Chapter 2

Evaluating Agricultural Value Chains on CISS-F Framework

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2.1 Technology, Institutions and Markets Driving Value Chains

Technology, institutions and markets together drive agricultural value chains in becoming more competitive, inclusive, sustainable and scalable, and in improving access to finance (Fig. 2.1). Technology has been instrumental in streamlining value chains, improving efficiency, and enabling farmers' participation. Institutions that focused on aggregating marginal and small farmers, empowering them with better bargaining power, inducing economies of scale and creating market linkages have been pivotal in the successful transformation of agricultural value chains. Dairy co-operatives, co-operative unions in the case of grapes and the integrator model in poultry, are some examples. Institutions have been effective in bringing in the right agricultural practices as observed in the case of pomegranate, banana, and mango. Institutions have a critical role in enhancing governance and accountability and addressing equity concerns in high-value agriculture.

Commodities like tomato, onion, potato and pulses, despite high volumes and value but marketed largely through traditional market channels, are more susceptible to price volatility compared to grains. Time and again, farmers have suffered from crashing prices but have not gained as much from price escalation in the wholesale or retail markets. Much of this can be explained by limited marketing opportunities for farmers and the inability to undertake marketing risks. The role of technology, institutions and markets and their critical interplay have been analyzed in greater detail in assessing the value chains in the CISS-F framework.

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Fig. 2.1 Technology, institutions and markets strengthening CISS-F of value chains. *Source* Authors' illustration

2.1.1 Technology

Technological breakthroughs have played an important role in strengthening value chains in the dairy, poultry, and horticulture (primarily potatoes, grapes and bananas) sub-sectors.

In the dairy sector, the issue of low productivity of Indian bovines (milk yield of less than 1 kg/day) was addressed by importing high-genetic merit bulls and, production and import of high-quality semen. The large-scale adoption of artificial insemination (AI) was effective in improving bovine productivity. Innovations in the protocol to select indigenous bulls of higher genetic merit based on pedigree or progeny testing were effective in boosting productivity. Cross breeding technology resulted in average productivity increasing from less than one kilogram per animal per day in the pre-Operation Flood (OF) era (prior to 1970) to 4.5 kg per (in-milk) animal per day. The increased availability of milk resulted in competitive prices and the import of skimmed milk powder (SMP) was no longer necessary to meet domestic demand. Before Operation Flood (OF) III (1985–1996) was completed, India depended on imported SMP to meet domestic milk demand. Milk production increased from 84.4 million tonnes in 2001–02 to 187.7 million tonnes in 2018–19, with the highest productivity gains coming from crossbred cows. This resulted in India becoming competitive in SMP exports in certain years.

Other technology interventions that helped the development of the dairy sector in India included technology to make milk powder from buffalo or mixed (cow and buffalo) milk that ensured that surplus milk in flush season was bought from farmers. This was instrumental in ensuring that farmers did not lose out on income and India could leverage increased export opportunities. Technology related to the fabrication of insulated (non-refrigerated) rail containers for transporting milk and milk dispensing machines (used by Mother Dairy) strengthened milk marketing. Interestingly, the availability of the lactometer had a positive impact on inclusiveness. A simple technology that could determine the quality of milk enabled the smallest milk

farmer to participate in the value chain. The awareness that milk adulteration could be detected, and payments for milk were made on easily verifiable quality and quantity, prevented farmers from indulging in malpractices. This laid the foundation of trust in the co-operative milk marketing system in India.

In the poultry sector, backyard poultry did not support the rapid expansion of production through productivity breakthroughs or large-scale market integration. To overcome the productivity challenge, large-scale organized players demanded liberalization of import of improved genetic material. Until 2001, the import of grandparent stock was controlled by permits and governed by a duty structure. A bold decision to allow duty-free import of grandparent stock (like Bowans, Hyline, Lohman LSL, among others) from the USA and other countries enabled the development of crossbred varieties like BV-300. The egg productivity for improved fowls increased from 237.5 per bird per year in 2000-01 to 297 per bird per year in 2017-18.

In the case of poultry meat, technology breakthrough with improved varieties like Cobb, Hubbard, Lohman, among others enabled India to achieve high-conversion ratios and reduced the period needed for chicken to gain the required weight (33–45 days). The technologies suited the integrator model involving a large number of small farmers. The integrators took the responsibility for running and maintaining hatcheries to ensure genetic purity and control over disease outbreak. The development of modern hatcheries in the private sector, modernization of feed mills, development of protocols for the management of small size (3000–5000 birds) farms, standard operating procedures (SOP) for containment of disease and skill development at the farm level also contributed to the growth of the poultry sector in India.

In potato, the introduction of the early season variety *Kufri Pukhraj* and mid-season varieties by scientists at CPRI-Shimla enabled a productivity breakthrough and reduced crop duration. In tomato, a production breakthrough was achieved largely through hybrids developed by the private sector and better crop management. In the case of both potato and tomato, large private processors brought in technologies and best practices for pre- and post-harvest operations. In the case of onion, crop management technology, raised bed planting, micro irrigation, and development of season specific varieties for the *kharif*, late *kharif*, and *rabi* seasons, made a lot of difference in productivity. Dehydration and storage technologies in onion further boosted value addition.

Grape cultivation was transformed by the introduction of the Thomson seedless cultivar of the USA origin. It helped improve both the quality and volume of production to enable India to export table grapes and attain productivity levels comparable globally. In pomegranates, productivity and crop loss issues were overcome by adopting tissue culture of sturdy varieties that could withstand water stress for long spells. These varieties were developed by a private entrepