.

As on October 2020, there is no updated estimate from NSSO after its 2012–13 survey, therefore one is left with little choice for analysis but to use NAFIS results.

Additionally, it may be important to note that all the three years for which we have data on farmers' income were rain-deficient years. The years 2002–03 and 2015–16 were drought years, i.e., when the actual rainfall fell short of its long-period average (LPA) by more than 10% (the drought threshold for India), while 2012–13, rainfall was −7.1% below LPA. It, therefore, is likely that the available income estimates are lower than what they would be in normal rainfall years. It is also possible that during drought years, when crops fail, farmers are forced to move out and work as labourers outside farming. This may raise the share of wages and salaries in comparison to income coming from the cultivation of crops.

10.2.2 Level and Structure of Farmers' Incomes

In 2002–03, an average Indian farming household earned about Rs. 2115 per month of which about Rs. 970 was earned from cultivation, Rs. 91 from livestock activities, about Rs. 818 from wages and salaries and Rs. 236 from non-farm business activities.

In 2012–13, the average total income of a farming household increased to Rs. 6427 per month. Of this, Rs. 3081 came from cultivation, Rs. 763 from livestock, Rs. 2071 from wages and salaries and Rs. 512 from non-farm business.

In 2015–16, the total average income of an average farming household went up to Rs. 8931 per month, of which Rs. 3140 came from cultivation, Rs. 711 from livestock, Rs. 4469 from wages and salaries and Rs. 611 from non-farm business.

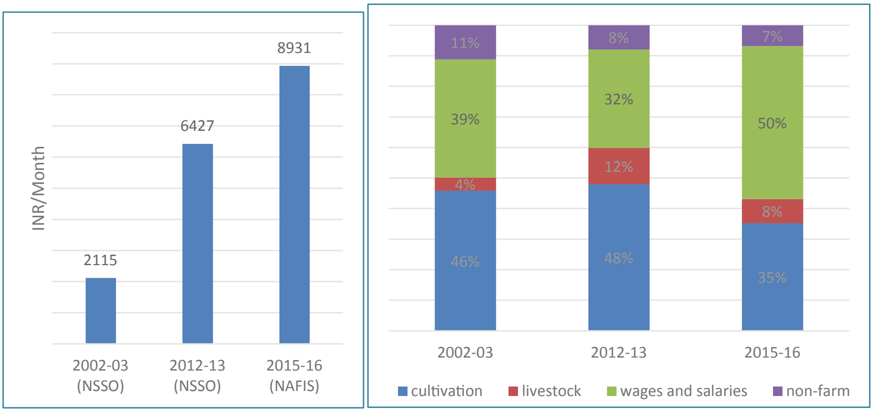

Fig. 10.1 Average farm income level and composition of farmer's incomes. *Source* NSSO and NAFIS

In the 13 years between 2002–03 and 2015–16, these incomes grew at an average CAGR of 11.8%. With the consumer price index for agricultural labourers (CPI-AL) increasing at 8.1%, the CAGR of a farmer's real income works out to be about 3.7%. Breaking up the farmer incomes into its four components, the sharpest CAGR is observed in the case of incomes coming from livestock as they are estimated to have grown at 17.1% in the 13 years. A summary of an average farming household's nominal incomes and their composition is presented in Fig. 10.1. Annexure Table 10.1 contains state-wise composition of farming household's income for the period of 2002–03 to 2015–16.

The statistics reveal some interesting facts about the composition of the income of a farmer:

1. Share of income from cultivation and livestock—The share of income from the two activities has fallen between 2002–03 and 2015–16. From 50% (in 2002–03), it first increased to 60% (in 2012–13) and subsequently fell to 43% (in 2015–16). In actual terms though, income earned from these two activities increased, *albeit* marginally, throughout the period: from Rs. 1060 (2002–03), to Rs. 3844 (2012–13) to Rs. 3851 (2015–16)
2. Income from livestock—Barring income from livestock, the absolute level of income did not fall for any other income component in the studied years. Incomes increased from Rs. 91 (share of 4% in the total income) in 2002–03 to Rs. 763 (share of 12% in total income) in 2012–13 but then fell to Rs. 711 (share of 8% in total income) in 2015–16.
3. Share of income coming from wages and salaries (W&S)—In the three years under the study, the share of income from wages and salaries shows a trend that is opposite to the trend observed in the income from cultivation. By 2012–13, the share of income from cultivation rose (from 46% in 2002–03 to 48%), and that

of income from W&S fell (from 39 to 32%). Then by 2015–16, while the share of income from cultivation fell to 35%, but that from W&S increased to 50%.

4. Income from the non-farm sector—This component of farm incomes is the smallest and has grown the slowest.

These are crucial indicators for policy makers, but the fact that the data (as also mentioned above) were collected in drought years does cast doubts on their usefulness.

In a drought year, reduced activity on the farm will push several small and marginal farmers to work as agricultural labourers on other's farms to sustain their families. Thus, the falling share of income from cultivation and rising share of W&S observed above is plausible. However, 2015–16 was not just a normal drought year; it was the second consecutive drought year after 2014 (a situation that happened only three times in India's 100 years of rainfall history before this) and that raises questions about the year being an outlier and the data being representative of an exceptionally vulnerable year, thus making it incomparable with data points in other years.

The fact that NAFIS studied larger and richer areas compared to those studied under the NSSO also makes the 2015–16 data incomparable to the extent that it is likely to have an upward bias in incomes from off-farm activities (including W&S).

Hopefully future surveys, if timed for normal rainfall years and done for individuals with similar profiles, will throw better light on the trends of various components of farming household incomes.

Farmers' Incomes as per Landholding Sizes

Normally, one expects that with shrinking landholding size, farmers' incomes will also decline. This is also borne by data from NAFIS for 2015–16.

India's marginal farmers (i.e., ones operating on less than 1 ha of land) earned between Rs. 6650 and Rs. 8171 per month and small farmers (i.e., those operating on 1–2 ha of land) earned about Rs. 9990 per month. The highest incomes were earned by the larger farmers, i.e. those operating on landholding of greater than 2 ha, who earned about Rs. 14,682 per month.

In terms of sources of incomes vis-à-vis the average landholding size, the share of income from cultivation increases with an increase in the land holding size. Smaller landholder households earned most of their income from livestock and through wages and salaries (see Fig. 10.2).

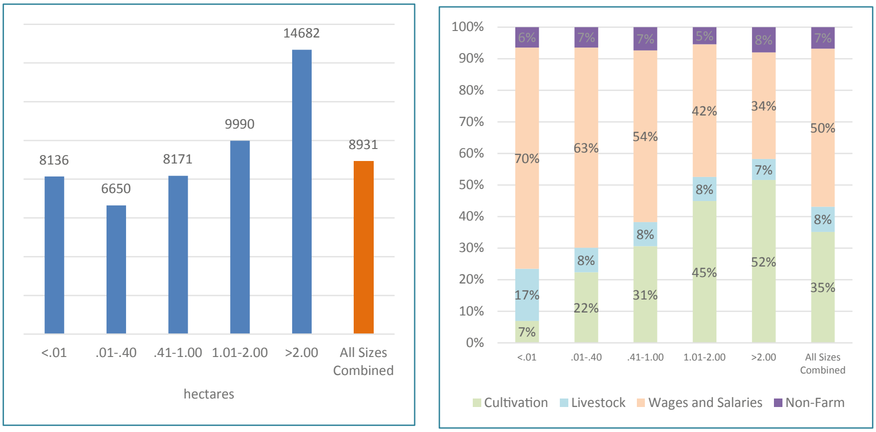

Fig. 10.2 Landholding-wise incomes (INR/month) and composition of farmers' incomes by landholding size. *Source* Data from NABARD's NAFIS

10.2.3 Farmers' Income in Indian States

Overall Trends

There is wide variation in the average agricultural household incomes across states. As per NABARD's NAFIS, the highest incomes (monthly basis) were earned by Punjab farmers (Rs. 23,133 per month), followed by Haryana (Rs. 18,496 per month), Kerala (Rs. 16,927 per month) and Gujarat (Rs. 11,899 per month). Low incomes were earned by farmers in the eastern Indian states of Odisha (Rs. 7731 per month), Bihar (Rs. 7175 per month) and Jharkhand (Rs. 6991 per month) and the southern state of Andhra Pradesh (Rs. 6920 per month); the lowest incomes were earned by UP farmers (Rs. 6668 per month).

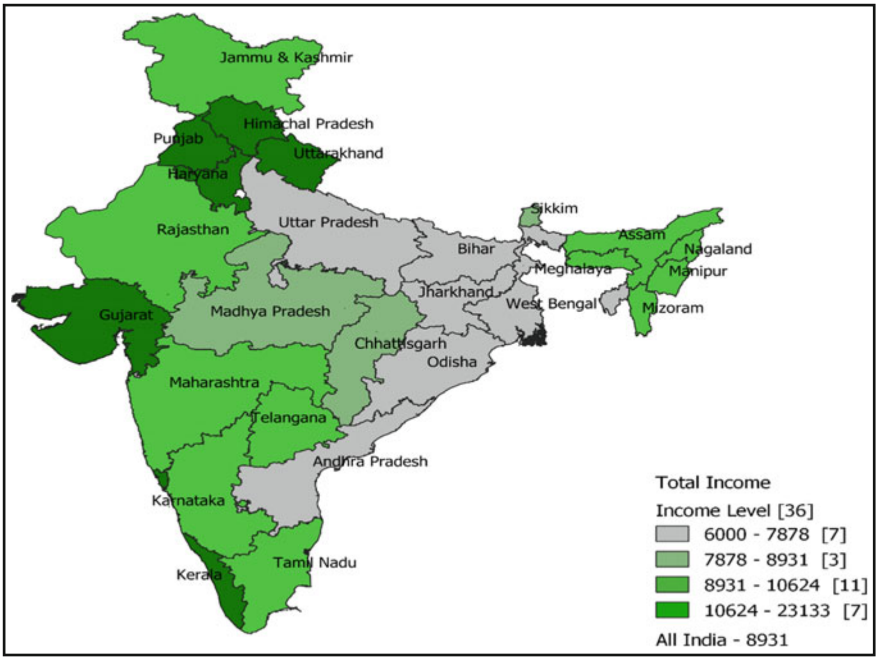

Fig. 10.3 Farmers' average monthly incomes in major Indian states: 2015–16 (INR/month). *Source* Created by authors from NAFIS data

Figure 10.3 presents the average monthly farmer income levels in different Indian states. The darker the green colour gets, the higher the average level of income. In states coded in grey, farmers earn low levels of income. As can be seen from the map, these states are Uttar Pradesh, Bihar, Jharkhand, West Bengal, Odisha and Andhra Pradesh, and, as per Census 2011, these states are home to close to 40% of Indian farmers.

Mapping Cultivators and Farmers' Incomes

As per Census 2011, India has a total agricultural workforce of about 263 million of which around 119 million are cultivators (i.e. who own land or have the right to operate land) and the remaining, i.e. about 144 million work as agricultural labourers (i.e. who do not own land and work on farms owned by others in return for wages paid to them in cash or kind). We mapped state-level farmers' incomes (2015–16 as per NABARD's NAFIS) with the states to which the cultivators belonged and found two interesting trends (Fig. 10.4).

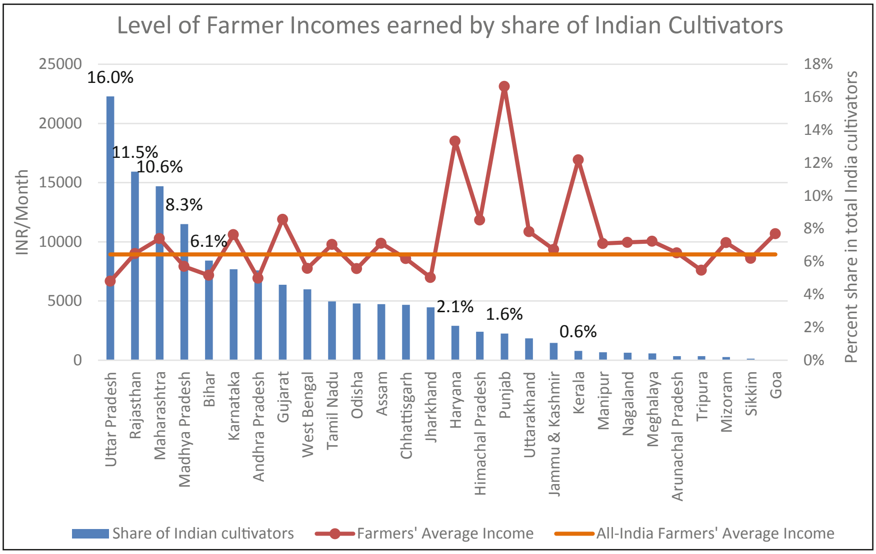

Fig. 10.4 Mapping cultivators with farmers' incomes. *Source* NABARD's NAFIS and Census 2011

1. States that were home to about 50% of Indian cultivators (UP, Rajasthan, Maharashtra, Madhya Pradesh and Bihar) earned the lowest in the country. In India, UP has the largest number of cultivators (16% of India's cultivators), and this state has the lowest level of farmers' incomes.
2. Less than 5% of Indian farmers earned the highest incomes in the country: Punjab, Haryana and Kerala together account for 4.3% of Indian cultivators, and their average monthly income is about Rs. 19,519,[3] which is more than twice the Indian average.

It is to be noted that income levels are low for a majority of cultivators. States mentioned in (1) above must be focal states for any strategic action by the Indian government to enhance farmer incomes in the country. Their abysmally low current levels of incomes offer an opportunity, much like a low-hanging fruit, to double their incomes quickly. This was proven by the eastern Indian state of Odisha as shown below.

Growth Rates of Farmers' Incomes Across Major States

Although farmers in eastern states like Bihar, Odisha and West Bengal earn very low levels of income compared to the more successful northern states of Punjab, Haryana or the western state of Gujarat, income growth rates can be pretty high. This is clearly demonstrated by Odisha, where farmers' real incomes increased by CAGR of 8.4% between 2002–03 and 2015–16. UP (3.9%), Bihar (3.7%) and Andhra

[3]This is a simple average of farmers' incomes in these states.

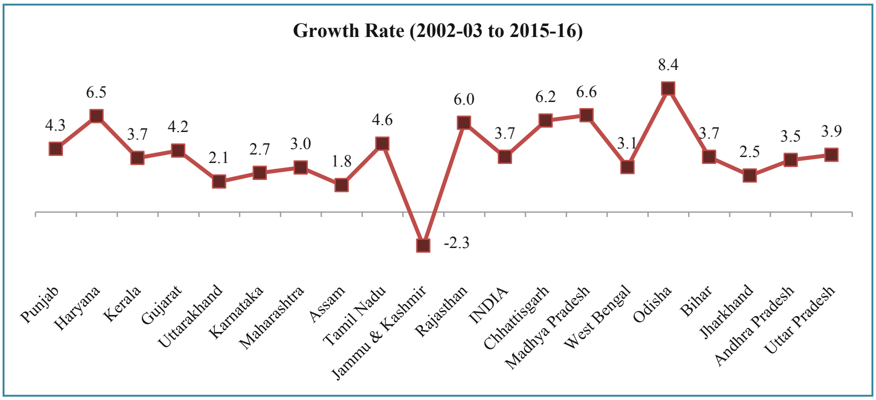

Fig. 10.5 Growth in farmers' real incomes (CAGR), 2002–03 to 2015–16. *Source* NSSO & NABARD

Pradesh (3.5%) hovered very close to the all-India trend rate of 3.7%. In J&K, real farm incomes fell between 2002–03 and 2015–16 (Fig. 10.5).

Composition of Farmers' Income

According to NSSO estimates from the "Situation Assessment Survey", an increasing share of agricultural household income has been from cultivation with its contribution growing from 45.8% in 2002–03 to 47.9% in 2012–13. Government policy documents (Dalwai Committee Report), based on the results of the NSSO survey, have targeted raising the share of income from cultivation and livestock to 70% by 2022–23. However, an analysis of the composition of farmers' income based on NAFIS data shows that a major share of income came from wages in 2015–16 (50% of total income). Wage employment as a vital source of livelihood in rural India is not surprising. It is widely experienced that as an economy grows, the labour force gradually shifts from farm to non-farm activities.

State-wise analysis shows that in most states, the share of income from wages in 2015–16 was higher than at the national level; among them, Jammu and Kashmir (71%), Tamil Nadu (69.8%), Bihar (66.3%), Rajasthan (63.2%), Uttarakhand (57.2%) and Odisha (56.5%) are states where the wage income is high. In the period from 2002–03 to 2015–16, the scale of increase in the contribution of wages to total income is the highest for Uttarakhand (41.2% points) followed by Bihar (38.8% points) and Jammu & Kashmir. Punjab and Karnataka are the only two states that experienced a marginal decline (1% point) in the contribution of income coming from wages. Temporal changes in the composition of income are presented in Table 10.1.

In the NSSO survey, non-farm business is defined as all household economic activities other than those covered under farm business. It included manufacturing, mining and quarrying, trade, hotels and restaurants, transport, construction, repairing and other services. The share of income coming from "non-farm businesses" decreased

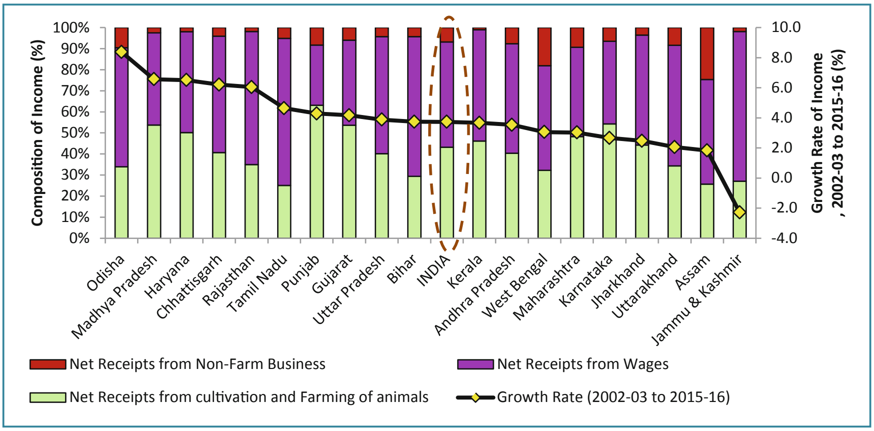

Fig. 10.6 State-wise farmers' income growth (2002–03 to 2015–16) and composition of farmers' income, 2015–16. *Source* NSSO and NABARD

from 11.2% in 2002–03 to 8% in 2012–13 and further to 6.8% in 2015–16. Among the states, Assam (24.7%) has the highest share of income coming from non-farm businesses, followed by West Bengal (18.1%) and Odisha (9.6%) (Fig. 10.6).

The analysis also reveals that except for Bihar, Jammu and Kashmir and West Bengal, there has been an increase in the share of income coming from rearing and farming of animals between 2002–03 and 2012–13 in all states. A significant increase in the share is observed for Rajasthan (32% point), Haryana (29% point) and Madhya Pradesh (22.7% points) with more than a 20% point increase in the share of income coming from cultivation and farming of animals.

From 2012–13 to 2015–16, the data shows a major decline in the share of income coming from cultivation and farming of animals except in Kerala. States like Assam, Bihar, Jammu & Kashmir and Uttarakhand show a more than 20% point decline in the share of income coming from cultivation and farming of animals, and this decline is compensated by a huge increase in the share of income from wages. Such a major change in the structure of income in the period of three years seems unlikely, and this may well be the result of the use of different definitions and samples in the two surveys.

10.2.4 Agricultural GDP Growth and Farmer Incomes

Higher returns on cultivation encourage farmers to invest more, which raises agricultural GDP, which in turn augments farmers' income. However, higher agricultural GDP growth rates, interestingly, may or may not result in higher growth in incomes of farming households. Among the six states presented in Fig. 10.7, despite high AGDP growth, farmer incomes have failed to rise as fast in Gujarat and MP (to some

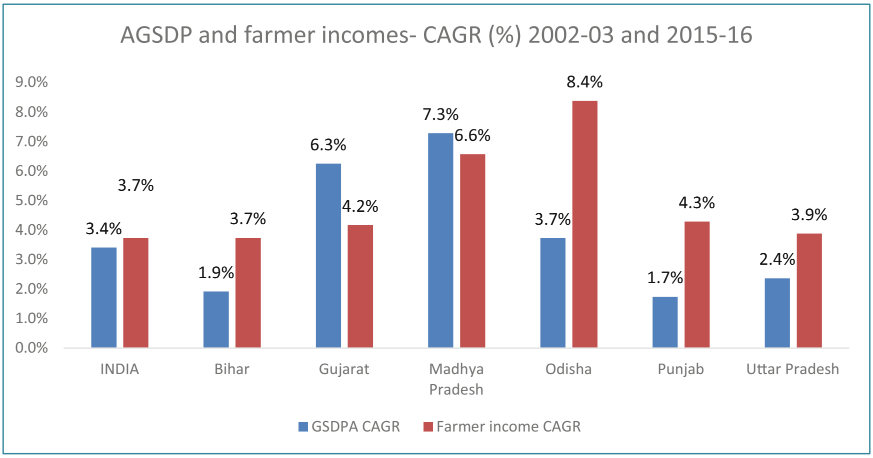

Fig. 10.7 CAGR of GSDPA and FY between 2002–03 and 2015–16. *Source* MOSPI, NSSO and NABARD. *Note*: Growth rates are estimated as CAGR of terminal values of Agricultural and allied-GDP and farmers' income for the years 2002–03 and 2015–16

extent). Contrarily, farmers' incomes have risen sharply in Odisha, Punjab, UP and Bihar despite the not-so-impressive AGDP performance.

Some parts of this disconnect between AGDP, and farm income trends may be explained by the way the data for each are segregated and analysed. Certain sources of incomes like wages and salaries that agricultural HHs made from, for example, working in schools, tuition centres, etc., will be counted as income from services and not attributed to agriculture; hence, even though an agricultural HH earned that income, it does not get reflected in agricultural GDP. Similarly, although income from fisheries will be accounted for in GDP from agriculture and allied activities, it will not be counted in data on farmers' incomes. This and many more data issues raise the need to look at both agricultural GDP and the level of farmer incomes to monitor their impact on poverty alleviation in the country.

Major Findings

After analysing farmers' incomes, a few striking trends become apparent[4]:

1. The share of income coming from cultivation has been falling: In 2002–03, 46% of monthly farmers' incomes came from cultivation, and by 2015–16, this share has fallen to 35%.
2. The share of income from livestock has grown from 4% (2002–03) to 8% (2015–16). However, the trend reverses when one looks at the data between 2012–13 and 2015–16—both the absolute level and share in total income from livestock has fallen.

[4]Because of the difference in the definition of a "farmer" between NSSO and NABARD, as mentioned in the main text, there is a perceptible upward bias in NABARD's estimates and we use extreme caution in comparing the data between the two surveys.

3. Wages and salaries are the most important source of incomes for Indian farmers (2015–16). In a country with shrinking landholdings, farmers inevitably rely on jobs in the informal and formal sector. Experience around the developing world, especially in China, has revealed that in a booming economy, normally it is the construction sector that absorbs much of the labour force coming out of agriculture. In India, the government offers employment guarantee programmes like MGNREGA, which could have absorbed some agricultural labour, especially during drought years. However, this outmigration from agriculture to non-farm activities requires a much more detailed study, which is not attempted here. However, one upshot is clear: for the first time, in the years mentioned above, farm families seem to have derived more than half their income from wages and salaries.
4. Trends in farmers' incomes may or may not necessarily follow the agricultural GDP growth path of a state.

10.3 PM's Dream to Double Farmers' Incomes

The Prime Minister of India, Shri Narendra Modi, made a call to double farmers' incomes by 2022 at a *kisan* (farmer) rally in Bareilly on 28 February 2016. It was not clear initially whether it was a political statement expressing his "dream" or an announcement of a policy measure followed by a strategic plan of action. However, the statement assumed a serious note when Finance Minister Arun Jaitley mentioned this in his budget speeches of 2016–17 and 2017–18. It was followed by the setting up of a committee for doubling farmers' income (DFI) in April 2016 under the chairmanship of Ashok Dalwai. The Committee submitted its final report [referred to hereafter as the Dalwai Committee Report (DCR)] to the GoI in September 2018.

What does doubling of farmers' incomes mean?
As per the DCR, the PM's target was to double the real incomes of farmers in seven years, i.e. by 2022–23 over the 2015–16 income level. In 2015–16, DCR estimated, by extrapolating 2012–13 survey data, that farmers' average income was about Rs. 8059 per month (as per NABARD's NAFIS, the 2015–16 estimate of farmers' income was Rs. 8931). The DCR also makes it clear that the target of doubling farmers' incomes by 2022–23 was in real terms, not nominal. That would amount to raising their 2015–16 levels of income to Rs. 16,118 per month (in real terms) in seven years, i.e. by 2022–23 (as per NAFIS's estimate, the target 2022–23 income level would be Rs. 17,862) (Fig. 10.8).

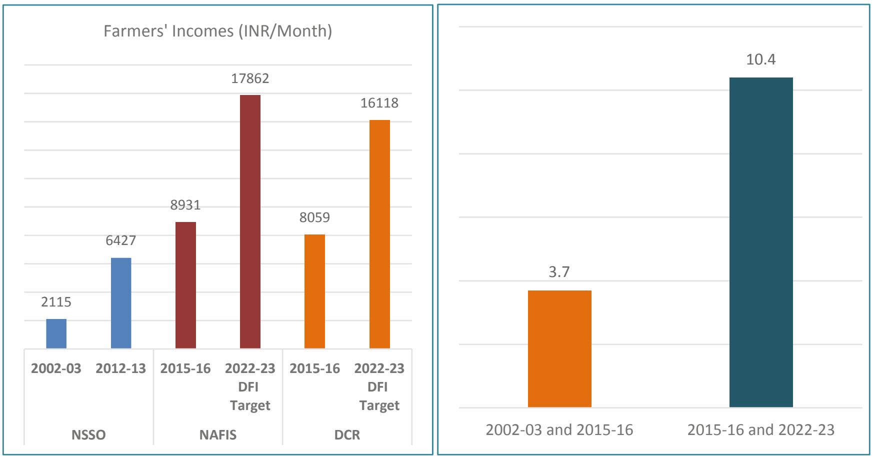

Fig. 10.8 What doubling income means: actual and required CAGR (%). *Source* DCR, NSSO and NAFIS

Between 2002–03 and 2015–16, average income of farmers grew in real terms at a CAGR of 3.7%. To achieve the DFI target, the required growth rate at the all-India level was estimated to be 10.4%, i.e. 2.8 times the growth rate achieved historically.

To achieve this, DCR prepared 14 volumes (containing close to 3000 pages) proposing strategies on almost every aspect of agriculture. This voluminous report has summarised recommendations in Volume 14 that presents about 619 recommendations. Some of these are highlighted below.

- **Improvement in Crop Productivity**:
  Given the inelastic nature of land and high concentration of farmers' families, achieving high productivity is crucial for food security as well as global competitiveness. The report proposes increasing the per hectare productivity of millets from 1.1 to 1.6 tonnes, pulses from 0.7 to 1.4 tonnes and oilseeds from 0.96 to 1.5 tonnes, respectively. It also suggested a shift from the current measurement of grain per hectare approach to a grains (in calories) plus nutrients/ha approach. Location-specific causes of the yield gap need to be identified, and strategies should be outlined to close that gap.
- **Improvement in Livestock Productivity**:
  To augment farmers' incomes through livestock, the productivity of dairy animals has to be increased. Steps like quality artificial insemination, genome selection and embryo transfer for sustainable breed improvement and incentivising feed mills to produce compound feed should be the major areas of intervention. The report suggests dissemination of region-specific technologies to cultivate green fodder in uncultivable, saline land. Scarcity of quality fodder should be dealt with through development of hybrids of fodder crops, perennial grasses, legumes, etc. Silage making of surplus green fodder can be helpful in the lean season.

- **Resource-use efficiency** :
  The report points out that moving from food security to income security for farmers requires diversification of the system from crop to high value products. Diversification in turn promotes resource-use efficiency. The recommendations include making the soil health card scheme more practical and flexible; bringing in more technical competence in collecting and testing soil samples; encouraging private sector infrastructure and so on. According to the report, soil health-related issues can be dealt with by linking the soil health card portal with the integrated fertiliser management system (I-FMS); facilitating soil testing at reasonable cost, preparing district-level nutrient maps and other steps like organic farming, adopting an ecosystem-based approach to plant nutrition etc.
  The Dalwai committee accepted the fact that earlier policies to achieve food security did not consider sustainability issues and that cost us water security. Water-related recommendations include testing and recording water health on the lines of the soil health card, recycling wastewater and encouraging micro-irrigation. Since there is no single law dealing with groundwater legislation across the country, the reports talk about implementing the proposals made in the model bill drafted by the CGWB.
- **Efficient Monetisation of Farm Produce** :
  DCR extended the concept of the post-production value chain by going beyond agricultural marketing to “monetisation”. According to this, the objective should be to obtain the best possible value for farm produce by facilitating the efficient transfer of produce from farms to the end-consumer. Major recommendations include the development of well-functioning warehouse facilities, promotion of warehouse-based post-harvest loans, special focus on building aggregation units at the village level for horticulture produce and developing marketing co-operatives. To establish a more efficient market model, it has proposed a new structure comprising primary rural agricultural markets (PRAM), competitive wholesale markets and export markets. This is proposed keeping in mind that small and marginal farmers dominate the agricultural space in India, but they fail to reap benefits of marketing infrastructure and hence do not receive the right price for their produce. The committee proposes that PRAM could be used as an aggregation platform. The recommendations also include adopting the Model Agriculture Produce and Livestock Marketing (APLM) Act, 2017, and increasing the number of wholesale and retail markets to 10,000 and 20,000 respectively.
- **Diversification: Secondary Agricultural Activities** :
  Given that farm families are engaged in agriculture for about 185 days a year, the Dalwai committee recommended the creation of additional productive jobs, utilising primary products and by-products of farming activities using local skills. These secondary incomes could help farmers in times of volatility and falling prices. The report recommends that these activities be promoted by exempting these activities from GST or keeping tax rates low, providing special category funding and incentivising micro-enterprises led by women.

The committee has produced a comprehensive and detailed analysis of the current agricultural situation in India. The committee has estimated the additional investments needed to attain an annual growth rate in farmers' income of 10.4% growth at about Rs. 640,000 crore at 2011–12 prices, of which the government's contribution would be 80%. It also targets raising the share of monthly income of farmers coming from cultivation and livestock from the present level of 60% (in 2012–13 survey) to 70%[5] (in one place it says even 80%)[6] over the target period (2016–17 to 2022–23).

While the efforts of Dalwai Committee are well appreciated and the government has instituted a mechanism to track the implementation of recommendations, four major questions remain unanswered:

(i) Under the business as usual scenario based on, say, the last 10–15 years, growth rates of agricultural GSDP and in farmers' incomes have been around 3.6% (page: 25, Report of the Committee on Doubling Farmers' Income Volume II "Status of Farmers' Income: Strategies for Accelerated Growth"). Is it feasible to set a double-digit target at the national level for doubling farmers' income in the coming years until 2022–23?
(ii) Where will the government mobilise the additional fund of Rs. 6.4 lakh crore at 2011–12 prices that is mentioned in the report, especially when loan waivers and other welfare schemes are on the rise?
(iii) Even if the government succeeds in mobilising funds for the extra investment and it does achieve the 10.4% growth in farmers' incomes, who will absorb the massive surpluses in agricultural production? What is the rate at which domestic consumption of agricultural goods has been rising over the last 10–15 years? What is the growth in agricultural exports? In fact, during the period from 2014–15 to 2018–19, exports of agricultural products have come down compared to where they were in 2013–14. Given this, does the economy have the capacity to absorb such a high growth rate in agriculture and farmers' incomes?
(iv) How, in such a short period, is the government going to implement the interventions listed in the report?

The key issue with these reports is that there are way too many recommendations in it and by the time the final DCR Report; i.e. Volume 14 titled "comprehensive policy recommendations" was released, two and a half years of the total seven-year period envisaged by PM Modi to double farmers' real incomes had already elapsed.

During the five-year tenure of the Modi government, i.e., 2014–15 to 2018–19, the average annual agricultural GDP growth rate of the country was 2.9%. If one assumes that farmers' incomes broadly increase in line with the rate of growth of agricultural GDP, as has been the case in the last decade, it is obvious that the country lags far behind the required CAGR of 10.4%, the annual growth rate required to achieve PM

[5]Page: 150, Chapter 7, Policy Recommendations, Report of the Committee on Doubling Farmers' Income Volume II "Status of Farmers' Income: Strategies for Accelerated Growth".

[6]Page 149, Key Extracts, Report of the Committee on Doubling Farmers' Income Volume II "Status of Farmers' Income: Strategies for Accelerated Growth".

Modi's dream of doubling farmers' real incomes by 2022–23. This means that in the remaining years until 2022–23, farmers' real incomes need to increase by about 13–15% per annum. This appears almost impossible with the set of policies followed during the last five years.

If the country has to reach anywhere near the goal of doubling the real incomes of farmers by 2022–23, it cannot be done without increasing the profitability of cultivation and livestock farming. In the next section, we look at the historical trends in the profitability of major crops and identify the factors influencing profitability.

10.4 Profitability in Major Crops in Important Producing States

In this section, we look at the net profitability of major crops produced in India. We concentrate on two variants of the cost of cultivation. A2 is the paid out costs by the farmer and includes the value of hired labour and machinery, value of *owned machine labour*, value of seeds, fertilisers, manure, pesticides, irrigation charges, land revenue, interest on capital and rent paid on leased in land. C2 includes paid out costs by farmers plus imputed rental costs of owned land, imputed interest on owned capital and imputed value of family labour employed. Since the BJP election manifesto of 2014 had promised implementing the Swaminathan Committee formula for pricing, which suggested a 50% profit over C2 cost, our analysis involves estimating profitability over both A2 and C2 costs. Profitability is calculated by subtracting A2 and C2 costs per hectare from the gross value of output per hectare. Data on the actual value of output and cost per hectare are available up to 2015–16. Major producing states are considered for our analysis. Profitability at the all-India level is calculated by taking the weighted average of net profits of the states, the weights being the share under a particular crop in the total GCA under that crop in a state. The results show that the net profit margin differs across states as well as crops, but in most cases, margins have fallen in the period from 2012–13 to 2015–16, the latest years for which actual cost of cultivation is available. We briefly discuss these below. The figures showing profitability over C2 cost are presented in the annexure.

Paddy

Rice is the most widely produced and consumed crop in India. The top five paddy producing states are West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh and Tamil Nadu. Other important producers are Bihar and Odisha. These states together account for 59% of the area under paddy cultivation and contribute 63% of the total production. The results indicate that, barring Punjab, profits have declined in all states (there was a marginal fall in profitability in the years 2014–15 to 2015–16 in Punjab too). Profitability based on C2 cost has turned negative in some states (West Bengal, Odisha and Uttar Pradesh). In 2015–16, Punjab farmers had a 203% margin over A2 cost. This is not surprising given that farmers in Punjab receive assured minimum support price, which at least covers their cost. Farmers in most other rice producing states,

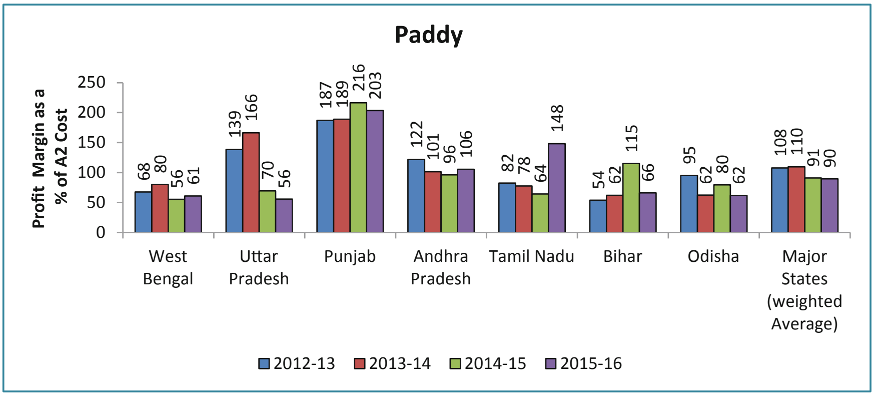

Fig. 10.9 Profit margin as per cent of A2 cost for paddy. *Source* Calculated by the authors using DES cost of cultivation data

barring Andhra, generally do not get even MSP for paddy. The weighted average of these seven states shows the net margins over A2 cost falling from 108% in 2013–14 to 90% in 2015–16 (Fig. 10.9) while the net margin over C2 cost has fallen from 8% to minus 4% in the same period (Fig. 10.23).

Wheat

Wheat is another important staple consumed all over India. The crop is mostly cultivated in the temperate region of western India in the *rabi* season. Uttar Pradesh, Madhya Pradesh, Punjab, Haryana and Rajasthan are the largest producers of wheat accounting for 80% of the GCA under the crop and 86% of total wheat production. Comparatively, wheat farmers appear to be better placed than paddy farmers. All the top producing states have a positive margin over A2 cost. But unfortunately profit margins have declined for all major states. At the all-India level, (calculated by taking the weighted average based on share in GCA), the profit margin over A2 cost and C2 cost has declined from 183 and 35%, respectively in 2012–13 to 155 and 19.5%, respectively, in 2015–16 (Figs. 10.10 and 10.24).

States like Punjab, Haryana and MP have a well-functioning procurement mechanism. Punjab procures 74% of rice and 67% of the wheat produced in the state while Madhya Pradesh procures 53% of its total wheat production. The Madhya Pradesh government launched a bonus policy over and above the centre's MSP, which has helped increase production and procurement of wheat in the state (Gulati et al. 2017). But in states like Bihar, Odisha and UP, the procurement mechanism is poor and the farm harvest price remained consistently lower than the announced MSPs.

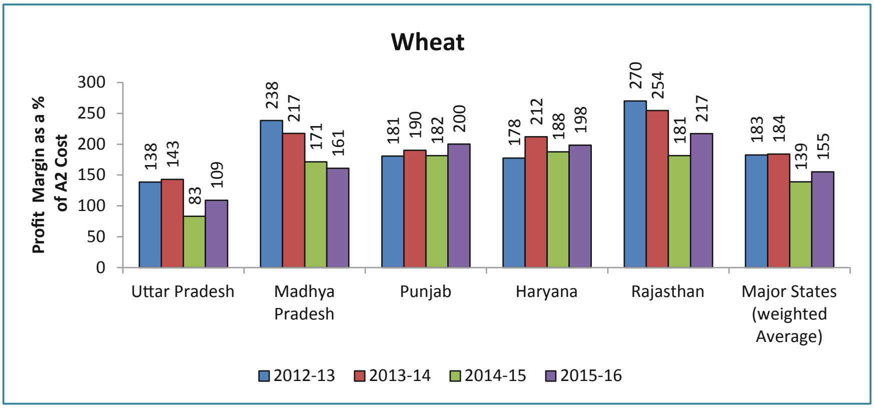

Fig. 10.10 Profit margins as a percentage of A2 cost for wheat. *Source* Calculated by authors using DES cost of cultivation data

Maize

After rice and wheat, maize is the most widely produced cereal in India and is used as both food and fodder. Maize is a *kharif* crop, but in some states, it is also cultivated during the *rabi* season. Our analysis shows that maize is unprofitable in all the major producing states (Figs. 10.11 and 10.25). Even though Punjab, Haryana and western Uttar Pradesh have geographical conditions that are suitable for maize cultivation, they continue growing rice and wheat due to the latter's higher profitability that is largely facilitated by a robust procurement mechanism under the MSP regime. The profit margin in the case of maize over A2 and C2 cost declined from 101% and 18%, respectively, in 2012–13 to 79% and −3%, respectively, in 2015–16.

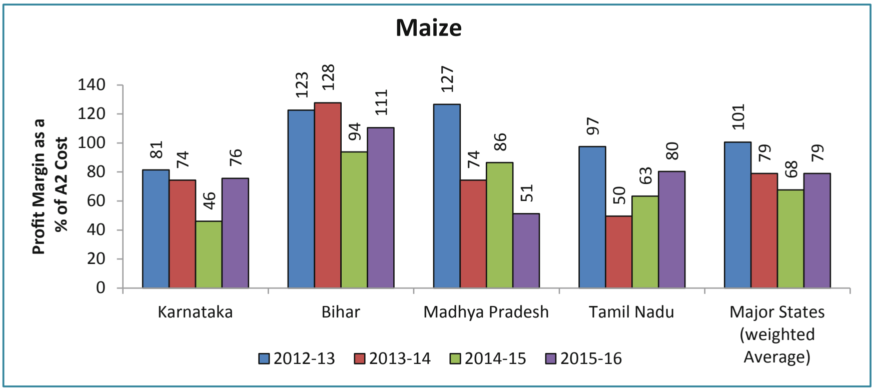

Fig. 10.11 Profit margins as per cent of A2 cost for maize. *Source* Calculated by authors using DES cost of Cultivation Data

Arhar

India is the largest producer, consumer and importer of pulses in the world. It is considered a cheap source of protein for the poor. Pigeon pea is an important item in the consumption basket of the Indian population. Madhya Pradesh, Maharashtra, Gujarat, Karnataka and UP are the largest producing states, together contributing 76% of the total production of *arhar* (also called *tur*) in India. Pulse prices have experienced major volatility in the past few years as did net profitability (Figs. 10.12 and 10.26). Due to severe back-to-back droughts during 2014–15 and 2015–16, the production of all pulses plummeted to 16.5 MMT. Increased imports by India put pressure on international prices. The price of *tur* dal in the retail market shot up to Rs. 180 per kg and the farmers responded to this price signal by bringing more area under pulses, and a good rainfall led to a bumper harvest in 2016–17. *Tur* production, for example, shot up by a massive 65%, from 2.5 MMT to 4.2 MMT, while overall, pulses production went up by 33% from 16.5 MMT to 22 MMT. This resulted in a substantial drop in the market price of *tur*, from about Rs. 10,000/quintal in September–October 2016 to Rs. 4000–4500/quintal in February–March 2017, even below the MSP. Such low prices did not bring much profit compared to other crops. This was evident in the 2016–17 profitability figures.

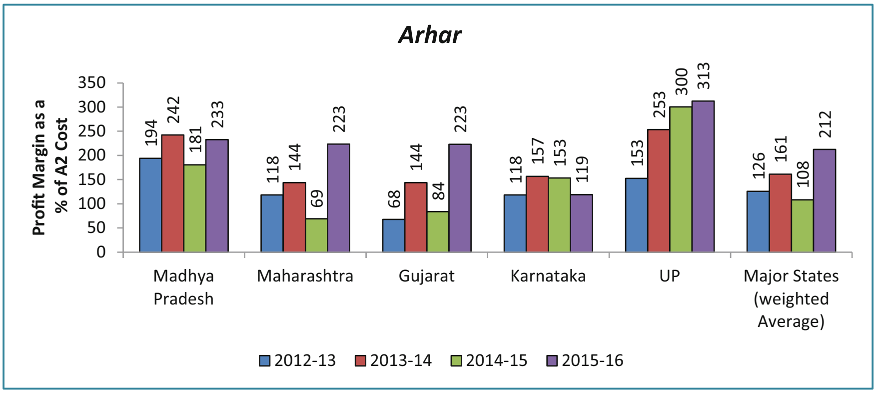

Fig. 10.12 Profit margins as per cent of A2 cost for *Arhar*. *Source* Calculated by authors using DES cost of Cultivation Data

Sugarcane
Sugarcane is one of the major cash crops produced in India and the crop consumes a lot of water. The largest producers include Uttar Pradesh, Maharashtra, Karnataka and Tamil Nadu, which together produce 80% of the total production. In both UP and Maharashtra, sugarcane is cultivated in irrigated areas. Sugarcane is a 9-month crop in UP, which need to be irrigated 7–8 times. As against this, in Maharashtra, it needs to be irrigated at least 25 times. In terms of profit margins, sugarcane cultivation is more profitable in Uttar Pradesh than in Maharashtra and other significant producing states. However, all states including Uttar Pradesh have experienced a reduction in profit margins between 2012–13 and 2015–16 (Figs. 10.13 and 10.27).

The sugar sector has also been facing the same kind of volatility faced by pulses in recent years. Domestic sugar production dropped to 20.3 MMT, which led to an increase in demand for imports and domestic ex-mill sugar prices crossed Rs. 36 per kg. As a result, farmers expanded the area under sugarcane and a good monsoon led to an improvement in the yield and recovery ratio. The production of sugar increased from 20.3 MMT in 2016–17 to 32.3 MMT in 2017–18. This helped reduce imports but during these time, world prices of sugar dropped by 50%. It made Indian sugar non-competitive in global markets.

Cotton
Cotton is the most important fibre crop produced in India. The significant producers include Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Telengana that together account for 82% of the total production. After the introduction of BT cotton in India, production increased enormously. The export of raw cotton increased from $10 million in 2002–03 to $4258 million by 2011–12. But, international prices crashed thereafter and the value of export started declining and eventually reached $1536 million by 2016–17. Consequently, the net profit margin on cotton across states has declined. The weighted average margin of major producing states shows a steady decline, especially in the last two years (Figs. 10.14 and 10.28).

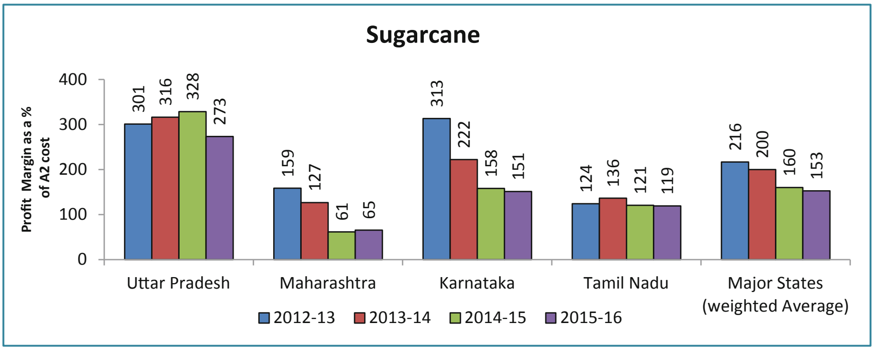

Fig. 10.13 Profit margin as per cent of A2 cost for sugarcane. *Source* Calculated by authors using DES cost of cultivation data

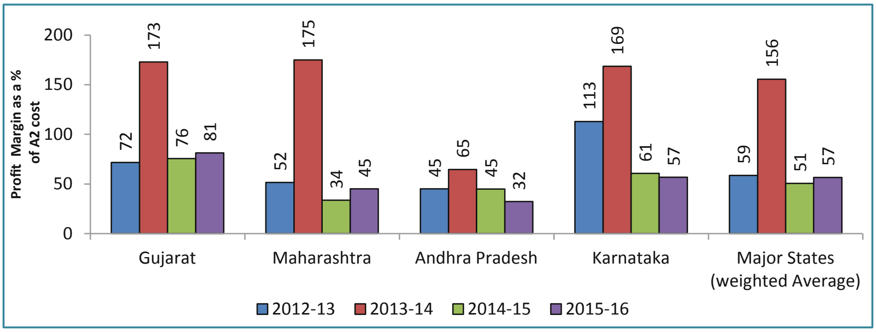

Fig. 10.14 Profit margin as a percentage of A2 cost for cotton. *Source* Calculated by authors using DES cost of cultivation data

Soybean

Soybean is the most important form of edible oil consumed in India. Among all the food groups consumed in India, consumption of edible oil has been increasing at the highest pace. Domestic production is insufficient to fulfil growing demand, and India is heavily import dependant. Of the total soybean produced in the country, more than 90% is contributed by Madhya Pradesh, Maharashtra and Rajasthan. There has been a steep decline in net profit in the last three years (Figs. 10.15 and 10.29).

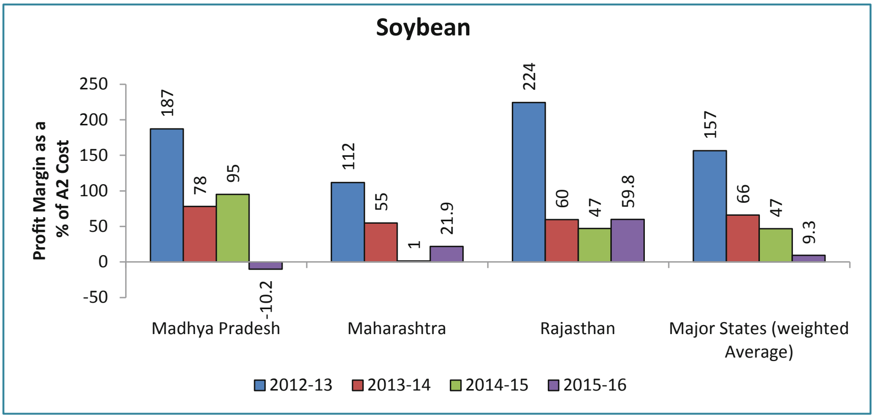

Fig. 10.15 Profit margin as a percentage of A2 cost for soybean. *Source* Calculated by authors using DES cost of cultivation data

Onion

Onion is one of the most important commercially grown vegetables, and India is the world's second largest producer with production of 21 million MT in 2015–16. The largest producers of onions include Maharashtra, Karnataka, Madhya Pradesh, Bihar and Gujarat. Unfortunately, we only have profitability data for the states of Maharashtra, Karnataka and Gujarat that together contribute 52% of total production. Onions are always in the news for the volatility in its prices and consequently in its profit margin (Figs. 10.16 and 10.30). One of the major reasons behind high volatility in onion prices is the lack of storage facilities that have not kept pace with rising production. Our analysis shows that all the states experienced volatility in the profit margin in the past four years (Fig. 10.16). This boom and bust in onion prices takes place almost every alternate year. In 2017 (May–June), onion prices went down to around Rs. 2/kg in various *mandis* in Madhya Pradesh. This resulted in a farmers' agitation, police firing and unfortunate deaths. The immediate band-aid measure was procuring onions at Rs. 800/quintal; due to the scarcity of storage facilities, 8.76 lakh tonnes of onion was disposed of through the public distribution system (PDS) at almost one-fifth the cost. Since then, onion prices have moved up and down several times. Major investment needs to be made to improve the cold chain infrastructure and processing facilities.

To summarise the crop-wise results, the profitability of important crops in major producing states has actually declined over the four years covered. We have calculated the weighted average profitability of major crops from state-level profitability by using the share of the state in the total cropped area under that crop. The unfortunate truth is that the net profit margin in almost all major agricultural commodities covered here has declined in recent years. Farmers cultivating paddy, maize, sugarcane, cotton and soybean all experienced losses in 2015–16 compared to previous years (Figs. 10.17 and 10.18).

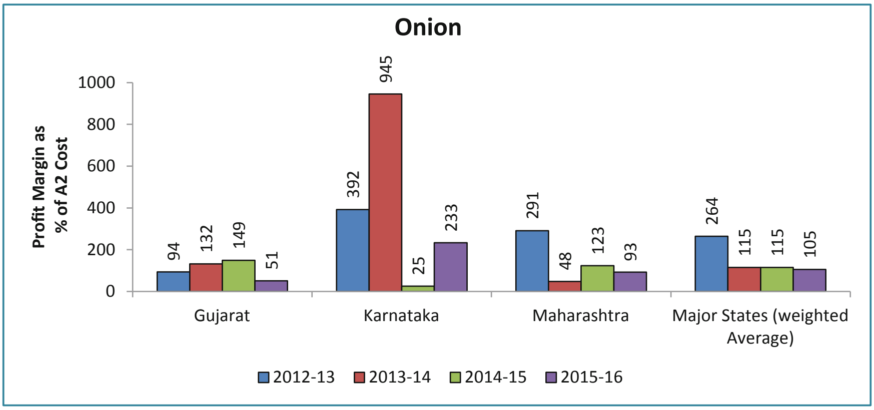

Fig. 10.16 Profit margin as percentage of A2 cost for onion. *Source* Calculated by authors using DES cost of cultivation data

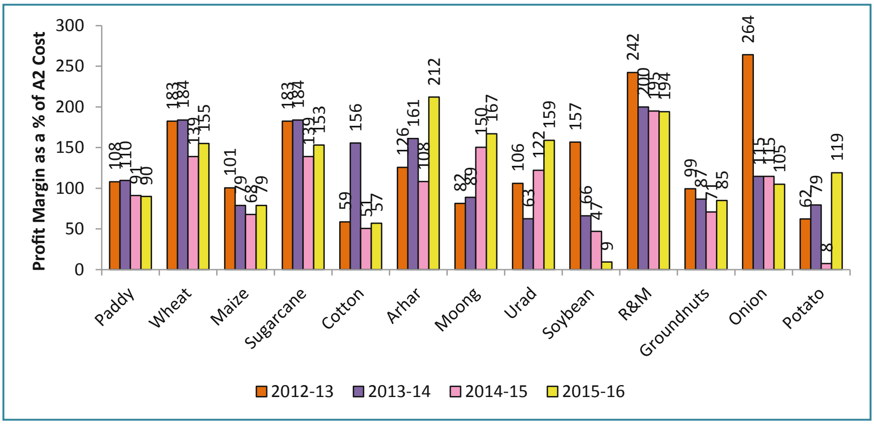

Fig. 10.17 Trends in profitability (over A2 cost) of important crops in India (weighted average of major producing states). *Source* Calculated by the authors using DES cost of cultivation data

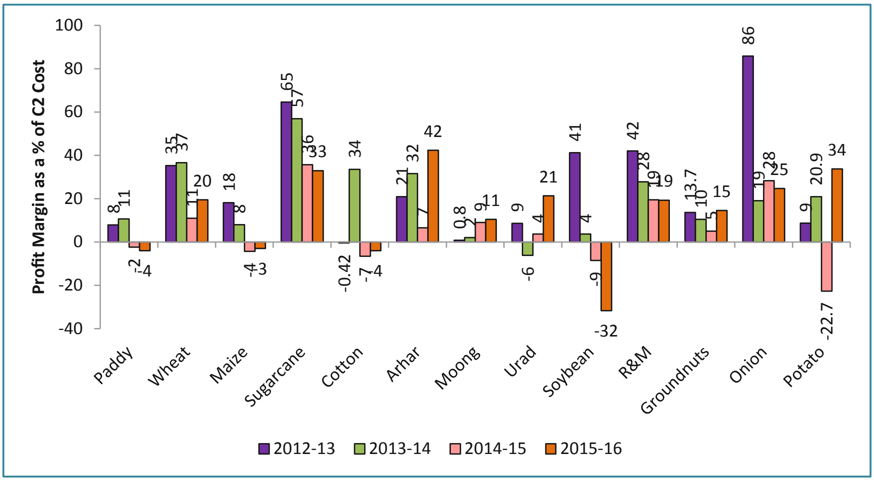

Fig. 10.18 Trends in profitability (over C2 cost) of important crops in India (weighted average of major producing states). *Source* Calculated by the authors using DES cost of cultivation data

It may be noted that there is normally a lag of two to three years to get data on the cost of cultivation from government sources. But in recent years, some major *kharif* crops were in the news because of the high volatility in their prices. Hence, it would be interesting to see the recent trends in profitability of major *kharif* crops (*kharif* seasons of 2016, 2017 and 2018). Actual market prices have been obtained by taking the weighted average of market prices in the major markets of the largest producing states, the weights being the share of the state in the total production of that crop. As state-wise actual cost figures are not available for the period of analysis, the projected cost derived by CACP for calculating MSPs is taken as a proxy.

Figures 10.19 and 10.20 show that farmers producing *kharif* crops are incurring huge losses, particularly so in *kharif* 2017. In 2018, profit margins recovered in the case of some crops but not enough to compensate for the decline in 2017. No wonder, one witnessed a large number of farmers' agitations during 2018, just ahead of the 2019 parliamentary elections.

If margins over costs were not improving, and in fact falling over the last five to seven years, the absolute profits on a per hectare basis could still have improved if productivity gained sufficiently to compensate for the losses in profit margins. However, productivity growth in most crops has also remained sluggish during the

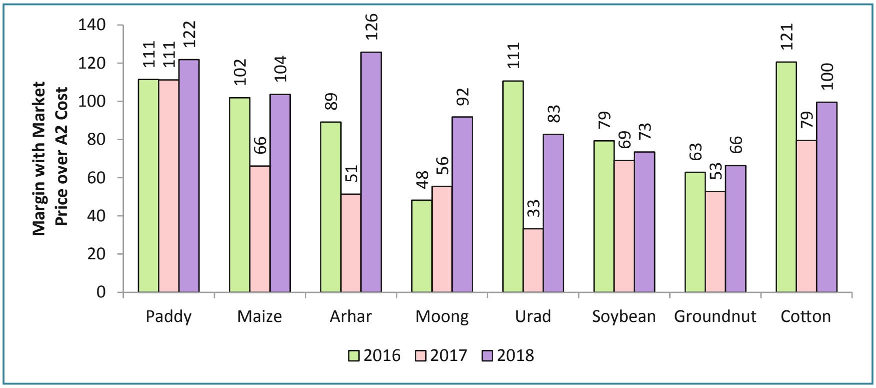

Fig. 10.19 Net margin (market price-projected A2 cost) as percentage of projected A2 cost. *Source* Agmark.net, CACP

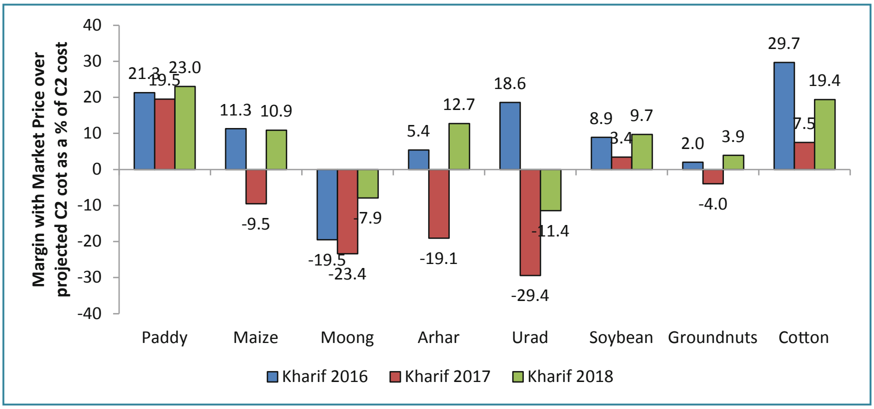

Fig. 10.20 Net margin (market price-projected C2 cost) as percentage of projected C2 cost. *Source* Agmark.net, CACP

last 15 years or so, suggesting that real profits even on a per hectare basis may have been shrinking. The productivity of major crops has increased very slowly over the years (Fig. 10.21 and Table 10.2). Compared to neighbouring countries, India's productivity gain is very poor. In 2016–17, paddy (rice) and wheat productivity in China stood at 6.9 MT/ha and 5.4 MT/ha, respectively (FAOSTAT). In the same year, India's productivity was 3.8 MT/ha and 2.7 MT/ha for rice and wheat, respectively. Productivity of rice in India is even lower than in Bangladesh. Given the inelastic nature of land, increasing population and the need to ensure global competitiveness, stagnant productivity can affect profitability more severely unless prices rise sufficiently.

Rising production costs have also affected profitability. Figure 10.22 shows that in the period of 2004–05 to 2015–16, there was a steady increase in production costs (in 2011–12 prices) for all major crops. The cost of production of maize, *arhar, urad*, groundnuts and onion increases at an annual rate of more than 8% in real terms while the increase was more than roughly 5% in the case of the rest of the crops. This is a cause for concern as it reflects that productivity gains, whatever little there has been, have not reduced real costs of production on a per unit basis. And if output prices too have not risen sufficiently in line with rising costs, the inevitable result is shrinking margins. Historical crop wise cost of production and year on year growth rate of A2 cost of production is tabulated in the annexure Tables 10.3 and 10.4.

Rising costs and tumbling margins do not auger well for doubling farmers' incomes by 2022–23 as envisaged by the PM. These trends need urgent attention; otherwise, falling incentives in cultivation will also adversely impact capital formation in agriculture by farmers, further slowing down the growth rate of agricultural

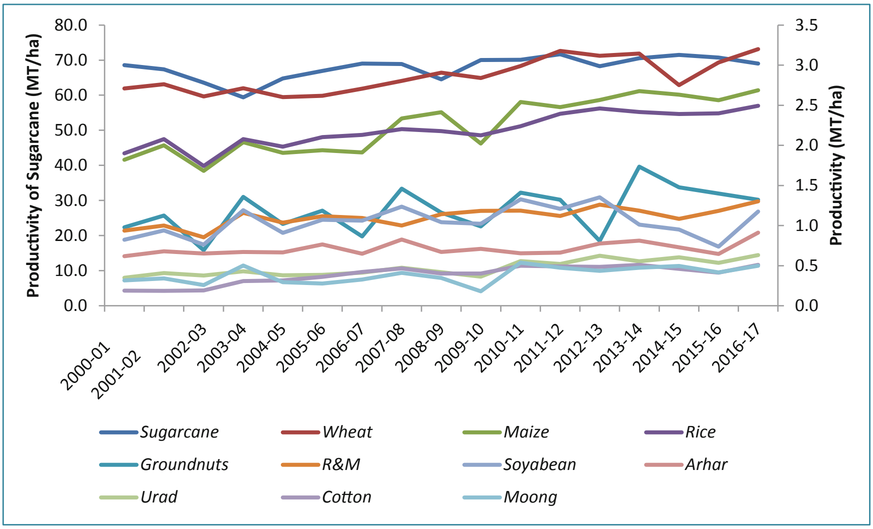

Fig. 10.21 Productivity of important crops in India. *Source* Directorate of Economics and Statistics

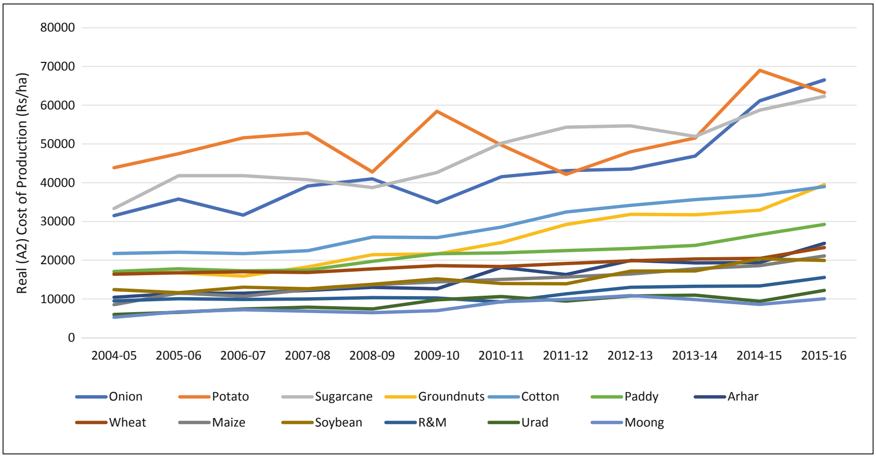

Fig. 10.22 Cost (A2) of production (Rs/ha) of major crops, 2004–05 to 2015–16. *Source* Directorate of Economics and Statistics

GDP, which has already fallen from 4.3% during UPA-2 (2009–10 to 2013–14) to just 2.9% during Modi period-1 (2014–15 to 2018–19).

With such slow growth, it emerges nearly impossible for the governmnet to be able to double incomes of farmers by year 2022–23. But there are countries, like China, which managed to achieve this miracle in the early years of reform. China increased its farmers' real incomes by almost 15% per annum during 1978–84 just by focusing on land reforms (dismantling the commune system and adopting the household responsibility model) and substantially freeing prices from government controls. There are still a wide range of opportunities available that can help boost Indian farmers' incomes, if not double them, by 2022. The issue of markets and low prices is a current problem, given that imports have flooded the markets and exports have not increased in the last five years. Market reforms, along with strategic changes in trade policy, are low-hanging fruits and need to be initiated immediately. They will improve market price realisation for farmers. Substantial improvements in productivity by carrying out supply side reforms (agricultural R&D, irrigation, fertilisers, power, etc.) can cut down costs and improve margins for farmers. The business as usual (BAU) scenario cannot double farmers' incomes in the absence of any major reform of agricultural markets or of measures to step up productivity substantially.

Dairy
Livestock constituted 29.3% of the value of output from agriculture and allied activities while milk alone contributed 14% of GVOA in 2015–16. However, of total income, only 8% was contributed by the livestock sector in the same year. India has experienced unprecedented growth in milk production since 2014–15. Currently, India is the largest producer of milk in the world, and it provides livelihood to small and landless agricultural households. However, in 2017–18 milk prices declined by 20–30% in major milk producing states creating a stress in the dairy industry. Farmers in those states protested by spilling milk on the streets. The situation of over production was worsened by plummeting global skimmed milk powder (SMP) prices from around $4744/tonne in 2013–14 to $1925/tonne in 2017–18. As a result, India's SMP exports declined from 124 thousand tonnes in 2013–14 to 11.3 thousand tonnes in 2017–18, adversely affecting farmers' profitability and incomes. There is no market price assurance for countless small farmers struggling to manage their livelihood by selling liquid milk. India needs to create demand to match increasing supplies of milk by investing in value added products. The government can introduce milk in mid-day meal schemes to boost demand.

10.5 Challenges in Augmenting Incomes

Apart from the constraints highlighted in the section above, the following challenges make it difficult to augment farmer incomes.

1. Shrinking *land* and landholding size—resource-use efficiency is adversely affected by land constraints.
2. *Productivity* as a route to higher production—As highlighted in previous chapters, yields for several crops and in many states have been stagnating or falling. This may be due to the use of inappropriate seeds, inefficient use of fertilisers, inability to adjust and adapt to changing weather and climatic conditions, etc.
3. *Inadequate access to credit*—As per NABARD's NAFIS, between July 2015 and June 2016, 43.5% agricultural HHs took loans. Of these, 60.5% took institutional loans and about 9% took loans from both institutional and non-institutional sources. This means that about 30.3% Indian agricultural HHs took loans from institutions, implying that about 70% of agricultural HHs took loans from non-institutional (NI) sources, which includes borrowing from relatives, friends, moneylenders, landlords, input suppliers, etc. Anecdotal evidence suggest that the interest charged on NI loans was anywhere between 2 and 3% per month. This lack of access to credit adversely affects a farmer's ability to invest.
4. *Highly volatile crop prices—Volatility in crop prices arise because:*

    i. There is dearth of storage facilities and an individual farmer is too small and poor to invest in storage facilities on his farm.

ii. Processing facilities and value chains do not exist, leading to a price slump during a bumper crop year. This is typically the case with most horticultural crops.
iii. Insufficient markets—As per Dalwai Committee Report (Volume 4, pp 57), Indian farmers on average have to travel about 12 km to access a market and this distance varies between states. In Assam, this distance is about 45 km, while it is only 6 km in Punjab. As per the National Commission on Agriculture (1970), the ideal distance should be 5 km.

5. *Inadequate access to relevant techniques and production technology.*
6. *Low cropping intensity due to lack of access to water.*

Challenges for income from livestock

1. Dairy: Here the biggest challenges are threefold: breed of the animal (and thus its genetic yields), feed for the animal and inadequate demand for the final product, i.e. milk. The high costs of artificial insemination and inadequate availability of high-yielding cattle/buffalo semen forces dairy farmers to rear inefficient animals. Besides, the increasing cost of feed, shrinking grasslands for open grazing due to the growing pressure on land, inadequate knowledge of the appropriate balanced diet for animals, and lack of access to vaccination facilities for animals reduce yields further. Central to all these problems in the lack of formal milk processing centres in the country, the absence of which causes prices to fluctuate widely.

10.6 Conclusion

It is apparent from the analysis that the relentless focus of government(s) on increasing agricultural GDP may not by itself increase farmers' incomes and thus farmers' welfare. Despite achieving high agricultural GDP growth rates, farmers' incomes in states like Gujarat and Madhya Pradesh did not grow as fast. In contrast, there were states like Odisha, Bihar and, to some extent, UP where despite average agricultural GDP growth rates, farmers' incomes grew rapidly.

Overall, PM Modi's dream of doubling the 2015–16 level of farmer incomes by 2022–23 is unlikely to be realised, mainly on two accounts—(a) four of the seven years have gone by with an average agricultural GDP growth rate of 3.7% (much lower than the required rate of 10.4%); and (b) the profitability of cultivation has been declining due to plummeting agricultural prices in recent years and rising cultivation costs, mainly on account of rising labour costs.

Nevertheless, the drive to enhance farmers' incomes should continue. Interventions required to achieve this at the policy and operational level are discussed and presented in the next chapter.

Annexures

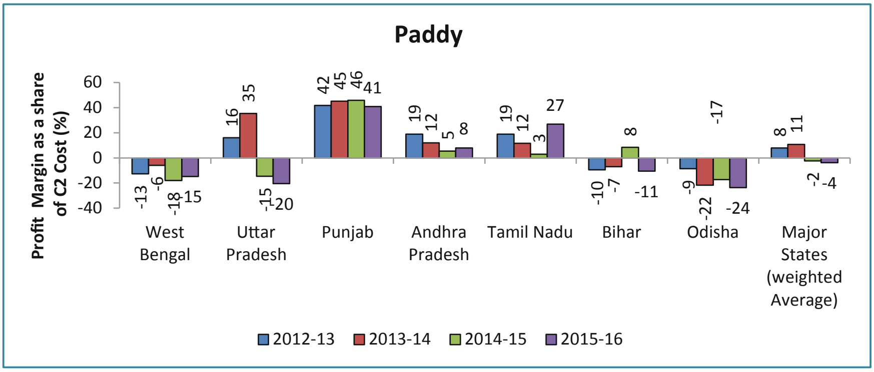

Fig. 10.23 Profit margin as percentage of C2 cost for paddy. *Source* Calculated by the authors using DES cost of cultivation data

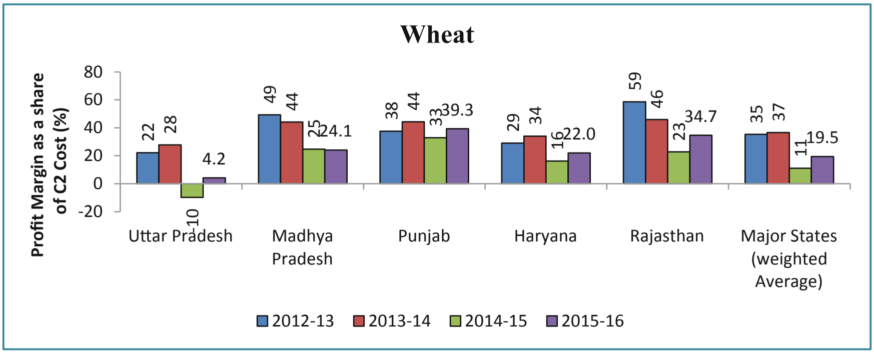

Fig. 10.24 Profit margin as percentage of C2 cost for wheat. *Source* Calculated by the authors using DES cost of cultivation data

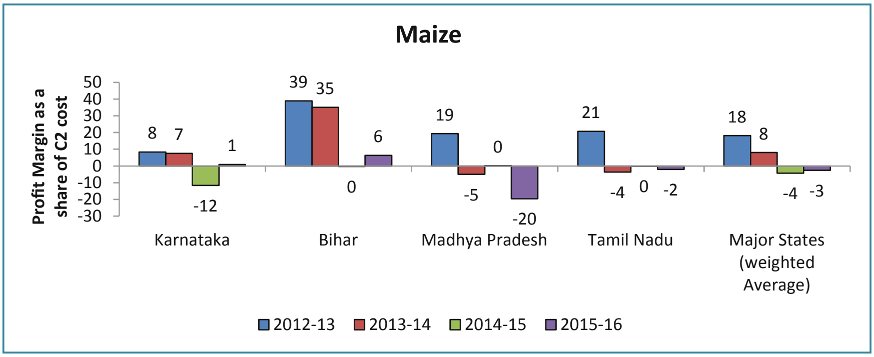

Fig. 10.25 Profit margin as percentage of C2 cost for maize. *Source* Calculated by the authors using DES cost of cultivation data

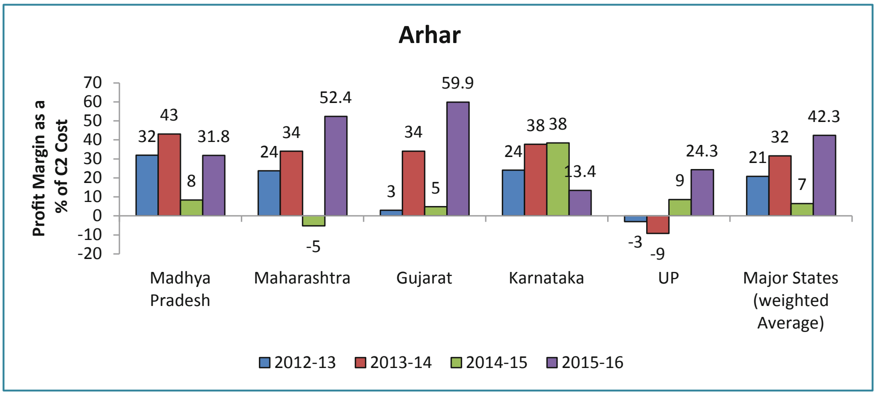

Fig. 10.26 Profit margin as percentage of C2 cost for *arhar*. *Source* Calculated by the authors using DES cost of cultivation data

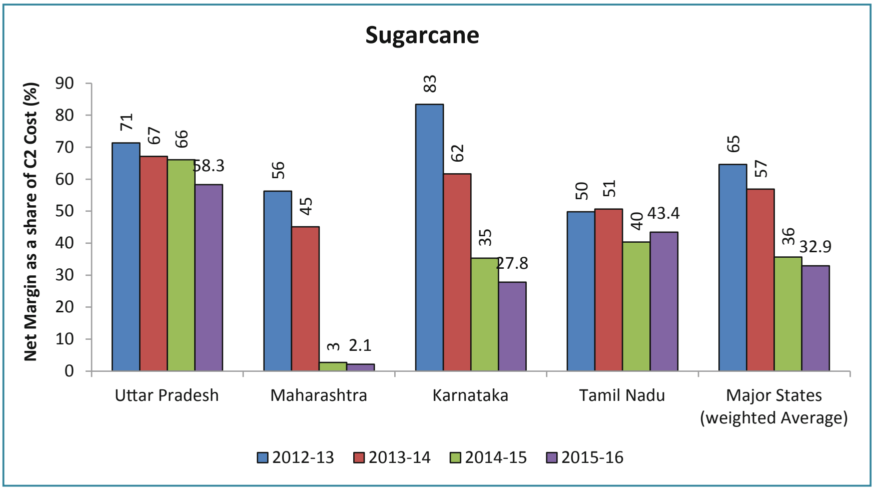

Fig. 10.27 Profit margin as percentage of C2 cost for sugarcane. *Source* Calculated by the authors using DES cost of cultivation data

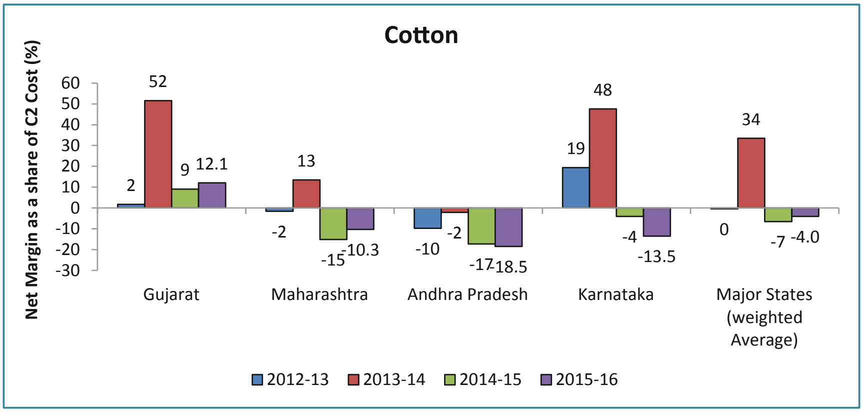

Fig. 10.28 Profit margin as percentage of C2 cost for cotton. *Source* Calculated by the authors using DES cost of cultivation data

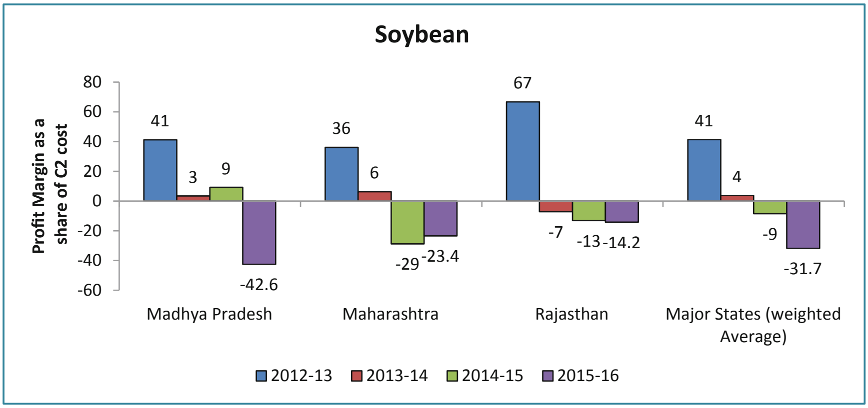

Fig. 10.29 Profit margin as percentage of C2 cost for soybean. *Source* Calculated by the authors using DES cost of cultivation data

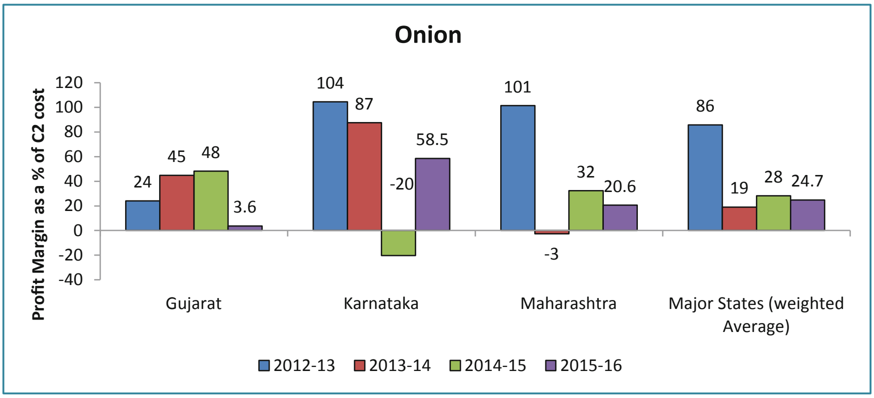

Fig. 10.30 Profit margin as percentage of C2 cost for onion. *Source* Calculated by the authors using DES cost of cultivation data

Table 10.1 Composition of agricultural households' income (percent of total monthly income), 2002–03 to 2015–16

Major states	Net receipt from cultivation and farming of animals			Net receipts from non-farm business			Income from wages		
	2002–03	2012–13	2015–16	2002–03	2012–13	2015–16	2002–03	2012–13	2015–16
Andhra Pradesh	51.2	51.8	40.3	9.5	6.7	7.7	39.4	41.5	52.0
Assam	61.2	74.8	25.7	8.1	3.8	24.7	30.8	21.4	49.6
Bihar	61.4	56.1	29.4	11.2	6.7	4.3	27.5	37.2	66.3
Gujarat	60.3	61.4	53.6	5.2	4.8	6.0	34.5	33.9	40.3
Haryana	43.7	72.8	50.2	12.4	3.0	2.0	44.0	24.2	47.8
Himachal Pradesh	36.4	44.7	39.8	16.4	9.4	3.7	47.3	45.9	56.5
Jammu & Kashmir	51.2	30.5	27.1	11.3	11.7	1.9	37.5	57.8	71.0
Karnataka	53.4	62.6	54.3	6.4	7.1	6.5	40.2	30.3	39.2
Kerala	31.8	34.5	46.2	17.9	21.3	1.0	50.3	44.2	52.8
Madhya Pradesh	53.8	76.5	53.8	7.1	2.1	2.5	39.2	21.5	43.8
Maharashtra	57.1	59.5	48.3	10.4	11.3	9.4	32.4	29.2	42.4
Orissa	33.1	54.7	34.0	12.9	10.8	9.6	54.0	34.5	56.5
Punjab	61.7	69.3	63.1	8.9	4.2	8.4	29.5	26.5	28.5
Rajasthan	24.3	55.9	34.9	13.6	9.7	1.9	62.1	34.5	63.2
Tamil Nadu	37.1	43.2	25.1	9.6	15.2	5.1	53.3	41.6	69.8
Uttar Pradesh	54.4	69.0	40.1	11.3	7.6	4.3	34.2	23.4	55.6
West Bengal	39.2	30.3	32.2	18.2	16.3	18.1	42.7	53.4	49.7
Jharkhand	45.3	56.0	44.2	10.0	5.0	3.6	44.7	39.0	52.2
Chhattisgarh	49.9	64.3	40.6	6.2	0.0	4.1	43.8	35.7	55.2
Uttarakhand	68.7	71.9	34.3	15.4	5.4	8.4	16.0	22.7	57.2

(continued)

Table 10.1 (continued)

Major states	Net receipt from cultivation and farming of animals			Net receipts from non-farm business			Income from wages		
	2002–03	2012–13	2015–16	2002–03	2012–13	2015–16	2002–03	2012–13	2015–16
India	**50.1**	**59.8**	**43.1**	**11.2**	**8.0**	**6.8**	**38.7**	**32.2**	**50.0**

Table 10.2 Productivity of major crops (MT/ha)

	Rice	Wheat	Maize	*Arhar*	*Moong*	*Urad*	Sugarcane	Cotton	Soybean	Groundnuts	R&M
2000–01	1.9	2.7	1.8	0.62	0.32	0.35	68.6	0.19	0.82	0.98	0.94
2001–02	2.1	2.8	2.0	0.68	0.34	0.41	67.4	0.19	0.94	1.13	1.00
2002–03	1.7	2.6	1.7	0.65	0.26	0.38	63.6	0.19	0.76	0.69	0.85
2003–04	2.1	2.7	2.0	0.67	0.50	0.43	59.4	0.31	1.19	1.36	1.16
2004–05	2.0	2.6	1.9	0.67	0.29	0.38	64.8	0.32	0.91	1.02	1.04
2005–06	2.1	2.6	1.9	0.76	0.28	0.39	66.9	0.36	1.07	1.19	1.12
2006–07	2.1	2.7	1.9	0.65	0.33	0.41	69.0	0.42	1.06	0.87	1.10
2007–08	2.2	2.8	2.3	0.83	0.41	0.48	68.9	0.47	1.23	1.46	1.00
2008–09	2.2	2.9	2.4	0.67	0.35	0.42	64.6	0.40	1.04	1.16	1.14
2009–10	2.1	2.8	2.0	0.71	0.18	0.36	70.0	0.40	1.02	0.99	1.18
2010–11	2.2	3.0	2.5	0.66	0.54	0.56	70.1	0.50	1.33	1.41	1.19
2011–12	2.4	3.2	2.5	0.66	0.47	0.52	71.7	0.49	1.21	1.32	1.12
2012–13	2.5	3.1	2.6	0.78	0.44	0.63	68.3	0.49	1.35	0.81	1.26
2013–14	2.4	3.1	2.7	0.81	0.47	0.55	70.5	0.51	1.01	1.73	1.19
2014–15	2.4	2.7	2.6	0.73	0.50	0.60	71.5	0.46	0.95	1.48	1.08
2015–16	2.4	3.0	2.6	0.65	0.42	0.54	70.7	0.41	0.74	1.40	1.18
2016–17	2.5	3.2	2.7	0.91	0.50	0.63	69.0	0.51	1.18	1.32	1.30

Source Agricultural Statistics at a Glance. Various Issues

Table 10.3 Cost of production of major crops in 2011–12 prices (Rs/ha)

	Paddy	Wheat	Maize	Arhar	Moong	Urad	Sugarcane	Cotton	Soybean	Groundnuts	R&M	Onion	Potato
2004–05	17,084	16,390	8513	10,426	5268	5976	33,338	21,727	12,405	16,888	9486	31,494	43,879
2005–06	17,759	16,763	11,542	11,460	6698	6545	41,792	22,038	11,611	16,742	10,053	35,782	47,502
2006–07	17,251	17,021	10,675	11,471	7219	7406	41,800	21,705	13,046	15,897	9857	31,633	51,587
2007–08	17,441	16,837	12,459	12,190	6838	7872	40,774	22,449	12,615	18,292	9975	39,149	52,811
2008–09	19,702	17,735	13,676	13,002	6453	7408	38,736	25,955	13,790	21,421	10,345	40,994	42,757
2009–10	21,669	18,600	14,372	12,617	6977	9771	42,633	25,832	15,202	21,598	10,251	34,843	58,420
2010–11	21,894	18,350	15,047	18,145	9288	10,628	50,190	28,568	13,993	24,572	9233	41,556	49,709
2011–12	22,471	19,129	15,645	16,312	9883	9434	54,307	32,452	13,906	29,218	11,317	43,115	42,153
2012–13	23,021	19,835	16,428	19,927	10,887	10,780	54,675	34,155	17,176	31,828	13,009	43,515	47,998
2013–14	23,808	20,303	17,793	19,296	9849	10,962	51,928	35,636	17,217	31,724	13,260	46,888	51,533
2014–15	26,601	20,461	18,587	19,394	8602	9385	58,725	36,739	20,344	32,921	13,358	61,125	68,994
2015–16	29,251	23,281	21,106	24,352	10,055	12,218	62,295	38,984	19,932	39,482	15,556	66,530	63,258

Source Cost of Cultivation Data, DES

Table 10.4 Year on year growth rate of real A2 cost of production

	Paddy	Wheat	Maize	Arhar	Moong	Urad	Sugarcane	Cotton	Soybean	Groundnuts	R&M	Onion	Potato
2004–05													
2005–06	3.9	2.3	35.6	12.1	27.1	9.5	25.4	1.4	−6.4	−0.9	6.0	13.6	8.3
2006–07	−2.9	1.5	−7.5	0.1	7.8	13.2	0.0	−1.5	12.4	−5.0	−2.0	−11.6	8.6
2007–08	1.1	−1.1	16.7	6.7	−5.3	6.3	−2.5	3.4	−3.3	15.1	1.2	23.8	2.4
2008–09	13.0	5.3	9.8	6.5	−5.6	−5.9	−5.0	15.6	9.3	17.1	3.7	4.7	−19.0
2009–10	10.0	4.9	5.1	−2.8	8.1	31.9	10.1	−0.5	10.2	0.8	−0.9	−15.0	36.6
2010–11	1.0	−1.3	4.7	38.5	33.1	8.8	17.7	10.6	−8.0	13.8	−9.9	19.3	−14.9
2011–12	2.6	4.2	4.0	−12.2	6.4	−11.2	8.2	13.6	−0.6	18.9	22.6	3.8	−15.2
2012–13	2.5	3.7	5.0	23.1	10.2	14.3	0.7	5.2	23.5	8.9	15.0	0.9	13.9
2013–14	3.4	2.4	8.3	−3.8	−9.5	1.7	−5.0	4.3	0.2	−0.3	1.9	7.8	7.4
2014–15	11.7	0.8	4.5	0.6	−12.7	−14.4	13.1	3.1	18.2	3.8	0.7	30.4	33.9
2015–16	10.0	13.8	13.6	26.7	16.9	30.2	6.1	6.1	−2.0	19.9	16.5	8.8	−8.3
Average growth rate	5.1	3.3	9.1	8.7	7.0	7.7	6.2	5.6	4.9	8.4	5.0	7.9	4.9

Source Calculated by author

References

Agriculture Produce and Livestock Marketing (APLM) Act. (2017). Department of Agriculture, Cooperation & Farmers Welfare, New Delhi, Ministry of Agriculture, Cooperation and Farmers Welfare, Government of India.

Dalwai Committee Report (DCR). (2018). Doubling Farmers' Income, Department of Agriculture, Cooperation & Farmers Welfare, New Delhi, Ministry of Agriculture, Cooperation and Farmers Welfare, Government of India.

FAOSTAT. (2016–17). FAO Statistical Programme of Work 2016-2017, Food and Agriculture Organization of the United Nations.

Gulati, A., Rajkhowa, P., & Sharma, P. (2017). *Making rapid strides—agriculture in Madhya Pradesh: sources, drivers, and policy lessons* (ICRIER Working Paper No. 339). New Delhi: Indian Council for Research on International Economic Relations.

NABARD. (2018). NABARD All India Rural Financial Inclusion Survey (NAFIS) 2015-16. Mumbai: National Bank for Agriculture and Rural Development.

NSS 68th round. (2014). Employment and Unemployment Situation in India. New Delhi: Ministry of Statistics & Programme Implementation, Government of India.

Part V
Agricultural Policies and Way Ahead

Chapter 11
Indian Agriculture Under PM Modi 1.0 2014–2018

Shweta Saini and Ashok Gulati

11.1 Background

There has been no dearth of promises, slogans, new programmes and schemes ever since Mr. Narendra Modi commenced his first innings in 2014 as India's Prime Minister. Starting from his 2014 election manifesto, Mr. Modi has made promises to revolutionise Indian farming. The list of these promises broadened and expanded in the subsequent five years. Some of the most prominent and striking promises are listed below:

1. In the election manifesto of 2014,[1] the following promises appeared prominently:
    a. Radically transform the Food Corporation of India (FCI) by unbundling its operations into procurement, storage and distribution for greater efficiency.
    b. Leverage technology to disseminate real-time data, especially to farmers—on production, prices, imports, stocks and overall availability.
    c. Evolve a single "National Agriculture Market".
    d. Promote and support area-specific crops and vegetables linked to the food habits of people.
    e. Setting up a price stabilisation fund.
    f. Take steps to enhance the profitability of agriculture. These include (i) ensuring product prices that give at least 50% profits over the cost of production, (ii) delivering cheaper agricultural inputs and credit, (iii) introducing

[1] The 2014 election manifesto of BJP can be accessed at https://www.thehinducentre.com/multimedia/archive/03226/full_manifesto_eng_3226788a.pdf.

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the latest farming technologies and high yielding seeds and (iv) linking MGNREGA to agriculture.

g. Introduce soil assessment-based crop planning and setting up mobile soil testing labs.
h. Implement a farm insurance scheme to take care of crop loss due to unforeseen natural calamities.

2. Other prominent promises or launch of schemes during the five years between 2014–15 and 2018–19 were as follows:

   a. Doubling farmers' incomes, announced in February 2016
   b. *Pradhan Mantri Krishi Sinchayee Yojana*
   c. Promise to take agricultural exports to $100 billion by 2022–23 (DCR 2018), replacing it later with the promise to double agricultural exports by 2022–23 in April 2018 (MOC 2018).

In its election manifesto, BJP had stated that "In 2022, we will be celebrating 75 years of India's Independence. In Indian culture, this is celebrated as *Amrit Mahotsav*. For us, every day and every step, every journey and every process will be dedicated to make *Amritmay Bharat*. And all this will be done by all of us, for all of us!" Propelled by this spirit and wanting to make 2022 a big year, PM Modi, once in office, made big commitments centred round it: for one, he promised to double farmers' real incomes by 2022–23. He even committed to halving urea consumption by 2022–23; although that dream has long been lost, the dream of doubling incomes continues to be mentioned and is the focus in ongoing government discussions and deliberations.

To achieve the big dreams, PM Modi started some important initiatives, including the following.

1. In March 2016, to simplify the leasing of farmland, under PM Modi's direction, NITI Aayog prepared the Model Land Leasing Act to facilitate states to enact their leasing laws to improve, *inter alia*, long-term credit flow to tenant operated agricultural lands. This will incentivise tenant farmers to increase investments on land and increase productivity.
2. In April 2016, comprehensive crop insurance under the *Pradhan Mantri Fasal Bima Yojana* (PMFBY) was launched.
3. A progressive and facilitative model Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act, 2017 (APLM Act 2017) was also introduced in April 2017, which, inter alia, provided for (i) notifying a whole state as one unified market; (ii) allowing the setting up of private markets, farmer-consumer markets and direct marketing; (iii) declaring warehouses/cold storages as market yards; (iv) rationalising market fee and commission charges; and (v) providing a single point levy of market fee and a unified single trading licence for e-trading. The government has approved a scheme for *Gramin Haats* to work as

centres of aggregation and for direct purchase of agricultural commodities from farmers.

4. In August 2017, the "per drop, more crop" initiative was launched to encourage micro-irrigation for optimal utilisation of water.
5. In March 2018, the *Paramparagat Krishi Vikas Yojana* (PKVY) was launched to promote organic farming.
6. The *Pradhan Mantri Annadata Aay Sanrakshan Abhiyan* (PM-AASHA) was launched in September 2018 to ensure remunerative prices to farmers for their produce.
7. To provide an impetus to agricultural exports, in December 2018, the government released its comprehensive "Agriculture Export Policy" aimed at doubling agricultural exports and integrating Indian farmers and agricultural products with global value chains.
8. To provide assured income support to the small and marginal farmers, the government launched the *Pradhan Mantri Kisan Samman Nidhi* (PM-KISAN) in February 2019, just before the Parliamentary elections in April–May.

In this chapter, we look at some of the biggest schemes/announcements and evaluate them for their effectiveness in alleviating farmer problems.

The chapter is organised as follows: Section 11.2 outlines the performance of Indian agriculture during Prime Minister Modi's first five-year term. Section 11.3 outlines and provides a brief evaluation of the biggest schemes while Sect. 11.4 presents the conclusions from the analysis.

11.2 Performance of Indian agriculture in the five years

Agricultural gross domestic product (AGDP) grew at an average rate of 2.9% in the five years since Narendra Modi took over. Incidentally, AGDP grew at the same rate even during 1998–99 to 2003–04, i.e. when PM Modi's political party, i.e. the Bharatiya Janata Party (BJP) (then as NDA), was last in power. In the last three decades (since 1990–91), India's AGDP grew the fastest between 2009–10 and 2013–14—at an average annual rate of 4.3 % (Fig. 11.1).

In terms of volatility (measured as coefficient of variation) in growth, the most volatile growth in AGDP was observed in the five years between 1998–99 and 2003–04 and the most stable growth in the five years between 2009–10 and 2013–14 (Fig. 11.1). It may not be incorrect to deduce that the country's AGDP grew the fastest and in the most stable manner during the UPA2 period.

The volatility in the performance of the Indian agricultural sector is closely linked to the rains the country receives during its four monsoon months, i.e., June, July, August and September. With 49 % of the 198 million hectares of the country's gross cropped area (2014–15) under assured irrigation (Ministry of Agriculture, GOI) and the remainder, i.e. more than half, depending on rains for meeting its irrigation needs,

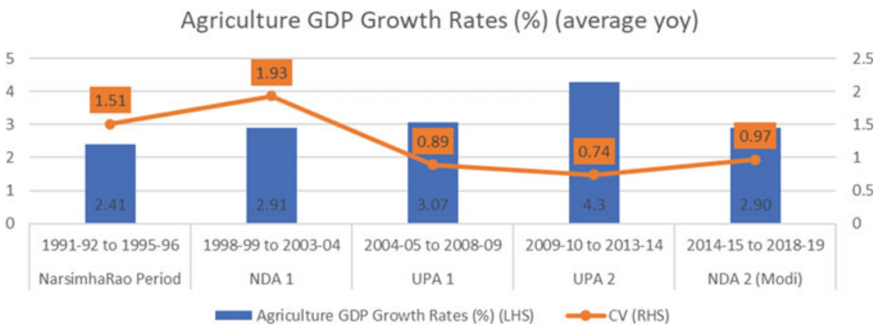

Fig. 11.1 AGDP trends in last three decades: growth rate and volatility. *Source* MOSPI, GOI. *Note* CV stands for coefficient of variation

monsoon rains become important for a country that is still agrarian, poor and food insecure at the micro-level (Fig. 11.2).

In the last 18 years (2000–01 to 2018–19), India faced droughts in five years (2002, 2004, 2009, 2014 and 2015) and in all of those, India's agricultural GDP growth rate and food grain production fell. The sharpest fall in food grain production was in the year 2002–03 when the rainfall inadequacy was 19.2% and the annual food grain production fell by more than 38 MMTs (Source: Ministry of Agriculture and IMD). In 2009–10, which was the worst drought year in recent years, the fall in food grain production was lower compared to 2002–03 at 16.4 MMTs even though

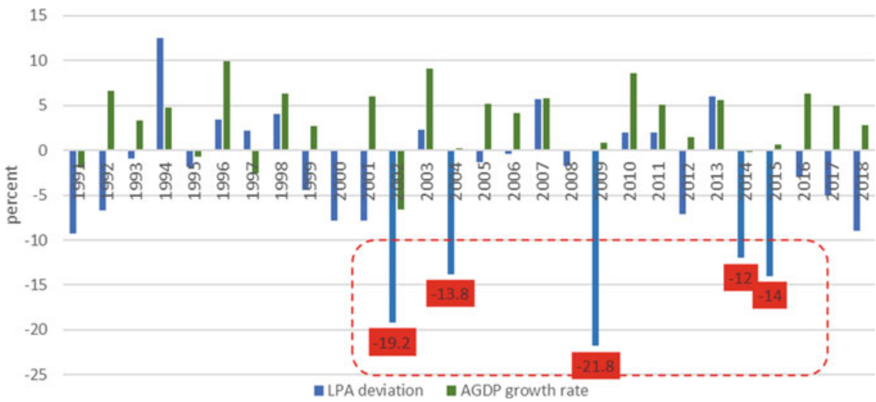

Fig. 11.2 Trends in agricultural GDP and performance of monsoon rainfall (per cent deviation from LPA). *Source* IMD and MOSPI. *Note* (i) A drought is defined as a situation when actual rainfall received in the monsoon months falls below the normal level by 10% or more and (ii) LPA stands for long period average

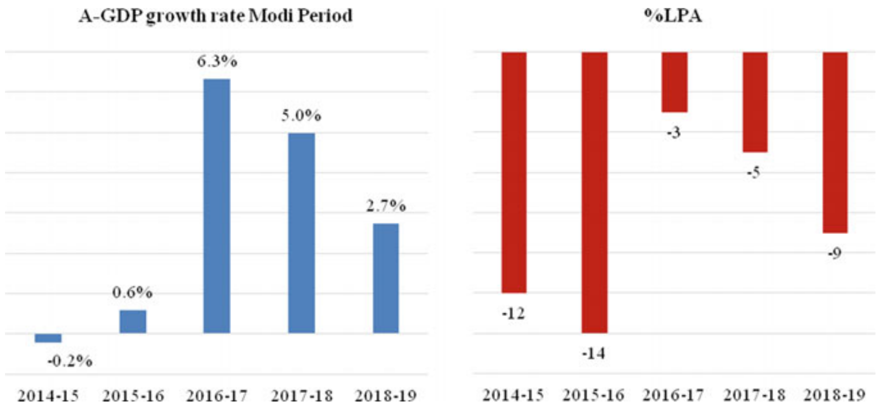

Fig. 11.3 Agriculture GDP growth (%) and rainfall deviations from long period average (LPA) (%) since 2014–15. *Source* MOSPI and IMD

the rainfall inadequacy was higher at 21.8% (Source: Ministry of Agriculture and IMD).

Last five years

Incidentally, since PM Modi took over the reins of the country, the agricultural sector suffered at the hands of climate. In all five years, the monsoon rains were below normal and there were droughts in two, i.e. 2014 and 2015 (Fig. 11.3).

A look at 118 years of rainfall history highlights two peculiarities about the last five years.

1. Consecutive drought years are a rare event—Since 1901, India has faced consecutive droughts four times in 1904 and 1905, 1965 and 1966, 1986, and 1987, and 2014 and 2015.
2. Negative deviation of actual rains from its LPA for five consecutive years—This has never happened in Indian rainfall history since 1901.

Apart from rains, the major challenges faced by Indian agriculture during the Modi 1.0 period included the following.

1. Cyclicality and volatility in domestic prices: During the last five years, while PM Modi started his tenure amidst rising prices and angry consumers, it ended with crashing prices and farm distress.
2. Crash in global prices: An unprecedented fall in global prices to the extent that it affected the competitiveness of India's agricultural produce resulted in a crash in agricultural exports.
3. There was rapid rise in food grain production in the domestic market.
4. Implementation gaps in policy reforms such as the introduction of e-NAM and FPOs had an adverse impact on farm profitability.
5. There was also the snowballing burden of unfulfilled political promises.

6. And there was demonetisation that resulted in loss of market liquidity and sentiment.

11.3 Analysing Selected Schemes

In this section, selected GoI schemes are analysed and presented. These schemes are clustered under four broad heads (Fig. 11.4):

We start with an analysis of India's grain mangement system which caters to the country's largest food-based welfare program ie. the Public Disribtion System (PDS) or the National Food Secuirty act (NFS) 2013. When PM Modi took over in May 2014, one of the first expert committees he set up was on reforming the grain management system, in particular the Food Corporation of India (FCI), and reorienting its historical role. With this announcement, he raised expectations because the inefficiencies of the FCI were palpable, pervasive and perhaps presumed incorrigible.

By announcing the setting up of an expert panel to review the role of the FCI, the ecosystem geared up for aggressive reforms in the agriculture and food space. However, not much happened on ground on that account. In fact, there were some trends, explained below, that indicate a worsening of the situation on account of food subsidy.

11.3.1 Analysing India's Grain Management System

India has a grain management system characterised by high levels of government intervention. The government procures large quantities of wheat and rice at minimum support prices (MSPs), stores these and then distributes it under the public distribution system (PDS) to a large number of identified beneficiaries at highly subsidised prices through almost 500,000 fair price shops (FPS) spread throughout the country. In terms of the number of beneficiaries, India's PDS is the largest in the world. In 2013, the PDS was replaced with a blanket scheme under the National Food Security Act,

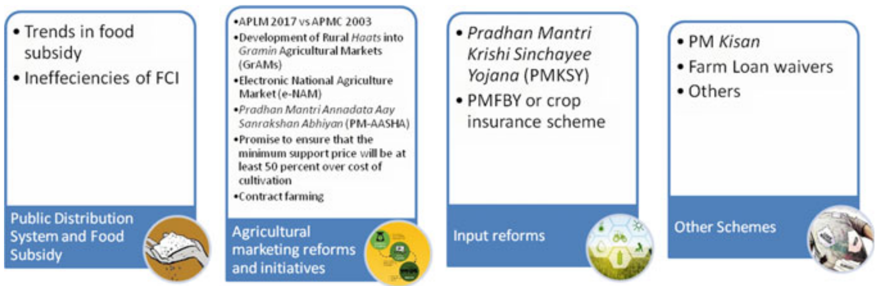

Fig. 11.4 Broader heads of schemes analysed

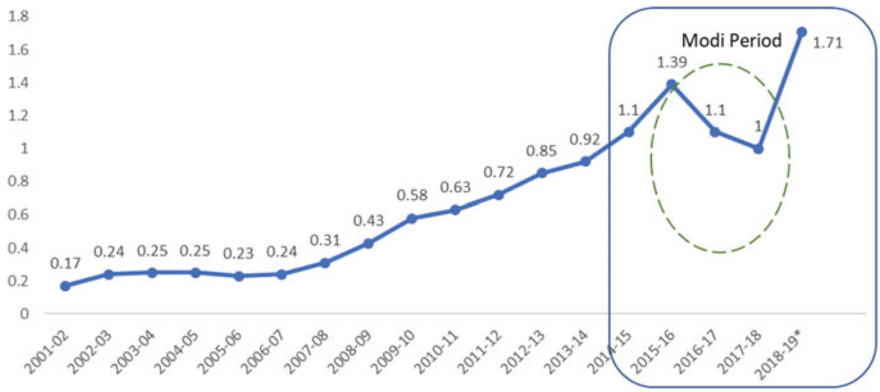

Fig. 11.5 India's food subsidy (INR lakh crore). *Source* Union Budget documents

2013 (NFSA 2013), which, *inter alia*, expanded the coverage under PDS, increased the extent of grain subsidisation, legalised the right to food and opened up scope for the substitution of grain entitlement with cash. For running the system smoothly, the Food Corporation of India (FCI), which is the nodal agency for implementing the NFSA, annually procures and distributes about 61.4 MMTs of grains to about 813 million people, i.e. about 67% of India's total population.

The GOI makes an annual budgetary allocation for running the PDS under the head "food security". The allocation is made to the Ministry of Consumer Affairs, Food and Public Distribution. Data on food subsidy is presented in Fig. 11.5.

In the 17 years since 2001–02, food subsidy expenditure increased 10 times. Barring three years (2005–06, and 2016–17 and 2017–18), food subsidy expenditure has consistently increased every year.

In 2005–06, the fall in subsidy was minor. However, the drop observed in 2016–17 and 2017–18 is significant—from highs of Rs. 1.39 lakh crore in 2015–16 to Rs. 1.1 lakh crore in 2016–17 and further down to Rs. 1 lakh crore in 2017–18 (Fig. 11.5).

We analyse this fall in expenditure in this section.

Every year, food subsidy is calculated as excess of expenditure (captured as economic cost incurred by GOI for running PDS) over revenue (the grains are sold at highly subsidised prices called the central issue price (CIP) to beneficiaries).[2] Between 2015–16 and 2017–18, while the economic cost of wheat and rice rose from Rs. 21.3 and Rs. 31.3 per kg, respectively, to Rs. 23 and Rs. 32.8 per kg, respectively, price realisation stagnated at Rs. 2 and Rs. 3 per kg, respectively (the CIP has been fixed at these levels since 2013). Besides, in the two years, both grain offtake (from FCI *godowns* for distribution under PDS) and grain procurement (for distribution under PDS) went up (Fig. 11.6). Interestingly, the number of beneficiaries remained the same as before.

[2]Both revenue and expenditure values are given on *per kg* or *per quintal* basis and the food subsidy is estimated after multiplying the excess of expenditure over revenue with the total amount of grain handled in the year.

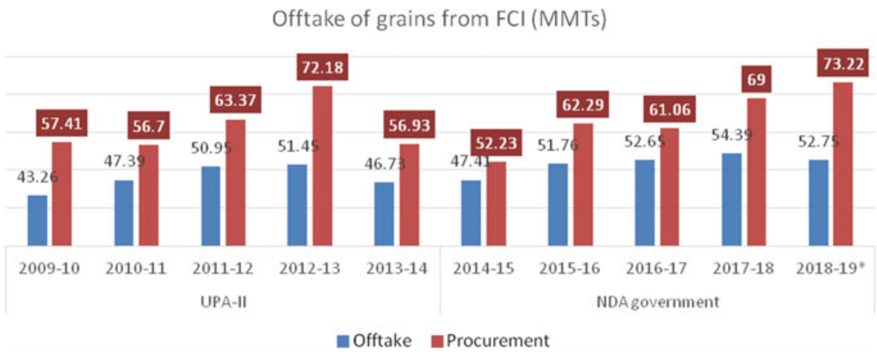

Fig. 11.6 Offtake of food grains by states and procurement (MMTs). *Source* FCI. *Provisional. Food grain is rice & wheat. The figure is adapted from Financial Express article by Das (2019). Accessed on May 24, 2019. Link: https://epaper.financialexpress.com/c/39661440

If both the components of food subsidy, i.e. excess of cost over price and the amount of grain handled under the system increased, how did the expenditure on food subsidy as reported in the budget fall?

We can begin answering that by first acknowledging that the downward trend in food subsidy expenditure did not continue as the expenditure rose to Rs. 1.71 lakh crore in 2018–19 and is now budgeted at Rs. 1.84 lakh crore for 2019–20.

Within a year, food subsidy expenditure grew by 71% in 2018–19 (Fig. 11.7). This is an unprecedented rate of annual growth rate.

What then explains the drop in the food subsidy bill in 2016–17 and 2017–18?

An analysis of FCI's accounts reveals that the answer lies in FCI's pending bills (orange bars in the Fig. 11.8). These are the bills which are unpaid or unsettled by the GOI in that year and the balance is taken forward to the next year. FCI had unpaid bills of Rs. 0.5 lakh crore in 2015–16, Rs. 0.8 lakh crore in 2016–17 and Rs. 1.36 lakh crore in 2017–18 (even rising above the year's budgeted annual subsidy).

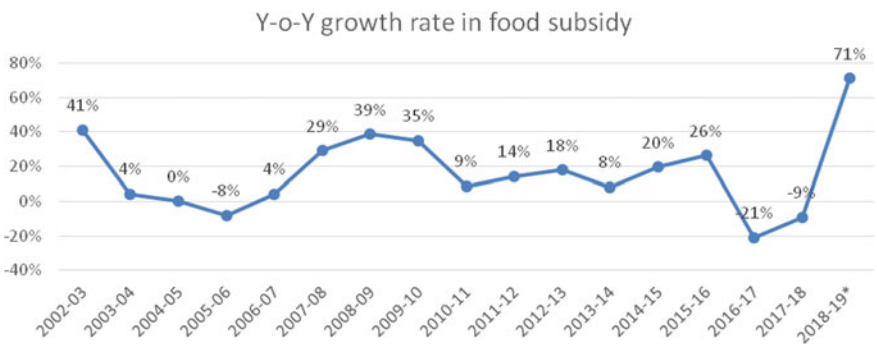

Fig. 11.7 Annual increase in food subsidy since 2001 (%). *Source* Based on data from Union Budget documents

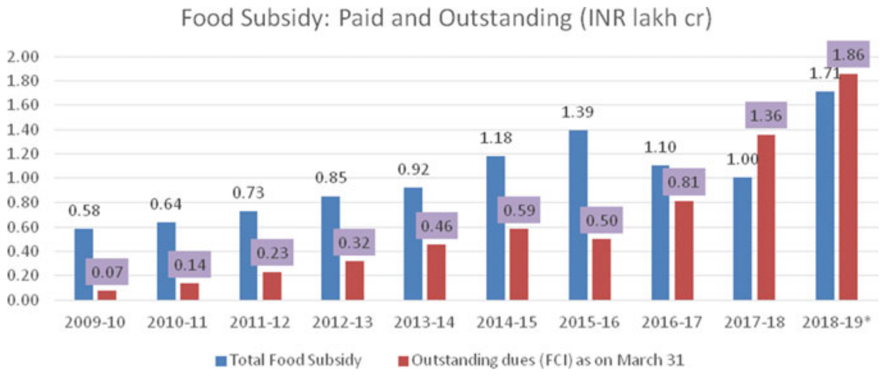

Fig. 11.8 Accounts of FCI: subsidy received and outstanding (INR lakh crore). *Source* Union budget documents and FCI *unaudited. Data on outstanding dues is adapted from Financial Express article by Das (2019). Accessed on May 24, 2019. Link: https://epaper.financialexpress.com/c/39661440

For running operations smoothly, FCI has had to borrow money from other sources.

On 1 April 2019, the outstanding bills of FCI stood at Rs. 1.86 lakh crore while the budgeted subsidy was Rs. 1.84 lakh crore.

Clearly, the union budget does not reveal the full extent of food subsidy. In 2018–19, the amount of food subsidy should be the sum of the budgeted amount and the FCI's outstanding amount as on 31 March 2019, i.e. the sum of Rs. 1.71 lakh crore and Rs. 1.86 lakh crore, which amounts to Rs. 3.6 lakh crore!

Burden of excess stocks

In addition to the burden of unpaid bills, the FCI is also saddled with excess stocks. As on 1 July 2019, the FCI had a total food grain stock of 75.25 MMTs, of which 28.4 MMTs was rice and about 45.83 MMTs was wheat. In addition to this, the FCI was to receive about 10.5 MMTs of rice from the millers. As per the buffer stocking norms, FCI is to only hold about 41.12 MMTs of grains on July 1, comprising about 13.5 MMTs of rice and 27.6 MMTs of wheat. This means that FCI is holding more than 34 MMTs of extra grain with an additional 10 MMTs of paddy still with the millers.

Inefficiencies of the FCI and the Shanta Kumar panel Committee Report

From expensive food grain management systems to the wastage of grain due to insufficient storage, logistical mismanagement and leakages and pilferages of grain in the value chain, the inefficiencies of FCI have existed for long and continue to mar the system. Among the first expert panels created by PM Modi was a high-level Committee under the Chairmanship of Mr. Shanta Kumar, former Union Minister for Food in the Vajpayee government, with a mandate to define the roadmap for "*reorienting the role and restructuring of FCI*". The Committee submitted its report in January 2015. Its major recommendations included (i) gradually replacing the existing grain transfers by moving towards direct cash transfers, (ii) scaling down

FCI's procurement operations, especially in states like Andhra Pradesh, Haryana, Madhya Pradesh and Punjab, while increasing procurement price support to the hitherto neglected states/regions of Eastern Uttar Pradesh, Bihar, West Bengal, etc., (iii) reducing coverage of people under NFSA to 40% of the population instead of 67% as provided for under the NFSA, and increasing the grain entitlement of the really vulnerable beneficiaries, (iv) outsourcing stocking operations to state agencies and the private sector (v) and encouraging competition in every step of the food grain supply chain, with a focus on upgrading the chain with bulk handling and computerisation and reducing reliance on manual operations, which is one of the major reasons for large-scale corruption.

Despite this roadmap, the government has undertaken only piece-meal reform of the grain management system. These reforms include the introduction of direct benefit transfer (DBT), where cash replaces grain entitlements in the UTs of Chandigarh, Puducherry and D&N Haveli and introducing point-of-sale (POS) devices at ration shops among others. No major Indian state is even considering shifting to DBT, though they have undertaken most operational and delivery reforms.

The slow pace of reform of the grain management system has saddled the government with greater stocks and deepened the system's fiscal and operational inefficiencies.

11.3.2 Pricing and Other Agricultural Marketing Reforms

As of 31 March 2018, there are 6676 (DCR Vol. 4, p. 64) regulated wholesale markets in the country. These markets, however, are not sufficient to meet dynamically changing marketing requirements and meeting the aspirations of farmers for better and competitive price realisation.

The policy drive by the GOI in agricultural marketing is well represented through its various schemes, initiatives and policies such as the following:

1. Launch of the Model Act "The—State/Union Territory **Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017**" (APLM 2017)
2. Development of Rural Haats into ***Gramin*****Agricultural Markets (GRAMs)** 2018–19
3. **National Agriculture Market (NAM)** and its electronic platform, i.e. e-NAM launched in 2016
4. **PM-AASHA** in September 2018
5. **Agricultural Export Policy** 2018
6. Contract Farming and Adoption of Model Contract Farming Act, 2018: The State/UT **Agricultural Produce & Livestock Contract Farming and Services (Promotion & Facilitation) Act**, 2018
7. **Removal of Licensing Requirements, Stock Limits and Movement Restrictions on Specified Foodstuffs Order** , 2016

8. **Raising MSPs to above 50% of costs of production** in 2018–19

APLM 2017 Versus APMC 2003

To create efficient, inclusive and broader markets, the Government of India formulated and circulated a model APMC Act in 2003 to be adopted by states/UTs on the recommendation of the Inter-Ministerial Task Force on Agricultural Marketing Reforms (TFAMR 2002). The aim was to give farmers the option to sell their produce directly to agricultural businesses, like processors or bulk buyers, at a lower transaction cost and in the quality/form required by buyers. The Model Act also allowed for contract farming and direct marketing by private trade.

Over the last 15 years since the circulation of the Model APMC Act 2003, most states made only partial and minimal reforms; thus, there was no noticeable progress, except in a few states like Maharashtra, Gujarat, Karnataka and Rajasthan. Sikkim has an APMC Act, but it never implemented it. Bihar implemented the APMC only to later withdraw it in 2006. States and UTs like Kerala, Manipur, Andaman and Nicobar Islands, Lakshadweep Islands, Dadar and Nagar Haveli and Daman Diu implemented the model APMC.

Farmers all over the country suffer from inefficient, non-transparent and monopolistic agricultural markets. To improve the situation, in April 2017, the government through the Ministry of Agriculture & Farmers Welfare formulated the model APLM Act, 2017, and circulated it to states/UTs for adoption to reform the marketing of agriculture and livestock products.

The Model APLM Act, 2017 proposes, *inter alia*, the following changes in APMC Act of the states,

1. Notifying the whole state as one unified market
2. Allowing the setting up of private markets, farmer-consumer markets and direct marketing
3. Declaring warehouses/cold storages as market yards
4. Rationalising market fees and commission charges
5. Clear provision for e-trading, a single-point levy of market fees and unified single trading licence.

As of May 2019, states are at various stages of adopting the model act, barring Arunachal Pradesh that has completely adopted the 2017 Act as APAPLM (Arunachal Pradesh Agriculture Produce and Livestock Marketing Act) (*Source:* Agricoop, MOA, GOI).

To give a further thrust to agricultural marketing, in the Union Budget 2018–19, the government declared its intention to develop and upgrade rural *haats*/shandies into GRAMs, discussed next.

Development of Rural *Haats*into *Gramin*Agricultural Markets (GRAMs)

Located in rural and interiors areas, rural *haats* act as markets for a great majority of Indian farmers, particularly small and marginal farmers. There are 22, 941 *haats* in India and as per Union Budget 2018–19, 22,000 of these will be upgraded into GRAMs. Upgrading would involve, *inter alia*, the following:

1. Strengthening physical infrastructure using government schemes such as Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA);
2. Ensure that the GRAMs are exempted from APMC regulations and linked to e-NAM to provide farmers the facility to make direct sales to retail and bulk consumers.

To strengthen marketing infrastructure, the GOI, with NABARD, created an Agricultural Market Infrastructure Fund (AMIF) with corpus of Rs. 2000 crore to upgrade 10,000 GRAMs and 585 APMCs. As for March 2019, the AMIF fund is still to play out and most states have not even identified potential rural *haats* to be developed into GRAMs (*Source:* Agricoop).

The provisions under the APLM and the creation of GRAMs, among other things, were to provide a base for the creation of a unified national market, also referred to as the National Agriculture Market (NAM), discussed below.

Electronic National Agriculture Market (e-NAM)

The government approved the setting up of the National Agriculture Market (NAM) through the Agri-Tech Infrastructure Fund (ATIF) on 1 July 2015, with a budget of Rs. 200 crore. The project was to be implemented in the period 2015–18. PM Modi launched e-NAM on 14 April 2016, in eight states—Gujarat, Telangana, Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, Himachal Pradesh and Jharkhand, covering 21 markets. The aim was to achieve higher transparency in the farming sector, increase farmers' income and provide them access to a larger number of buyers from within and outside the state.

As a concept, e-NAM did not imply a marketplace separate from and parallel to the existing APMCs. It is an electronic trading platform that is offered as a plug-in to any market yard (APMC or private). It aims to leverage the existing physical infrastructure of the *mandis*, connect them to the online trading platform, offering sellers a larger number of buyers sitting in the local area.

There are three prerequisites for any state wanting to on-board e-NAM:

1. They have to ensure a single unified trading licence applicable across the state.
2. There has to be a single point levy or market fee across the state.
3. They have to provide for e-auction as a mode of price discovery.

Only those states/UTs that have provided for these three prerequisites will be eligible for inclusion in the scheme. On the basis of their priorities, states will specify the APMC markets that they wish integrated with e-NAM, which will then be considered by the Government of India for integration.

So far, 585 APMC markets in 16 states and 2 union territories have been integrated into the e-NAM platform (Source: e-NAM portal). A target to integrate an additional 415 markets by March 2020 has also been declared.

More than 50% of the 585 *mandis* are in four states: UP, Gujarat, Maharashtra and MP. Himachal and Uttarakhand are front runners, adding e-NAM to 34 and 28% of their existing regulated markets. Only 6.7% of the *mandis* in Maharashtra, 5.5% in Rajasthan and 2% in Odisha have been integrated with e-NAM (Fig. 11.9).

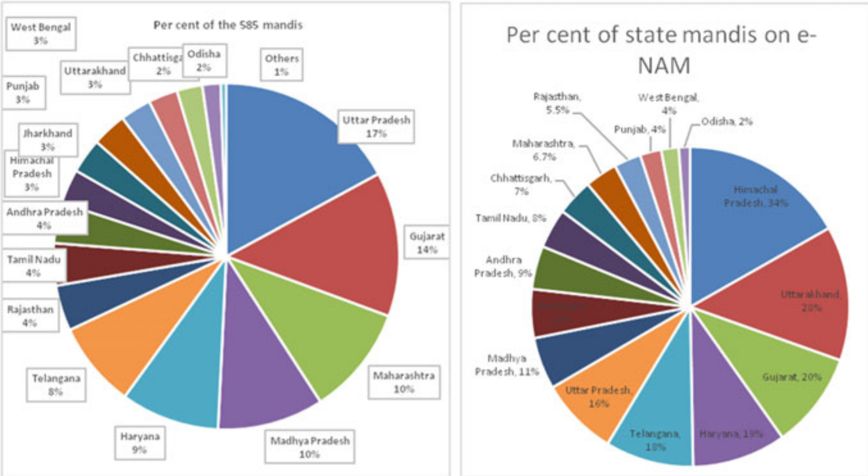

Fig. 11.9 *Mandis* under e-NAM: share of states and *Mandis*. *Source* Portal of e-NAM and Dalwai Committee Report

These 585 *mandis* have benefitted about 1.66 crore farmers, i.e. about 11% of all Indian farmers. About 18.7 MMTs have been traded on e-NAM till date.

In January 2019, e-NAM undertook a major initiative by encouraging states to begin inter-state trade. Earlier, trade used to happen either within the APMC or between two APMCs situated within the same state. As of 7 February 2019, 21 e-NAM *mandis* of eight states, namely Uttar Pradesh, Uttarakhand, Andhra Pradesh, Telangana, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh, have joined hands to start inter-state trade on e-NAM.

The three main problems faced by the portal are the following.

1. The data reflected on the e-NAM portal is artificially inflated by adding the value of MSP-procurement operations by states like Haryana. Including such transactions made at fixed prices (MSP) by a fixed buyer (procurement agency) onto the e-NAM platform violates the true spirit of e-NAM, i.e. of free and competitive marketing.
2. Additionally, according to the Department of Agriculture Co-operation and Farmers' Welfare, most reported transactions are intra-*mandi* transaction. Inter-*mandi* and inter-state trading on the platform are minimal. What this means is that the states on e-NAM have not been able to provide farmers with better price discovery in other *mandis* of the same state or across states.
3. The department also acknowledges that e-payment facilities are not available in most *mandis* and that there is no competitive bidding reported in these states. This clearly implies that the monopoly of the APMCs continues unabated in the 18 states/UTs, and the aim of creating a truly unified NAM with an efficient price discovery mechanism is still a far-fetched dream.

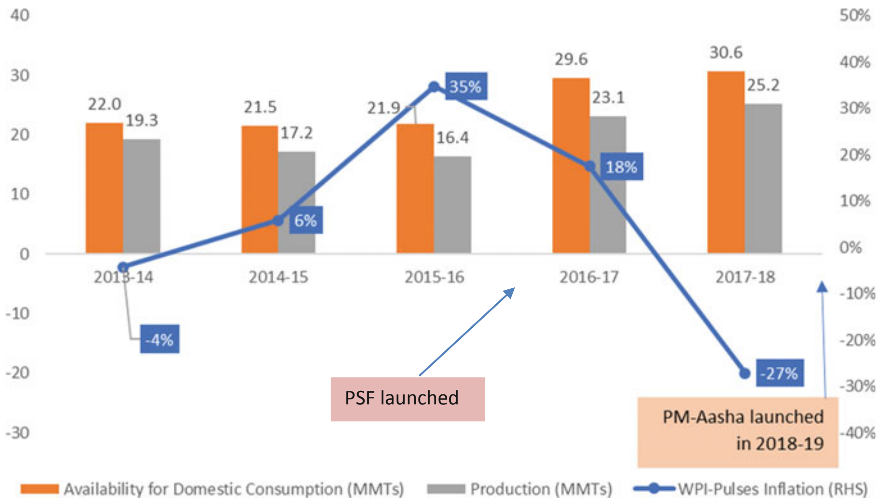

Fig. 11.10 Indian pulses: production, availability and inflation. *Source* Ministry of Agriculture and MOSPI, GOI

Pradhan Mantri Annadata Aay Sanrakshan Abhiyan **(PM-AASHA)**

The first year of Prime Minister Modi's tenure, 2014, was a drought year that was followed by another, more severe, drought in 2015. The production of food grain in the two years fell by 13.03 and 0.5 MMTs and that of pulses fell by 2.1 MMTs and about 0.8 MMTs, respectively. Food inflation rose with lower grain supplies. The highest inflation was observed in the case of pulses (see Fig. 11.10). Inflation measured through the wholesale price index (WPI) of pulses averaged about 35% in 2015. The consumer price of pulses too increased by about 33% in the first half of 2016.

To contain and reverse inflation, particularly in the case of pulses, the government undertook measures to increase its production and availability to consumers. These included aggressive increases in the MSP of pulses and the creation of a pulse buffer stock under the Price Stabilisation Fund (PSF) in 2016. These measures were complemented by better rains in subsequent years. Consequently, production increased and with continued high imports of pulses, domestic availability improved, moderating the domestic prices of pulses. But by 2017–18, pulse prices fell sharply. The situation was similar in the case of oilseeds. To contain farmer distress, the government launched PM-AASHA.

In summary, when PM Modi started office in 2014, he fought rising prices of pulses and an angry and vociferous consumer lobby, to counter which he created the PSF but when farm prices for most crops began to fall, particularly after 2017–18, faced with farmer agitations, PM Modi started PM-AASHA.

The objective of the *Pradhan Mantri Annadata Aay Sanrakshan Abhiyan* (PM-AASHA) is to ensure remunerative prices to farmers for their produce. The details of the three sub-schemes are:

a. Under the *Price Support Sche*me (PSS), central nodal agencies, actively aided by state governments, are required to procure pulses, oilseeds and copra. In addition to NAFED, the Food Cooperation of India (FCI) has also been asked to take up PSS operations in states/districts. The procurement expenditure and losses due to procurement are to be borne by the central government as per norms.
b. Under the Price Deficiency Payment Scheme (PDPS), it was proposed to cover all oilseeds for which MSP is notified. Direct payment of the difference between the MSP and the selling/modal price was to be made to pre-registered farmers selling his produce in the notified market yard through a transparent auction process. All payments were to be made directly into the farmer's registered bank account. This scheme did not involve any physical procurement of crops as farmers were to be paid the difference between the MSP price and sale/modal price on disposal in notified markets. The central government support for PDPS was to be given according to laid down norms.
c. The government had also decided that the participation of the private sector in procurement operations needed to be piloted and, based on past experience the ambit of private participation in procurement operations be increased. Therefore, in addition to PDPS, it was decided that for oilseeds, states will have the option to roll out the Private Procurement Stockist Scheme (PPSS) on a pilot basis in selected districts/APMC(s).

These operations will be undertaken on the request of the state governments/union territories. PSS will be implemented to procure pulses, oilseeds and *copra* of fair average quality (FAQ) at the minimum support price (MSP), whereas the PDPS will be implemented in the case of oilseeds. However, states/UTs have the options to choose either the PSS or PDPS in a given procurement season with respect to a particular oilseed crop for the entire state. Besides, PPSS will also be implemented for oilseeds on a pilot basis and states have the option of implementing the scheme through private stockists in a district/selected APMC(s) of a district.

In the first year of its roll-out, no state had started with the PPSS, and one state proposed to implement a pilot under the PDPS scheme. The PSS is already being criticised for its inadequate operations with market prices ruling below prevailing MSPs for several crops. The PSS is discussed in greater detail below.

The major *kharif* crop in India is paddy. In addition to paddy, we studied price trends for maize and soybean in the 2018–19 *kharif* season to see if *mandi* (wholesale or WH market) sales were happening at above, below or at the prevailing MSP (Figs. 11.11, 11.12, 11.13 and 11.14).

In all major producing states, the prices for all the four crops were below the MSP at least during the peak arrival season.

Loss Incurred by farmers because of failure of PM-Aasha

By multiplying the monthly arrivals (shown above) with the difference between the wholesale price and the MSP, we estimated the loss (in case the WH price was

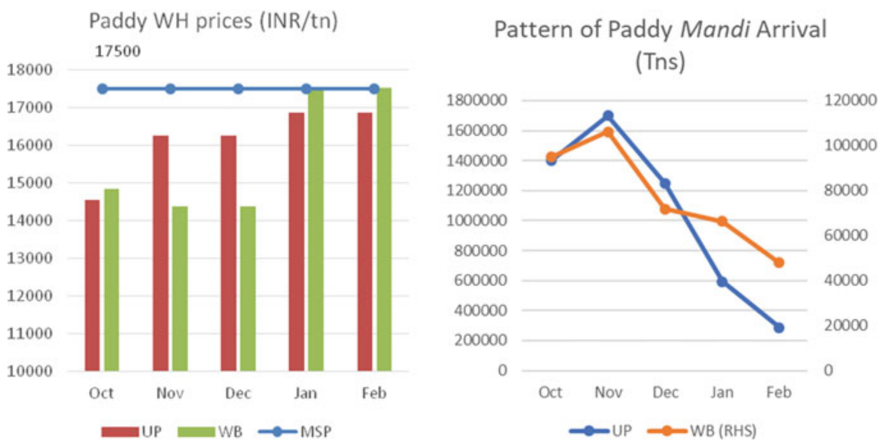

Fig. 11.11 Paddy: price and arrival pattern in *Kharif* 2018–19

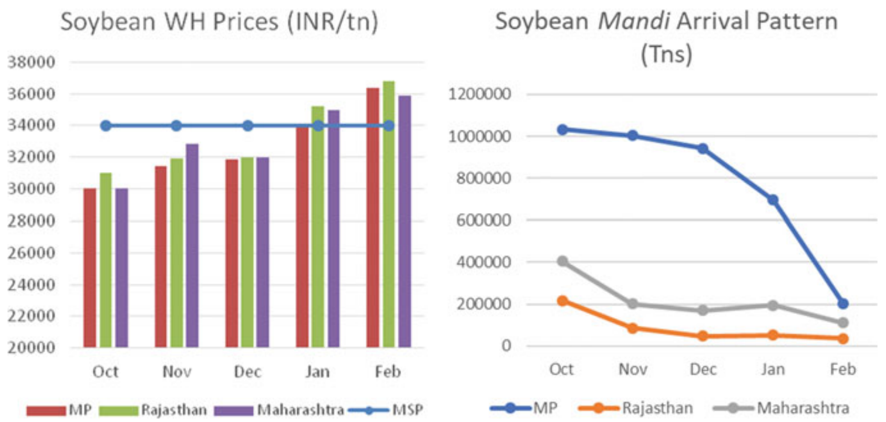

Fig. 11.12 Soybean: price and arrival pattern in *Kharif* 2018–19

below MSP) or gain (in case the WH price was above MSP) that was incurred by farmers because they sold at prices lower than the MSP. The results are presented Fig. 11.15.

For *kharif* 2018–19, farmers in the largest producing states suffered losses as farmers sold at prices below MSP. The largest loss was suffered by UP paddy farmers, who lost the Rs. 837 crore that they would have earned had they sold their produce at MSP. Similarly, farmers in other states and crops also suffered losses.

This estimate of the loss is lower than the loss actually incurred by farmers because these estimates are based on Agmarknet prices, i.e. prices reported from the *mandi*. The proportion of farmers, especially small and marginal farmers, who do not bring

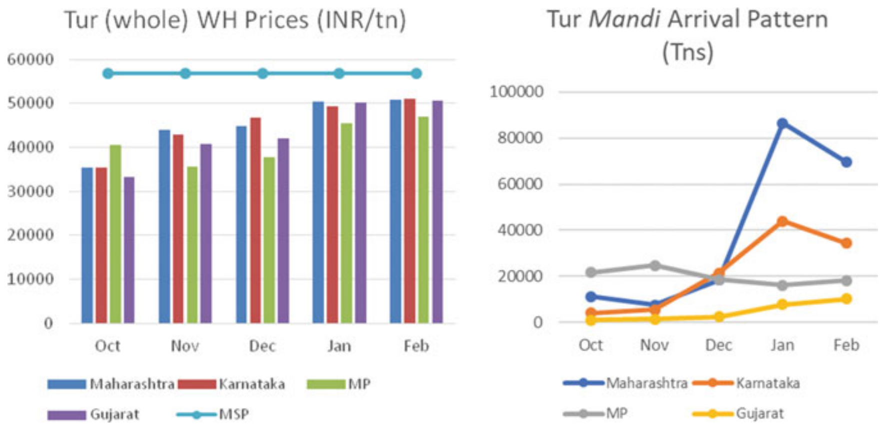

Fig. 11.13 *Tur (arhar)*: price and arrival pattern in *Kharif* 2018–19

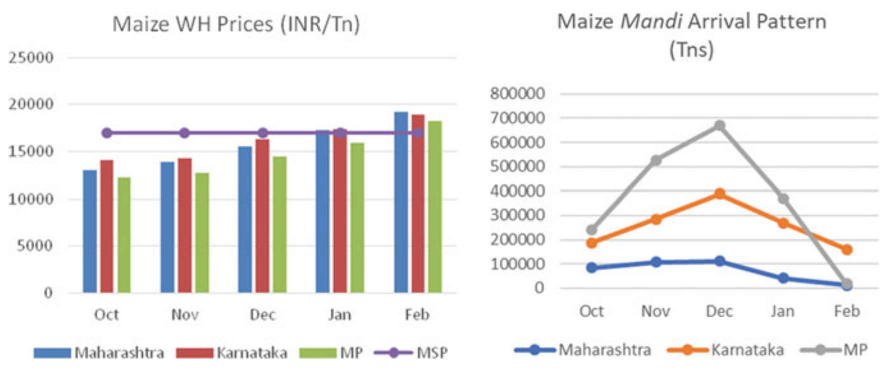

Fig. 11.14 Maize: price and arrival pattern in *Kharif* 2018–19. *Source* Agmark*net*

their produce to the *mandis* but sell them at the farm-gate are likely to have sold at prices much lower than those prevailing in these *mandis*.

Clearly, PM-AASHA has failed to deliver. But was the MSP fixed too high compared to the market signal where the ongoing glut may have warranted a lower price? This requires a much deeper analysis and is beyond the purview of the current work.

Promise to deliver an MSP that is 50 per cent above cost of production

Delivering on his 2014 election manifesto promise of delivering 50% profits over costs to Indian farmers, the Union Budget 2018–19 announced MSPs that were at least 1.5 times the cost of cultivation. We present the MSP changes below.

The cost of cultivation that is taken as the base for increasing MSPs is the A2 + FL costs, that is, the sum of actual paid-out costs and the imputed cost of family labour (FL) (Table 11.1).

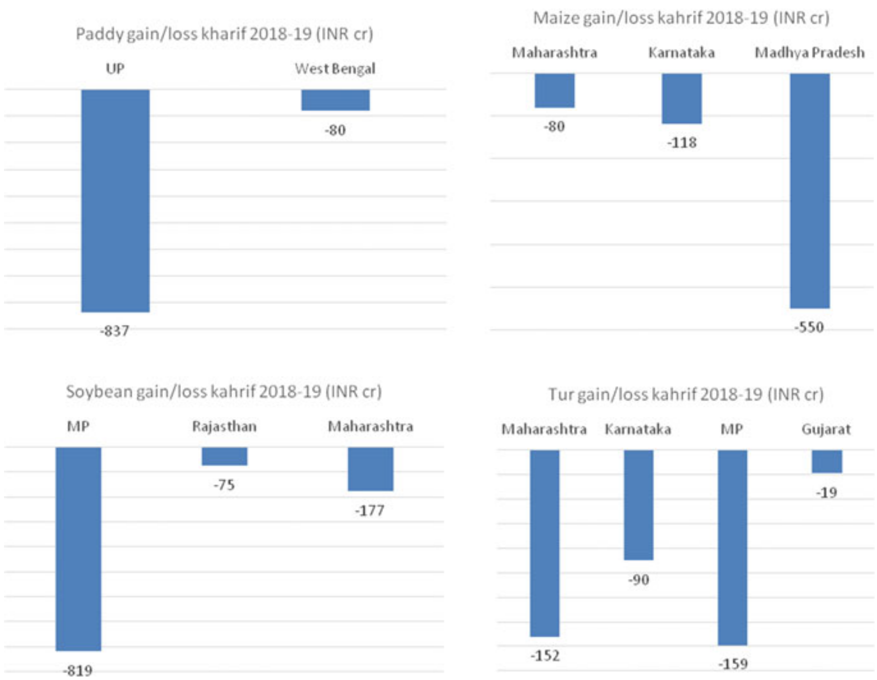

Fig. 11.15 Crop-wise losses incurred in *Kharif* 2018–19. *Source* Estimated by authors based on data from Agmarknet

Table 11.1 MSP increases as per cent of A2 + FL cost 2018–19 (all figures in quintals)

Kharif crops	MSP (2017–18)	MSP (2018–19)	Percentage change in MSP from 2017 to 2018 (%)	(A2 + FL) Cost 2018–19	MSP as a percentage of (A2 + Fl) 2018–19
Kharif crops					
Paddy	1550	1750	12.90	1166	150.09
Maize	1425	1700	19.30	1131	150.31
Tur	5650	5675	0.44	3432	165.36
Groundnut	4650	4890	5.16	3260	150.00
Soybean	3250	3399	4.58	2266	150.00
Cotton	4020	5150	28.11	3433	150.01
Rabi crops					
Wheat	1735	1840	6.05	866	212.47
Gram	4550	4620	1.54	2637	175.20
Lentil	4350	4475	2.87	2532	176.74
Rapeseed and mustard	4100	4200	2.44	2212	189.87

Source Commission for Agricultural Costs and Prices

In the election manifesto, PM Modi promised to increase MSP by fifty per cent above the cost of cultivation. It was, however, not clarified which cost estimate would be taken as the base cost. The costs which are paid-out by farmers are referred to as A2 costs and upon adding the imputed value of family labour (FL), capital and land to A2, an estimate of comprehensive cost of cutlivation, called C2, is derived. On an average, A2 + FL cost is about 38% below C2 cost. Even though the election manifesto did not clarify on this point, the expectations were that the MSPs will be raised to deliver 50 percent profits over C2 costs, in line with the proosals of the Swaminathan Committee. In reality, as we see the MSPs were raised benchmarking the A2+FL costs.

In terms of economics, however, the prices (in this case MSP) should not be misaligned to the overall demand and supply situation of the commodity/crop in the country (Gulati et al. 2018). So, if MSPs would be raised to deliver a profit of 50% over C2, it would have had an adverse impact on the domestic market and on the global competitiveness of the country in that commodity. As global prices collapsed in the year, it would have made GOI the residual buyer of large stocks of grains if PM Modi would have delivered on its original promise and would have had an adverse impact on the country's fiscal situation, let alone the impact it would have on the prices domestically. In fact, it was because of the faith the markets had in the inability of the MSP regime to deliver even after increases in MSP that none of the above fears came true. Farmer distress continued as the procurement regime failed the farmer again.

Contract Farming

To promote and expand contract farming in the country, "The *State/UT* Agricultural Produce & Livestock Contract Farming and Services (Promotion & Facilitation) Act, 2018" was formulated and released in May 2018 by the Ministry of Agriculture for adoption by states/UTs. The Model Act, inter alia, provides for.

1. constituting a "Registering and Agreement Recording Committee" or "designating officer" at district/block/*taluka* level
2. keeping contract farming activity outside the ambit of the APMC Act
3. engaging FPOs/FPCs
4. ensuring that there is no change/transfer of farmers' rights, title ownership, etc.
5. setting up contract farming facilitation groups (CFFGs) to promote contract farming and services at the village/*panchayat* level
6. setting up a dispute settlement mechanism at the lowest level possible for quick disposal of disputes.

Except for Tamil Nadu, which legislated the "Tamil Nadu Agricultural Produce Contract Farming (Promotion and Facilitation) Act 2018", in all other states/UTs, the Act is still under consideration.

Like other schemes, this initiative too seems to have lost steam.

Now, we move on to evaluate some of the reforms on the input side.

11.3.3 Input Side Reforms

Improving resource use efficiency is as important, if not more, as improving monetisation of produce if the dream of doubling farmers' real incomes by 2022 is to be achieved. To improve the efficiency of input use, PM Modi's government undertook several reforms. Some of the prominent schemes are presented below.

***Pradhan Mantri Krishi Sinchayee Yojana*(PMKSY)**

PMKSY was announced in 2015. In a year, the GOI had identified 99 priority projects (a total of 106 including sub-projects), which would together provide irrigation to 6.8 million hectares.[3] These projects were scheduled to be completed by December 2019 in a mission-mode exercise. To give a thrust to the initiative and provide resources for timely completion of the 99 projects, the GOI announced the Long-Term Irrigation Fund (LTIF) in the budget of 2016–17. It had an initial corpus of Rs. 20,000 crore that was later increased to Rs. 40,000 crores to be raised by NABARD.

According to the command area development and water management (CAD&WM) website, in 71 projects, there is no or less than 10% progress in creating field channels. Less than half the targeted field channels have been created in the case of 87 projects. As in February 2019, considerable progress was made in only four projects (more than 90%) (Gulati et al. 2019b). At the all-India level, only 51.4% of total targeted potential appears to be achievable by December 2019.

PMFBY or crop insurance scheme

In *kharif* 2016, PM Modi launched one of his major initiatives, the *Pradhan Mantri Fasal Bima Yojana* (PMFBY) or crop insurance scheme. It built on the earlier crop insurance scheme called Modified National Agricultural Insurance Scheme (MNAIS) initiated by UPA II, but the premium to be paid by farmers was reduced to 2% (for *kharif* crops) and 1.5% (for *rabi* crops). The premium for commercial crops was retained as before at 5%. Since 2017–18, PMFBY enrolment has been made *Aadhaar*-based.

The cap on sum insured was also removed under the new scheme. Due to the cap, farmers under MNAIS received only a fraction of the cost of cultivation in the case of crop loss. Under PMFBY, insurance was linked to the total cost of cultivation and this helped farmers claim much higher amounts in case of crop failure.

Only 22% of the gross cropped area was covered under the crop insurance in 2015–16. PM Modi set out to achieve a target of covering at least 50% of GCA by 2019. In 2016–17, the coverage increased to 29% but in 2017–18, it came down to 26.37%. In 2018–19, the area coverage stands at 29.33% (Table 11.2).

About 1.43 crore farmers in 2016–17 and 1.56 crore farmers in 2017–18 received claims under PMFBY.

Between 2016–17 and 2017–18, the number of farmers and area insured under crop insurance went down. The fall is attributable to three factors (GOI 2018[4]): (i) introduction of *Aadhar*-based enrolment which helped detect duplication and

[3] Earlier, this target was 7.6 million hectares.

[4] https://pib.nic.in/newsite/PrintRelease.aspx?relid=181469.

Table 11.2 Crop insurance trends since 2016–17

Period	Seasons	Farmer application/insured	Area insured	Proportion of farmers insured	Proportion of GCA insured
		(crore)	(Million ha)	(%)	(%)
2016–17	Kharif 16	4.04	38.24		
	Rabi 16–17	1.73	18.62		
	Total	5.77	56.85	39.6	29
2017–18	Kharif 17	3.49	33.97		
	Rabi 17–18 (provisional)	1.69	17.47		
	Total	5.19	51.43	35.6	26.37
2018–19	Kharif 18 (provisional)	3.45	31.99		
	Rabi 2018–19 (prov)	1.95	25.21		
	Total	5.40	57.20	37.1	29.33

Source Ministry of Agriculture, GOI

resulted in several beneficiaries being removed, (ii) the introduction of farm loan waiver schemes in many states which corrupted the credit culture and adversely affected people wanting to take new loans and (iii) an expected normal monsoon in the year 2017–18.

The scheme appears to have benefited insurance companies more than it supported farmers in distress, a claim also elaborated by Gulati et al. (2019a). The biggest criticisms of the scheme include the following.

1. The net gainers were insurance companies, who gained because the premiums received were greater than the claims settled.
2. State governments tend to delay payment of premiums, leading to a delay in claim settlement when distress arises.
3. Delays in negotiation and finalisation of bids by state governments risks raising premiums. IMD releases its first monsoon forecast by April; unless state governments negotiate the premium before this release, the premium amount is likely to be influenced by the rainfall prediction.
4. The fact that the premiums are negotiated by state governments for only a year pushes up the overall costs of insurance over years. Despite efforts by state governments, they are unable to get insurance companies to negotiate premium terms for at least two, if not three years. This is because of increasing climate variability because of which no company wants to take a risk without covering themselves through the reinsurer, who in turn is unwilling to negotiate long-term contracts because of the unpredictability of weather conditions. All this pushes up the cost of taking insurance.

5. There is delay in the claim-settlement procedure, partially because of inefficiencies in crop-cutting experiments.
6. There is virtually no focus on insuring horticulture and allied activities. Even though there is now a policy for insuring livestock, there has been no substantial ground adoption and penetration. Similarly, despite being high-value crops, horticultural crops are not insured in many states.

Based on the experience gained and analysis of the implementation of the scheme over two years and with a view to ensure better transparency, accountability and timely payment of claims to farmers, the government revised the operational guidelines (OGs) of PMFBY. The revised guidelines came into effect from 1 October 2018, i.e. from the 2018–19 *rabi* season. The brief features/changes in the revised OGs are as follows.

a. Provision of penalties/incentives for states, insurance companies and banks—A 12% interest rate per annum is to be paid by the insurance company to farmers for delays in settlement claims beyond the prescribed 10-day cut-off date for payment of claims.
b. Similarly, state governments have to pay 12% interest rate for delays in the release of states' share of subsidy beyond the prescribed three-month cut-off date/submission of requisition by insurance companies.
c. To rationalise the methodology for calculation of threshold yield (TY), the threshold yield used to calculate the claim amount will be estimated using a moving average of the best five out of the latest seven years.
d. The time for change of crop name for insurance has been increased to up to two working days prior to the cut-off date for enrolment instead of the earlier provision of 1 month before the cut-off date.
e. Farmers have been given more time to intimate individual claims—Instead of the 48 hours earlier, farmers now have 72 hours to report; reporting can be done through any relevant official and/or directly on the portal.
f. Post-harvest losses because of hailstorms, apart from those caused due to unseasonal and cyclonic rainfall, have been brought within the ambit of insurance.

One of the biggest setbacks anticipated now is that the interest penalty on insurance companies will be passed into the system as increased premiums and therefore, premiums for *kharif* 2019–20 are expected to rise. Can an already fiscally constrained country afford this? Does it reflect unpreparedness and lack of clarity on the part of the government?

Ironically, there appears a falling policy thrust on PMFBY in recent times. In fact, Gulati et al. (2019a) point to the fact that systemic inefficiencies and non-transparent operations are forcing private insurance companies to quit the PMFBY scheme. But can a country that is susceptible to massive weather fluctuations and is highly dependent on rains for sustaining agriculture afford to not get its crops (and farmers) insured? And if the private sector exits, can the government agencies offer the desired coverage? Some questions remain unanswered.

11.3.4 Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)

To increase farm incomes, the ***Pradhan Mantri Kisan Samman Nidhi****Yojana* (PM-KISAN) was launched by PM Modi just before the Parliamentary elections in 2019. Under the scheme, all small and marginal farmers[5] (i.e. those who operate on land-holdings of less than 2 hectares) in the country were to be given an unconditional cash transfer of Rs. 6000 per year in three instalments of Rs. 2000 each. This amount was to be paid directly into the bank account of the identified beneficiaries every four months.

Among the first announcements Mr. Modi made after getting re-elected as the country's PM in May 2019 was about the extension of the PM-KISAN scheme. The scheme was extended to cover all farmers instead of only small and marginal farmers.

Farmer families owning less than 2 hectares of land are eligible to receive payments under PM-KISAN. A family for this purpose is defined as "a family comprising of husband, wife and minor children who collectively own cultivable land up to 2 hectares as per land records of the concerned state/UT". According to the Agricultural Census 2015–16, India has over 14.6 crore farmers of whom 86.2% or 12.6 crore are small and marginal farmers.

With an annual budget of Rs. 75,000 crore for 2019–20, the scheme was retrospectively launched from the previous financial year, i.e. 2018–19, for which an additional budget of Rs. 20,000 crore was provided. The allocation for 2018–19 was to be used to make the payment of the first instalment of Rs. 2000 before 1 April 2019. As on 7 March 2019, about 2.2 crore beneficiaries had received the first instalment of Rs. 2000 directly into their bank accounts.

It is a central government scheme, and the entire financial liability is being borne by the Government of India. The responsibilities of state and UT governments include identifying beneficiaries, creating the database and integrating banking infrastructure with GOI's Public Financial Management System (PFMS) among others.

Main features of the scheme:

1. Beneficiaries:

   a. Targeted at only landowners—Only landowners are entitled to receive benefits under the scheme and the existing land ownership system is to be used for identifying beneficiaries. This implies that sharecroppers and the landless labourers are not entitled to receive benefits under this scheme
   b. Owners of non-cultivable land—only land which is cultivable entitles its owner for benefits under the scheme
   c. Landowners who are not entitled to benefit under the schemes are:
      1. Institutional landowners
      2. Families with one or more members having a government job, with an income tax paying member, with a member receiving a monthly pension

[5]Farmers are defined as the landowners. This means that landless or tenant farmers were not covered under this scheme.

of at least Rs.10,000, or with a member who is professionally qualified and is practising as a chartered accountant, doctor, lawyer, engineer or architect or any other profession

2. Amount to be transferred

   a. Unconditional cash transfer—The entitled amount will be transferred directly into the bank accounts of identified beneficiaries.
   b. The entitlement is Rs. 6000 per year to be paid in three equal instalments of Rs. 2000 each for every four-month period.
   c. Purpose of the amount—It is an unconditional transfer, and the farmer can use it for anything including procuring inputs related to agriculture and allied activities and meet domestic needs.
   d. Conditionality of production—Farmers who receive the money are not required to undertake farming activities.

3. Responsibility of the scheme:

   a. Financial Liability: It is an entirely central government funded scheme
   b. Identifying beneficiaries –State/UT governments are responsible for identifying the landholder families eligible for benefit under the scheme. The government(s) will use the existing land-revenue database to identify the beneficiaries.

4. *Aadhaar* enrolment is compulsory

What does Rs. 6,000 per year mean to a farmer?

a. On the income side,[6] the pay out of Rs. 6000 per farmer per year works out to between five and seven per cent of the estimated annual income of marginal farmers (those owning less than 1 ha) and five per cent of the estimated annual income of small farmers (those owning 1–2 ha) for 2018–19 (Fig. 11.16).
b. On the basis of the weighted average cost of cultivation[7] for major crops in India, Rs. 3000 per farmer per season (or Rs. 6000 per year) is approximately 10% of the estimated cost of cultivation in the case paddy, 11% in the case of maize, 12% in the case of wheat, 9% in the case of cotton and 5% in the case of sugarcane for 2018–19 (Fig. 11.17).

Challenges related to PM-KISAN

1. **Adequacy of amount**: Prima facie, an amount of Rs. 6000/year/farmer family or Rs. 17/day, appears to be extremely inadequate. But farmers' incomes and costs

[6] Average annual farmer income as per NAFIS 2015–16, indexed for inflation and brought forward to 2018–19.
#Method for Inflation Indexing used throughout the paper: 1. Inflation indexed amount = [Amount in base year/CPI for base FY]*CPI current FY; CPI base FY has been calculated by taking the simple average of all the months in the FY; Source for Data for CPI: MOSPI.

[7] Weighted average calculated with data for C2, Directorate of Economics & Statistics 2015–16, indexed for inflation and brought forward to 2018–19.

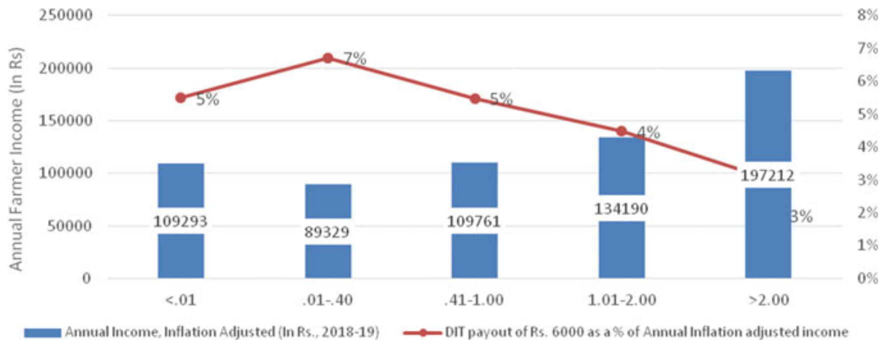

Fig. 11.16 Comparing annual farmer incomes (2018–19) with DIT of Rs. 6000/year. *Source* NAFIS 2015–16, indexed for inflation and brought forward to 2018–19

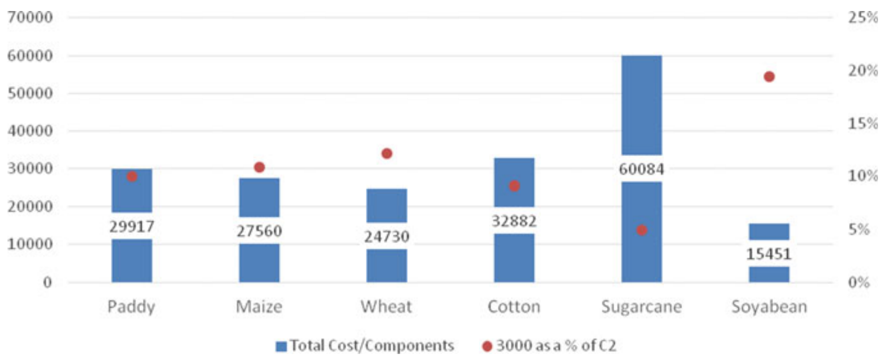

Fig. 11.17 Comparing DIT with cost of cultivation (C2) (INR/acre) of major crops. *Source* Directorate of Economics and Statistics 2015–16, indexed for inflation and brought forward to 2018–19

of agricultural inputs vary significantly across states in India. The implications and importance of Rs. 6000/year/farmer family, therefore, will be significant in some regions but inadequate in others. Further, the fact that this payment is not indexed to inflation and is instead fixed at least for the FY 2019–20 may lead to the net impact of this income support being negligible.

2. **Exclusion of sharecroppers, tenants and landless**: PM-KISAN, in its present version, covers only landowning small and marginal farmers under its ambit and excludes sharecroppers, tenant farmers and landless agricultural labourers. This, despite the fact that agricultural workers form a significant proportion of the overall agricultural labour force, renders a community of agricultural workers in financial distress almost invisible. PM-KISAN's counterpart KALIA, in Odisha, on the other hand, covers these sections and hence, is more inclusive.
3. **High chances of inclusion and exclusion**: The operational guidelines of PM-KISAN lay out a detailed exclusion criterion for beneficiaries such that the

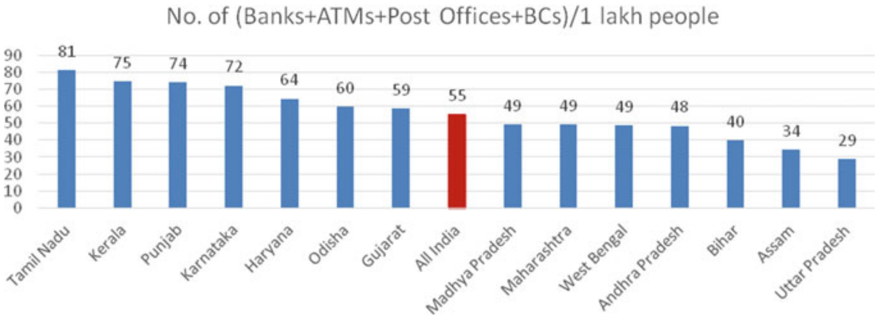

Fig. 11.18 Banking density across different states/UTs in India. *Source* No. of Bank Branches, ATMs: RBI: Sep 2018; No. of Post Offices: Department of Posts, Ministry of Communications & IT, 2014–15; No. of BCs: SLBC, Respective States/UTs

benefits of the scheme reach only the targeted audience. While parameters such as institutional ownership of land, former or present employees of government bodies, etc., do hold merit, a better approach could have been using household level granular data available in SECC 2015–16, which lays out information on household asset ownership, sources of household income, etc. Using this information as a means of exclusion/inclusion could have led to a more focused and targeted approach based on a realistic assessment of welfare among agricultural households. The present criteria could also give rise to a situation in which relatively prosperous households end up getting benefits of the scheme at the expense of those who may fall under one or more categories of exclusion for PM-KISAN but still may be under extreme financial distress. A more robust design, such as that of the 9-Point Action Plan for Public Distribution System (PDS),[8] would have minimised these concerns.

4. **Inadequately updated land records**: PM-KISAN uses landownership and landholding size as a means to target and identify farmers. However, the fact that land records across Indian states/UTs, despite initiatives like the Digital India Land Record Modernisation Programme (DILRMP) being enforced by the Union Government since 2008 are inaccurate raises questions about the degree of success of PM-KISAN.
5. **Last-mile connectivity**: Low banking density restricts the success of PM-KISAN as banking density or last-mile banking connectivity is crucial for delivering the direct cash benefits conceptualised under the scheme. Last-mile connectivity, which depends on the penetration of banking and financial institutions in rural areas, remains low despite institutionalised efforts in the form of the *Pradhan Mantri Jan Dhan Yojana* (PMJDY) (Fig. 11.18).

The combined number of bank branches, ATMs, banking correspondents and post offices per 1 lakh people is the highest for Tamil Nadu (81), Kerala (75) and

[8]Circular No. PDS-64—Civil Supplies Corporation, GoI (2007).

Karnataka (72), while it is the lowest for Uttar Pradesh (29), Bihar (40) and Andhra Pradesh (48). The all India average is 55.

6. **Crowding out investment**: PM-KISAN involves huge costs. The question is who pays for it? In the wake of the huge fiscal implications of PM-KISAN, and the limited scope for generating alternative stream of revenues, it is imperative for the government to reduce investments in areas other than agriculture in coming years. Crowding out investment from other essential key areas of the economy could lead to a self-defeating situation for India in which the price of PM-KISAN may be borne by an already struggling manufacturing sector, for instance. The best way, therefore, would have been to convert input subsidies, say on fertilisers, into direct income transfers. One hopes that it can still be done; otherwise, this additional expenditure on PM-KISAN may start eating into potential public investments in agriculture.
7. **Fiscal implications**: Rs. 75,000 crore is approximately 0.4% of the 2018–19 GDP, a huge sum for a country whose fiscal deficit for 2018–19 was reportedly 115% of its FY target and approximately 3.3% of the GDP for FY 2018–19.[9] An increase in the coverage of the scheme or amount of benefit/farmer could further put tremendous pressure on the fiscal health of the economy. A high fiscal deficit, coupled with payments for DIT and interest on loans by government, instead of infrastructure investment, could lead to a worsening of the fiscal situation, which would result in more than normal inflation, the burden of which will again fall on the poor the most.

We now turn to the issue of farm loan waivers.

11.3.5 Farm Loan Waiver

Although farm loan waiver was not an all-India policy, but when PM Modi declared a complete loan waiver in an election rally in Uttar Pradesh, it triggered a spate of similar announcements from other states too. Seven Indian states had announced farm loan waiver (FLW) schemes ahead of their state elections. We present below facts about these loan waiver schemes (Table 11.1). Four features of loan waivers stand out.

a. These promises are generally made by political parties before elections (Column 2).
b. These waivers are distributed in a phased manner between years; thus, the amounts are spread through state budgets in subsequent years (Columns 4 and 5).
c. As in other government schemes, there are large inefficiencies in the programme. For one, there is a very high exclusion error: the really needy, i.e. the poor and vulnerable farmer who does not have access to credit from institutions. As per

[9] Reserve Bank of India Bulletin (2019, February).

Table 11.3 Loan waivers announced and allocated by various states since 2017–18

	Fiscal year of loan waiver	Loan waiver amount		
	Announcement	Announced (Rs. crore)	Amount budgeted 2017–18 (RE) (Rs. crore)	Amount budgeted 2018–19 (BE) (Rs. crore)
(1)	(2)	(3)	(4)	(5)
Maharashtra	2017–18	34,000	16,000	8820
Uttar Pradesh	2017–18	36,000	25,000	4000
Punjab	2017–18	10,000	370	4250
Karnataka	2018–19	44,000	3910	10,420
Rajasthan	2018–19	18,000	–	1860
Madhya Pradesh	2018–19	36,500	–	–
Chhattisgarh	2018–19	6100	–	–
Total		184,600		

Source RBI

NABARD's NAFIS, only 30.3% of Indian agricultural households took loans from institutions; all others, i.e. about 70% of Indian peasantry did not take an institutional loan and thus do not stand to benefit from a FLW.

d. A farm loan waiver has an adverse impact on the credit culture in the state as most people who take loans do not return it in anticipation of a farm loan waiver (Table 11.3)

Overall, this type of farmer support is not only economically inefficient but is also not likely to yield much benefit to political parties because of the limited number of people it is likely to benefit.

11.3.6 Other Schemes

Innovation and Agricultural Entrepreneurship under RKVY-RAFTAAR— The *Rashtriya Krishi Vikas Yojana* (RKVY) is an important scheme of the Ministry of Agriculture and Farmers' Welfare (MoA&FW) aimed at strengthening infrastructure in agriculture and allied areas. In order to promote agricultural entrepreneurship and agro-businesses by providing financial support and nurturing an incubation ecosystem, a new component under the revamped scheme RKVY- RAFTAAR was launched in 2018–19.

Promotion of Agricultural Mechanisation for in-situ Management of Crop Residue: The objective of the scheme is to address air pollution caused by in situ crop residue burning in the states of Punjab, Haryana, Uttar Pradesh and the NCT of Delhi. The scheme envisages establishing custom hiring centres to provide subsidised machinery and equipment to individual farmers to dispose of in situ crop residue.

Financial assistance up to 50% of the cost of procuring equipment and machinery is to be provided to individual farmers. State governments, ICAR, KVKs, PSUs, etc., are also involved in taking up education and communication and information activities to spread awareness on in situ crop residue management techniques. Capacity building programmes, training, demonstration camps and mass awareness programmes are conducted for all interest groups to achieve zero straw burning.

***Rashtriya Gokul* Mission**: The mission focuses on the development, preservation and conservation of indigenous breeds. This is done through selective breeding and genetic up gradation of non-descript cattle using elite indigenous breeds like Gir and Sahiwal. The mission also works towards increasing milk production and productivity and breed improvement programmes for indigenous cattle to increase stocks. Besides, there is a provision for the distribution of disease-free, high genetic merit bulls for natural service and the establishment of an e-market portal for bovine germplasm to connect breeders and farmers. The scheme subsumes the National Programme for Bovine Breeding, Indigenous Breeds and the new National Mission on Bovine Productivity.

Scheme for Assistance to Sugar Mills for the 2017–18 season : The scheme is being implemented to clear arrears of the 2017–18 sugar season and for previous sugar seasons due to record sugar production. The scheme aims to provide financial assistance to sugarcane farmers at the rate of Rs 5.5/quintal of cane crushed.

***Pradhan Mantri Kisan SAMPADA Yojana*(PMKSY)**

The Ministry of Food Processing Industries (MoFPI) is implementing an umbrella central sector scheme the "*Pradhan Mantri Kisan SAMPADA Yojana* (PMKSY)" with a total allocation of Rs. 6000 crore. The implementation period is 2016–20. Under PMKSY, financial assistance as capital subsidy in the form of grants-in-aid is provided to eligible applicants against an expression of interest issued by the MoFPI from time to time. The PMKSY has seven component schemes, i.e. (i) mega food parks, (ii) integrated cold chain and value addition infrastructure, (iii) creation/expansion of food processing and preservation capacities, (iv) infrastructure for agro-processing clusters, (v) creation of backward and forward linkages, (vi) food safety and quality assurance infrastructure and (vii) human resources and institutions. Individuals, farmers, farmer producer organisations (FPOs), entrepreneurs, co-operatives self-help groups (SHGs), private companies and central/state PSUs, etc., are eligible for financial assistance. The scheme is being implemented in all states. The rate of subsidy ranges from 35 to 75% of the eligible project cost, subject to a maximum specified limit depending on the scheme and location of the project. However, state-wise allocation of funds has not been made under any of the schemes.

11.4 Way Forward

Unfulfilled promises and falling profitability in most crops have made farmers worse off in the last five years. Climate change and variability have only increased their woes and deepened the distress. From increasing MSP to giving farm loan waivers, all routes have been explored but have not brought about any amelioration of farm distress. So, what is the problem? Is the government unable to understand the problem? Or is the solution that is being advocated incorrect? Or is it that the solution is correct but there are gaps in the scheme or policy implementation because of which the farmers' problems have persisted over the years? Or is it a mix of all these problems?

The solution lies in a more comprehensive review of the Indian agricultural policy landscape as one starts looking ahead under Modi 2.0. The focus must be on effective and timely implementation of various commendable programmes that the government under Prime Minister Modi has initiated, be it *Fasal Bima Yojana* or *Krishi Sinchayee Yojana*, or the creation of a national agriculture market. This requires dispassionate analysis of what has gone wrong, hard work and perseverance through a concurrent evaluation of all major programmes so that they can be tweaked in time for better delivery, and if need be, be replaced by better alternatives. The litmus test is whether the farmers' economic situation improves, and whether the problems of poverty and malnutrition are alleviated faster. The thrust from the farming community will increase demand for manufacturing commodities, activating a multiplier effect on the overall economy. This truly will reflect "*sabka saath, sabka vikas*", which is the motto of PM Modi.

References

APLM. (2017). Model Act The State/UT Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act 2017. Ministry of Agriculture, Government of India. https://agricoop.nic.in/sites/default/files/APLM_ACT_2017_1.pdf.

Das. (2019). Reforming FCI not a piece of cake. The Financial Express. https://www.financialexpress.com/opinion/reforming-fci-not-a-piece-of-cake/1586038/

DCR. (2018). *Dalwai committee report volume 4*. https://farmer.gov.in/imagedefault/DFI/DFI%20Volume%204.pdf..

Gulati, A., Chatterjee, T., & Hussain, S. (2018). *Supporting Indian farmers: Price support or direct income/investment support?* ICRIER Working Paper Number 357.

Gulati, Hussain, & Khurana. (2019a).*Story of Indian crop insurance: Many successes, more challenges.* Upcoming ICRIER working paper.

Gulati, A., Sharma, B., Banerjee, P., & Mohan, G. (2019b). *Getting more from less: Story of India's shrinking water resources* . NABARD and ICRIER report, Indian Council for Research on International Economic Relations.

NFSA. (2013). National Food Security Act 2013. Government of India. http://www.egazette.nic.in/WriteReadData/2013/E_29_2013_429.pdf.

MOC. (2018). *Ministry of commerce, agriculture export policy*. https://commerce.gov.in/writereaddata/uploadedfile/MOC_636802088572767848_AGRI_EXPORT_POLICY.pdf..

TFAMR. (2002). Report of Taskforce on Agricultural Marketing Reforms. Directorate of Marketing and Inspection, Ministry of Agriculture. Government of India. https://dmi.gov.in/Documents/ReportTaskForceAMR.pdf.

Chapter 12
Way Forward

Ashok Gulati and Shweta Saini

12.1 Introduction

While the chapters until now in this book tell us about what the situation is and what explains the situation, this chapter builds on these and proposes suggestions for the future.

One thing is crystal clear: if India wants to grow, it cannot do so leaving its agricultural sector behind. In fact, this study tells us that it is worth focusing on agriculture as it has the potential to:

(i) Solve country's twin-problems of poverty and malnutrition faster and
(ii) Augment incomes of the largest segment of the country's workforce (agricultural workers). This will boost demand for manufactured products which will trigger a demand multiplier in the economy leading to overall development of the country.

But what is holding back agriculture today? This study has looked at the agricultural sector in six states in detail to decipher what works and what does not work in accelerating growth in agriculture. The study also looks at the overarching environment in which agriculture in India operates, and what reforms are needed in terms of institutional changes to give the right signals to farmers to attract higher investment in this sector leading to faster growth of agricultural GDP as well as the real incomes of the farmers.

Some contours of Indian agriculture are listed below:

(I) *Small-holder agriculture*: Indian agriculture is dominated by small holders. The average landholding size of a farm household has been falling (from

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2.28 ha in 1970–71 to 1.08 ha in 2015–16) and is likely to shrink yet further. With small and shrinking landholdings, it is always a challenge to access enough capital, quality inputs and insure against various risks that agriculture faces. As farm holdings are quite small, farmers often have to rely on alternate sources of income as exclusive reliance on income from cultivation and cattle rearing are not sufficient for them to sustain themselves. The smaller the size, the greater the dependence on off-farm sources for income. It may, however, be noted that although the small size of holding is a challenge, it is not such an insurmountable problem that it cannot be solved. The example of China may be relevant in this context. China's holding size even today is about 0.7 ha. It was just 0.46 ha when reforms in China started. China's overall gross cropped area is also about 166 million ha compared to India's 198 million ha and yet, China produces more than three times the value of agricultural produce compared to India. The lesson is straight forward: if we can get the incentives right, and if we can get the right investments in infrastructure and agricultural R&D, we can make the economic conditions of our farmers and those dependent on them much better, with lower poverty and lower malnutrition.

(II) *Challenge of aggregation and building value chains*: One of the key challenges in small-holder agriculture is to think in terms of building more efficient and more inclusive value chains for different commodities, especially perishables in the country. The Gujarat study in this book has clearly demonstrated that small holders have contributed to the milk revolution in the country, and it started with the aggregation of small surpluses, processing them and linking the processing units to organised retail outlets in major metro cities. The fact that these value chains were inclusive in the sense that they were formed and owned by farmers led to a situation where almost 75–80% of consumer spend is received by farmers. The challenge is to replicate the "AMUL" model in other commodities, especially fruits and vegetables. In this context, thinking of value chains through the creation of farmer producer organisations (FPOs) seems to be the way forward. From that angle, the finance minister's announcement of creating 10,000 additional FPOs (there are already around 4000 FPOs in the country that NABARD and SFAC are handling) in the Union Budget of FY20 is a welcome step. But to convert this into reality, and deliver the gains that milk value chains have given, one needs to tweak laws governing long-term agricultural credit that often require land as collateral. FPOs also need to be linked to markets/processors/exporters, etc.—the crucial link to realise better prices for farmers. Aggregation must start with the assaying of produce, standardisation, packaging, dispute settlement mechanisms, traceability, etc. So, there is lot of spade work that needs to be done before their produce can be put on e-NAM for wider market access and better prices.

(III) *Access to essential inputs like water, quality seeds, fertilisers*—This study identified that the main drivers of growth in agriculture in the past have been access to irrigation, access to better seeds, fertiliser consumption, etc. There is a clear, strong, positive correlation between timely access to quality inputs in sufficient quantities and production growth.

(IV) *Infrastructural deficits like roads, power for irrigation and markets* —This is just another challenge that needs to be overcome for higher agricultural growth and increased farm incomes. Even if a farmer is able to produce sufficient quantities for sale, non-existent roads and markets inflict losses and create wastages in the system. Similarly, with insufficient or no power, the farmer has restricted access to water. Today, only 49% of India's gross cropped area is under assured irrigation, which means that more than half the area depends on rains, mainly monsoon rains, to meet their irrigation needs. With high variability in rainfall patterns and the uncertainty due to fast climatic changes, insufficient access to irrigation constrains a farmer's ability to reach his full-potential.

(V) *Timely access to efficient markets* —Most farmers sell their produce at the farm-gate or in small local markets located in rural and interior areas. These market points are not modern and lack scientific weighing and grading equipment with the result that transactions are not very transparent and often lead to lower value realisation by the farmer. Besides, as noted more recently, farmers have been suffering due to bumper crops, as these create a glut in the market that is not equipped to handle large surpluses, again leading to lower value realisation by the farmer. Missing value chains in the agricultural sector, particularly for perishable commodities like fruits, vegetables and dairy, have heightened farmers' distress.

(VI) *Over-reliance on MSP-based procurement regime to alleviate market crisis*—Driven by farmers' demands and socio-economic objectives, successive governments have relied on the MSP-based procurement regime to assure markets to farmers. But, this regime itself has suffered on accounts of inefficiencies in the implementation machinery. While the system suffers on accounts of inefficiencies in grain handling and management, farmers in only about nine or 10 states, who are large enough to bring surpluses to the markets, have been able to benefit from the schemes. Farmers in most other states have been excluded from benefits under the procurement schemes.

(VII) *Over-reliance on wheat and rice*—When India attained independence, one of its primary objectives was to achieve food security for all. By producing large surpluses of food grains at the national level, India has achieved food security at least at the macro-level. But this has had some interesting side effects. These include an over-reliance on the policy environment, government agricultural machinery and overdependence on rice and wheat. Changing consumption patterns and the desire to increase farmers' incomes have both necessitated a shift in this pattern towards high-value agriculture that includes production of fruits and vegetables, pulses, etc. However, there has been inertia in the system with farmers continuing to produce rice and wheat even though these crops are not warranted in terms of environmental sustainability.

(VIII) *Problems of water efficiency and management* —As water becomes scarce and rainfall patterns become erratic, water management takes centre stage in India's drive to make its agriculture sustainable. This book found that in states like Punjab, the state government's supply of free electricity has led to unscrupulous drilling of underground water and that has led to massive depletion of water resources. Besides, the skewed cropping pattern where water-guzzling crops like rice and sugar cane are cropped in water-deficient areas has also been highlighted in this book.

(IX) *Issues with Policy and Governance*—This issue was identified as a major constraint across all six state studies. Even the analysis of Modi 1.0 programmes and schemes and the doubling farmers' income chapter identified issues with policy design and implementation that put unnecessary constraints on the agricultural sector. Among other things, this book identified two types of problems with policies: (i) some policies and programmes were found to be *archaic* like the Essential Commodities Act, 1955, land leasing laws, etc., and their implementation has been found inefficient and (ii) some policies resulted in inefficiencies in the system like the input support regime where government support has resulted in the inefficient and unsustainable use of scarce natural and fiscal resources.

These challenges, however, will need to be dealt with given the need to ensure continued food security and the implications of high agricultural growth rates on other sectors of the economy. And the way to address these challenges is to undertake structural, operational and policy reforms.

12.2 Centrality of Reforms

In October 2016, NITI Aayog launched its Agricultural Markets and Farmer Friendly Reforms Index (AMFFRI). This index evaluated Indian states on the extent to which each of them undertook required agricultural reforms. The reforms were categorised under three heads—agricultural market reforms, land lease reforms and reforms related to forestry on private land.

Each parameter had sub-parameters. States were given scores based on their performance on these sub-parameters. For example, if a state removed fruits and vegetables (F&V) from APMC's purview and did not levy any cess or market fee, it got a full score. On the other hand, if a state removed F&V from APMC but still levied fees or other charges, then the state got half the score. Based on the total score received by a state, ranks were assigned to all states. The lower the rank the more market friendly that state is.

As per 2016 October AMFFRI, Maharashtra topped the index and Puducherry came last. This means that Maharashtra has been the best performing state among all to have undertaken most required reforms.

If we plotted states as per their AMFFRI ranks together with the agricultural growth rates achieved by them historically, an interesting picture emerges (Fig. 12.1).

This simple exercise reveals that those states that undertook reforms (and thus were ranked low on the AMFFRI) registered relatively faster agricultural GDP growth rates (blue box) while those that did not initiate reform measures had relatively lower agricultural GDP growth rates.

There were some exceptions like Karnataka, Haryana and Maharashtra. These states undertook reforms (and thus had low AMFFRI ranks), but they also had a low agricultural GDP growth rate. This is likely to be attributed to the delayed effect of reforms on agricultural performance.

But overall, it may not be wrong to infer that states which undertook reforms grew faster. This establishes the importance and urgency of undertaking reforms.

So, what are these reforms? We present below policy recommendations that emanate from the analysis presented in this book.

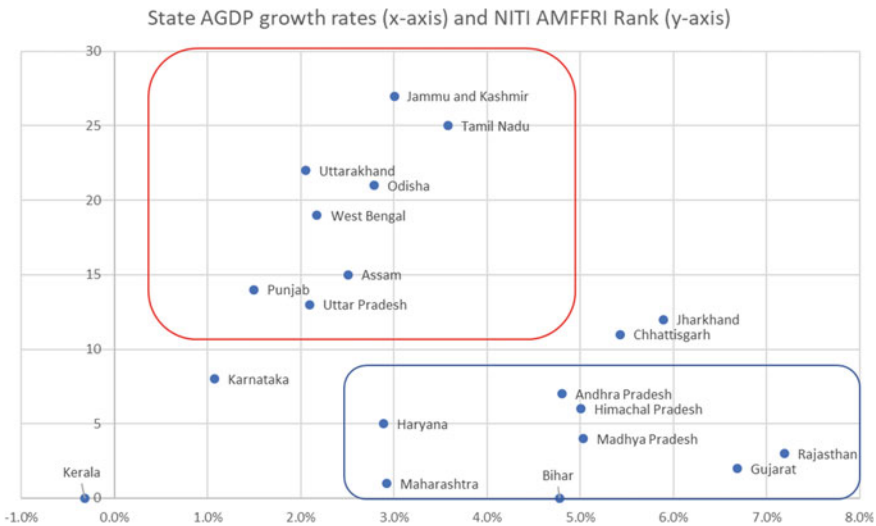

Fig. 12.1 Comparing State AGDP growth rates with AMFFRI Rank. *Source* Adapted from Saini (2019) based on data from MOSPI and NITI Aayog. Data for AGDP is for 2000–01 to 2015–16, and NITI ranking is as on October 2016. *Note* (i) A low AMFFRI rank imply that the state is undertaking desired reforms; the lower the rank, the better it is. (ii) Because both Kerala and Bihar did not have APMC acts, they do not have AMFFRI ranks

12.3 Recommendations

12.3.1 Irrigation

Improving and ensuring timely access to sufficient irrigation is integral to agricultural development and based on the analysis in the chapters, the following recommendations emerge:

1. Bridge the gap between irrigation potential created (IPC) and ultimate irrigation potential (UIP).
2. For expansion of groundwater and surface water irrigation:
   (a) Assured power is important. The government needs to effectively and expeditiously implement plans to increase investment to bolster the power transmission and distribution infrastructure.
      (i) In order to ensure assured supply of electricity for agriculture, high priority needs to be given to feeder separation. Besides, power needs to be properly priced to recover the cost of supply. If farmers need to be supported that support should come directly as income support (like PM-KISAN).
      (ii) States should take advantage of the funds under the Government of India's *Deen Dayal Upadhaya Gram Jyoti Yojana.*
   (b) With improved access to quality and timely power, areas with underutilised sub-soil water resources will gain enormously.
   (c) The use of solar pumping sets also needs to be popularised as an alternative to electric pump sets that depend on power supply from the grid, especially in areas with high water tables and shallow tube wells.
3. The coverage of micro-irrigation needs to be improved particularly for horticulture as it reduces water and energy consumption and increases productivity. Currently, the National Mission on Micro Irrigation is in position to promote sprinkler and drip irrigation. There is a need to increase the adoption of micro-irrigation works through demonstration via extension agents.

12.3.2 Markets

A well-functioning market plays a very important role in the growth of agriculture. The following recommendations are made based on the study:

(i) Adopt an electronic trading system (e-NAM) wherever possible.

   (1) This will lead to an improvement in the competitiveness and efficiency of agricultural markets and eliminate traders' cartels and price manipulation.

(2) It will offer increased selling choices for farmers. e-NAM is a public initiative and could bring benefits to a much larger number of farmers across a larger area if patronised by the state.

(ii) Encourage private sector participation particularly in high-value agriculture to create value chains, new markets for agricultural products and related infrastructure. The government has encouraged the private sector through subsidies, incentives and legislative support. State governments have also taken initiatives like *Krushi Mahotsav* which linked farmers with private players. These successes should be replicated and scaled up.

(iii) The procurement of rice should be capped at a quantity lower than the current level to disincentivise paddy cultivation in water-scarce states like Punjab. The amount of subsidy saved can be used to procure crops like maize.

(iv) Repeal and reform the restrictive APMC and the ECA. MP was among the first of the major states to remove horticulture produce from the ambit of the APMC. However, a few things need to be kept in mind:

(1) Repealing APMC is the first step, and it needs to be followed up with policy incentives to attract private market yards offering electronic and sample based trading. This will bring bulk buyers, processors, exporters, etc., to states for sourcing fresh produce and provide greater marketing choices to its farmers.

(v) Encourage state governments and the private sector to increase storage capacity in states.

(vi) Encourage FPOs-

(1) Government should put in place a set of incentives to strengthen these farmer owned organisations through financial support, infrastructure building and relaxation of the provisions of the APMC Act.

(2) Provide ready access to affordable working capital.

(3) Given that equity concerns are well addressed by such bodies, there is a justifiable case to enhance the level of public support to registered FPOs. Among the most effective measures would be a state-level credit guarantee fund, which could provide comfort to all institutional lenders licensed by RBI for loans advanced to FPOs up to a limit (say Rs. 200 lakhs).

12.3.3 Diversification

With increasing income, the demand pattern is changing and that should drive changes in the agricultural production basket. A need to expand livestock and the F&V sector was particularly identified in the chapters. Commensurately, the following measures are recommended:

(i) Promote dairy farming:

(1) The Gujarat dairy model can be replicated in other states to promote the dairy sector. There is considerable scope for expansion of dairy co-operative societies to increase collection, processing and marketing of milk produced in a state.
(2) The dairy sector should be more organised and liquid milk should be channelised to processing units for further processing.
(3) Milk productivity has to increase in the states of UP, Bihar and Odisha. Health and reproduction management is crucial for increasing productivity.
   (i) There is a requirement to increase the proportion of cross-bred bovines and to use germ plasm from superior breeds for cross-breeding.
   (ii) There is a need to make use of recent developments in technology and reduce the number of births of male calves to increase the number of milch animals in the herd.

(ii) Government should facilitate diversification away from rice towards maize and horticulture by creating infrastructure for value chain development. Maize production can be incentivised by developing maize value chains, thereby connecting farmers to feed producers, processed food industries making cornflakes, popcorn or food marts selling horticulture products like baby corn and sweet corn, starch and the ethanol industry.
(iii) With the increasing importance of the horticulture sector, there is need to expand and strengthen infrastructure such as cold storage, warehouses and processing units for value chain development. Incentives for farm-level, low-cost storages would significantly enhance the capacity of a state's farmers to benefit from price differentials in the lean supply months.
(iv) The use of solar pumps, particularly micro-solar pumps, also needs to be popularised as its use has great potential in states in which farmers grow vegetables on small plots of land. Innovations like creating a market for mobile solar pumps can also help, as would the *Uberisation* of other farm machinery for small holders to get access to their services at low cost.
(v) A large part of Odisha is mono-cropped with rice and remains fallow during the *rabi* season after the summer harvest. It is imperative to reduce the dependence of farmers on a single crop as recurring climatic anomalies make agriculture in the state doubly risky. A second crop of oilseeds, pulses, vegetables and fodder crops can be raised through greater use of ground water resources including through the deployment of solar pumps.
(vi) The government needs to increase R&D expenditure and investments in marketing, storage and processing facilities.
(vii) **Sugarcane** is an important crop for UP. The following are the recommendations for its development.

(a) Adopting the Rangarajan Committee (2012) recommendations on cane pricing based on fair and remunerative price and revenue sharing formula.
(b) Creating a price stabilisation fund for sugarcane.
(c) Changing the molasses policy to stop subsidising the liquor sector through the sugar industry and sugarcane farmers.
(d) Introducing a flexible ethanol blending programme to deal with the problem of sugar surpluses.
(e) Avoiding bailing out inefficient co-operative sugar mills while discriminating against profitable private mills.
(f) Privatising existing co-operative sugar factories through a transparent process.

12.3.4 Techniques and Technology

(1) Rice is India's staple crop and existing techniques of production including flood irrigation (which requires puddling of the field before tillage, fine grinding of top soil with water and creating an overlying water layer during transplanting) are found to be inefficient. The government should encourage agricultural scientists to identify new and efficient methods to replace this method and the extension system should be geared up to encourage their widespread adoption.
(2) Improving extension services for soil sampling, good quality seeds, agricultural implements, etc., to provide quality inputs to farmers to improve production, productivity and returns to farmers.

12.3.5 Other Recommendations from the Studies

(i) Investment in all-weather surfaced roads will ensure efficient movement of products to the market in the minimum possible time and minimise waste.
(ii) To improve power and water use efficiency, power supply should be metered and charged beyond a fixed level of free supply.
(iii) Land laws need to be reformed and legal leasing of land should be permitted. Implemented fairly, the land leasing law could help increase investment in better technology and irrigation as stable tenures and fair rents will encourage tenants to invest in productivity-enhancing measures.

12.3.6 Shift to DBT

1. *Power Subsidy*: In order to ensure timely access to sufficient water for cultivation, water charges have been kept at a low level and have not been changed for a long time. Although this has helped increase production manifold, the combination of

free water, power and procurement has led to rapid ground water depletion and inefficiency in the consumption of power. With limited resources, this increasing subsidy burden is not sustainable and there is an urgent need to rationalise the power sector. Power supply should be metered and charged beyond a certain level of free supply and the subsidy should be transferred to a farmer's account. Transferring a fixed amount will incentivise farmers to reduce consumption of both electricity and groundwater.

2. *Fertiliser Subsidy*: Fertiliser subsidy has helped achieve self-sufficiency in food grain production, but it has led to inefficient use of fertilisers. The extremely low price of urea has resulted in imbalanced fertiliser use. This affects the fertility of land and increases the subsidy burden. To rationalise the fertiliser subsidy, our main suggestion would be to switch to direct cash transfers to farmers on a per hectare basis, liberalise the fertiliser sector (especially urea sector) step by step and let domestic prices be determined by demand and supply forces in the open market. The government should seriously pursue the soil healthcare programme, and if possible, make cash transfers conditional upon regular soil health checks and recommended optimum fertiliser usage.
3. *PM-KISAN*: The government's direct income transfer scheme, PM-*Kisan*, provides a unique platform that can be used to subsume existing in-kind subsidies and support Indian farmers in a non-distortionary and efficient way.

Overall, we believe that moving from a production-centric approach to a value chain approach with FPOs at the centre of these chains is critical. It has to be supplemented by investments in basic infrastructure, like roads, markets, power supplies and agricultural R&D. And finally, converting input and output subsidies to direct income transfers to beneficiaries' accounts will empower them, and give the right signals to farmers to efficiently use these resources (fertilisers, power, water); it will also give consumers (food subsidy) better choices for a more diversified and nutritious diet. This will help put agriculture on a higher growth trajectory, augment farmers' incomes, promote sustainable development of agriculture, especially with respect to water and soil, and have a beneficial impact on consumers of food, feed and fibre.

References

AMFFRI. (2016). Agricultural marketing and farmer friendly reforms across Indian states and UTs, Niti Aayog, New Delhi.

Glossary

A2 + FL It covers actual paid-out costs plus an imputed value of unpaid family labour.

A2 Cost of Cultivation It covers all paid-out expenses, both in cash and in kind, incurred by farmers on seeds, fertilisers, chemicals, hired labour, fuel, irrigation, etc.

Agriculture Extension Services It refers to any organisation in the public or private sectors (e.g. NGOs, farmer organisations, private firms, etc.) that facilitates farmers' and other rural actors' access to knowledge, information and technologies, training and their interactions with other actors, and assists them in developing their own technical, organisational and management skills and practices, so as to improve their livelihoods and well-being (as per FAO).

Area Sown More Than Once It represents the areas on which crops are cultivated more than once during the agricultural year. This is obtained by deducting the net area sown from total cropped area.

Body Mass Index Body mass index (BMI) is the value derived from the mass (weight) and height of a person. The BMI is defined as the body mass divided by the square of the body height.

C2 Cost of Cultivation It is the comprehensive cost including imputed rent and interest on owned land and capital.

CAGR The CAGR or compound annual growth rate is the average rate at which GDP grows over time assuming that it was compounded annually.

Cropping Intensity It refers to the ratio of net area sown to the total cropped area.

Farm Households According to NAFIS, any household that earned at least Rs. 5000 from agriculture and allied activities in a year; this threshold under NSSO is at least Rs. 3000.

Farmers' Income Farmers' income includes four major sources of incomes—cultivation, livestock, wages and salaries and non-farm.

Farmers Producer Organisation It is a legal entity formed by farmers and/or other primary producers. It can be a producer company, a co-operative society or any

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other legally recognised organisation that provides for sharing of profits/benefits among members.

Gross Cropped Area This represents the total area sown once and/or more than once in a particular year; i.e., the area is counted as many times as there are sowings in a year. This total area is known as gross cropped area.

Gross Domestic Product It is measured as the gross output of all commodities, industries, etc., evaluated at factor cost minus the purchaser's value of intermediate inputs.

Gross Irrigated Area The gross irrigated area is the total irrigated area under various crops during the whole agricultural year, counting the area irrigated under more than one crop during the same year as many times as the number of crops grown. Inter-cultured or mixed crops are treated as one crop.

Gross Value Added (GVA) at Basic Prices Gross value added at basic prices is defined as output valued at basic prices minus intermediate consumption valued at purchasers' prices.

Gross Value of Output in Agriculture and Allied Activities (GVOA) It is the value of output produced by agriculture and allied sector of the economy during a financial year measured at the farm gate level.

Infant Mortality Rate The infant mortality rate (IMR) is the number of deaths of children under one year of age per 1000 live births among the population of a given geographical area during a given year.

Irrigation Potential Created The irrigation potential created by a project at a given time during or after its construction is the aggregate gross area that can be irrigated annually by the quantity of water that can be made available by all connected and completed works up to the end of the water courses or the last point in the water delivery system up to which the government is responsible for construction (as per Planning Commission).

Irrigation Potential Utilised The irrigation potential utilised is the total gross area actually irrigated by a project during the year under consideration (as per Planning Commission).

Irrigation Ratio The irrigation ratio is the ratio of gross area irrigated to the gross cropped area in a year expressed in percentage terms.

Literacy Rate According to the Census, a person aged seven and above who can both read and write with understanding in any language is treated as literate. A person, who can only read but cannot write, is not literate.

Micro Irrigation A scientific method of irrigation carrying desired water and nutrients directs to the root zone of the plant through drippers, sprinklers, foggers and by other emitters on surface or subsurface of the land.

MSP Minimum support price (MSP) is a form of market intervention by the Government of India to protect agricultural producers against any sharp fall in farm prices. The minimum support prices are announced by the Government of India at the beginning of the sowing season for 23 crops on the basis of the recommendations of the Commission for Agricultural Costs and Prices (CACP).

Net Area Sown It represents the total area sown with crops and orchards. Area sown more than once in the same year is counted only once.

Net Irrigated Area It is the area irrigated through any source once in a year for a particular crop.

Operated Area Operated area includes both cultivated and uncultivated areas, provided part of it is put to agricultural production during the reference period.

Operational Holdings All land is used wholly or partly for agricultural production and is operated as one technical unit by one person alone or with others without regard to the title, legal form, size or location (as per Agriculture Census).

Poverty Head Count Ratio The head count ratio (HCR) is the proportion of the population that lives below the poverty line.

Poverty Line Monthly per capita consumption expenditure of Rs. 972 in rural areas and Rs. 1407 in urban areas is treated as the poverty line at the all-India level.

Power Intensity in Agriculture Sector It is measured as the sale of power to the agriculture sector per hectare of gross cropped area.

Seed Replacement Rate It is the percentage of area sown out of total area under a crop in a season by using certified/quality seeds other than farm saved seeds.

Small and Marginal Farmers Farmers who operate less than 2 hectares of land fall in this category.

Stunted Low height for age (stunted) is defined as the percentage of children, aged 0–59 months, whose height for age is below minus 2 standard deviation from the median of the reference population.

Surfaced Road Density It is the ratio of surfaced road length (km) per 1000 km^2 of the geographical area.

Terms of Trade for Agriculture (ToT) It is measured as the ratio of agriculture deflator to non-agriculture deflator (industry/service deflator).

Total Road Density It is the ratio of total road length (km) per 1000 km^2 of geographical area.

Ultimate Irrigation Potential It is the gross area that can be irrigated from a project in a design year for the projected cropping pattern and assumed water allowance on its full development (as per Planning Commission).

Underweight Weight for age (underweight) is a composite index of height for age and weight for height. Children whose weight for age is below minus two standard deviations from median of the reference population are classified as underweight.

Wasting Low weight for height (wasting) measures body mass in relation to body length. Children whose Z-score is below minus 2 standard deviation from the median of reference population are considered wasted for their height.

Bibliography

Agriculture Census (2011–12). *All India report on number and area of operational holdings*. Department of Agriculture, Co-Operation and Farmers Welfare Ministry of Agriculture and Farmers Welfare, Government of India.

Ahluwalia, M. S. (2000). Economic performance of states in post-reforms period. *Economic and Political Weekly*, 1637–1648.

Bagchi, A. K., Das, P., & Chattopadhyay, S. K. (2005). Growth and structural change in the economy of Gujarat, 1970–2000. *Economic and Political Weekly*, 3039–3047.

Barooah, V. K. (2002). *The role of maternal literacy in reducing the risk of child under nutrition in India*. University of Ulster and ICER.

Basic Animal Husbandry and Fisheries Statistics (Various Issues). *Basic animal husbandry and fisheries statistics*, *various issues*. New Delhi: Department of Animal Husbandry and Dairying (AH&D), Ministry of Agriculture and Farmer's Welfare, Government of India.

Basic Road Statistics of India (Various Issues). *Basic Road Statistics of India*. New Delhi: Ministry of Road Transport and Highways, Government of India.

Bathla, S., Thorat, S. K., Joshi, P. K., & Bingxin, Y. (2017). Where to invest to accelerate agricultural growth and poverty reduction. *Economic Political Weekly, 52*(39), 36–45.

Bhagowalia, P., Kadiyala, S., & Headey, D. (2012). *Agriculture, income and nutrition linkages in India: Insights from a nationally representative survey*. International Food Policy Research Institute.

Bhartiya Janta Party (BJP) (2014). Election Manifesto. http://www.thehinducentre.com/multimedia/archive/03226/full_manifesto_eng_3226788a.pdf.

CACP (2016). *Price policy for rabi crops—The marketing season 2017–18*. Ministry of Agriculture and Farmers' Welfare, Department of Agriculture, Cooperation and Farmers' Welfare. New Delhi: Commission for Agricultural Costs and Prices.

CAG (2016). *Report of the comptroller and auditor general of India on performance audit of Pradhan Mantri Gram Sadak Yojna*. New Delhi: Union Government (Civil), Ministry of Rural Development, Indian Audit and Accounts Department.

CEA (Various Issues). *All India electricity statistics*. New Delhi: Central Electricity Authority, Ministry of Power, Government of India.

Central Water Commission (2015). *Water and related statistics*. New Delhi: Central Water Commission.

Chand, R. (2015). Subsidy structure too complex for knee-jerk response. *Farmers' Forum, 14* (6).

CSO (Various Issues). *State-wise gross domestic product*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

A. Gulati et al. (eds.), *Revitalizing Indian Agriculture and Boosting Farmer Incomes*, India Studies in Business and Economics,
https://doi.org/10.1007/978-981-15-9335-2

DESA, U. (2015). *World population prospects: Key findings and advance tables*. New York: United Nations, Department of Economic and Social Affairs, Population Division.

Dholakia, H., & Datta, S. (2010). *High growth trajectory and structural changes in Gujarat agriculture*. New Delhi: Macmillan Publishers India Ltd.

Directorate of Economics and Statistics (2015). *Agricultural statistics at a glance*. New Delhi: Ministry of Agri-culture. Government of India.

DoWR, Odisha. *An overview of irrigation scenario*. Department of Water Resources, Odisha, Government of Odisha.

Economic Survey of Punjab (Various Issues). *Economic survey of Punjab*. Office of Economic Advisor, Government of Punjab.

Fan, S., Gulati, A., & Thorat, S. (2008). Investment, subsidies, and pro-poor growth in rural India. *Agricultural Economics: The Journal of the International Association of Agricultural Economists, 39*(2), 163–170.

Fan, S., Hazell, P., & Thorat, S. (1999). *Linkages between government spending, growth and poverty in rural India*. Research Report 10, Washington DC: International Food Policy Research Institute.

Gillespie, S., & Kadiyala, S. (2011). Exploring the agriculture-nutrition disconnect in India. In *2020 IFPRI conference brief 20: Leveraging agriculture for nutrition and health*.

Government of Bihar (Various years). *Economic survey of Bihar*. GoB.

Government of India (2013–14). Crop diversification program in Haryana, Punjab & Western Uttar Pradesh. In *Sustainable agriculture with increased productivity and profitability*. Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Government of Punjab (1970–71 to 2003–04). *State domestic product of Punjab back series*. Economic Advisor, Government of Punjab.

Government of Uttar Pradesh (GoUP). (Various years). *District development indicators*. Lucknow: Economics and Statistics Division, State Planning Institute Planning Department.

Ground Water Scenario in India. (2016). *Central ground water board*. Government of India: Ministry of Water Resources.

Ground-Water Yearbook. (2013–14). Faridabad: Central Ground-Water Board, Ministry of Water Resources.

Gulati, A., & Banerjee, P. (2015). Rationalising fertilizer subsidy in India: Key issues and policy options. In *ICRIER Working Paper No. 307*. New Delhi: Indian Council for Research on International Economic Relations.

Gulati, A., & Hussain, S. (2017). Can UP farmers expect a better deal? In *From plate to plough*. The Financial Express. February 13, 2017.

Gulati, A., & Verma, S. (2017). Cow, culture and agriculture in UP. In *From plate to plough*. The Financial Express. March 27, 2017.

Gulati, A., Manchanda, S., & Kacker, R. (2016). *Harvesting solar power in India*. ZEF-Center for Development Research University of Bonn, Working Paper, 152.

Gulati, A., Shah, T., & Shreedhar, G. (2009). *Agriculture performance in Gujarat since 2000: Can it be a Divadandi (lighthouse) for Other States?* International Water Management Institute (IWMI); International Food Policy Research Institute (IFPRI).

Gulati, A., Wardhan, H., & Sharma, P. (Forthcoming). *Deconstructing value chains of tomatoes, onions and potatoes (TOP)*. New Delhi: NABARD-ICRIER.

Gulati and Saini (2019). Farm distress: MSP, loan waivers vs. direct income support. Financial Express. https://www.financialexpress.com/opinion/msps-farm-loan-waivers-or-direct-income-support/1435456/.

Gupta, P. R. (2017). *Dairy India* (7th ed.). New Delhi: Dairy India.

Headey, D. (2014). *An analysis of trends and determinants of child under nutrition in Ethiopia, 2000–2011*. Working Paper No-70. International Food Policy Research Institute (IFPRI).

Hoda, A., Rajkhowa, P., & Gulati, A. (2017). *Working paper 336: Unleashing Bihar's agriculture potential: Sources and drivers of agriculture growth*. New Delhi: Indian Council for Research on International Economic Relations.

Horticulture Statistics at a Glance (2015). *Horticulture statistics at a glance*. Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

ICAR. (2008). *Fisheries development in Bihar: An action plan*. Retrieved from http://ahd.bih.nic.in/Docs/ICAR-Report-Fisheries-Dev-Bihar.pdf.

Jose, S., & Navaneetham, K. (2008). A factsheet on women's malnutrition in India. *Economic and Political Weekly*, 61–67.

Kalkat, G. S. (2013). *Agriculture policies for Punjab*. Committee for Formulation of Agricultural Policy for Punjab State, Government of Punjab.

Labour Bureau (2016). *Report on fifth annual employment-unemployment survey 2015-16* (Vo. I). Chandigarh: Ministry of Labour and Employment, Government of India, Labour Bureau.

Livestock Census (2007). *16th Livestock Census-2007 All India Report*. New Delhi: Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India.

Modi, S. K (2018, 27 February). *Budget speech 2018–19* . Government of Bihar. Retrieved from www.finance.bih.nic.in/Budget/Budget-Speech.pdf.

MoSPI (Various Issues). *State wise estimates of value of output from agriculture and allied activities*. New Delhi: Ministry of Statistics and Programme Implementation, Government of India.

Mundial, B. (2008). *World development report. Agriculture for Development*. Washington, DC: World Bank.

NABARD (2018). *NABARD Signs project agreement with green climate fund*. Retrieved from NABARD: https://www.nabard.org/PressReleases-article.aspx?id=25&cid=554&NID=36.

NFHS-4 (2005). *National family health survey 2005–06* . International Institute for Population Sciences (IIPS).

NFHS-4 (2017). *National family health survey 2015–16* . International Institute for Population Sciences (IIPS).

Odisha, D. E. S. (Various Issues). *Odisha agriculture statistics*. Bhubaneswar: Directorate of Economics and Statistics of Odisha.

Radhakrishna, R., & Ravi, C. (2004). Malnutrition in India: Trends and determinants. *Economic and Political Weekly*, 671–676.

Ramji, S. (2009). Impact of infant and young child feeding and caring practices on nutritional status and health. *Indian Journal of Medical Research, 130*(5), 624–626.

Randhawa, M. (1977). *Green revolution in Punjab. Agricultural History, 51*(4), 656–661. Retrieved from http://www.jstor.org/stable/3741754.

Shah, T., Gulati, A., Shreedhar, G., & Jain, R. C. (2009). Secret of Gujarat's agrarian miracle after 2000. *Economic and Political Weekly*, 45–55.

Singh (2018, June 6). *Bihar becomes first state to launch its own insurance scheme for farmers*. Retrieved from https://www.indiatoday.in/india/story/bihar-becomes-first-state-to-launch-its-own-insurance-scheme-for-farmers-1251597-2018-06-06.

Singh, K. (2012). Electricity subsidy in Punjab agriculture: Extent and impact. *Indian Journal of Agricultural Economics*, *67*(902-2016-66726).

Singh, S., Kaur, M., & Kingra, H. S. (2009). Inadequacies of institutional agricultural credit system in Punjab State. *Agricultural Economics Research Review, 22*(347-2016-16855), 309–318.

Subbarao, D. (2012). *Agricultural credit—Accomplishments and challenges* . Speech delivered at the thirty years anniversary celebration of NABARD at Mumbai on July, 12.

Tripathi, A., Mishra, A. K., & Verma, G. (2016). Impact of preservation of subsoil water act on groundwater depletion: The case of Punjab, India. *Environmental Management, 58*(1), 48–59.

UNCTAD (2004). *Financing commodity based trade and development: Innovative agriculture financing mechanisms* . Report prepared by the UNCTAD secretariat for the Expert Meeting on Financing Commodity-Based Trade and Development: Innovative Financing Mechanisms.

UNICEF. (1990). *Strategy for improved nutrition of children and women in developing countries*. A UNICEF Policy Review. New York: UNICEF.

Verka (2013-14). *Verka annual report*. The Punjab State Cooperative Milk Producers' Federation Ltd.

Verma, S., Gulati, A., & Hussain, S. (2017). *Doubling agricultural growth in Uttar Pradesh: sources and drivers of agricultural growth and policy lessons (No. 335)*. Working paper No. 335. New Delhi: Indian Council for Research on International Economic Relations.

Wooldridge, J. M. (2009). *Introductory econometrics: A modern approach.* South Western CENGAGE Learning. IWMI Water Policy Research Highlight.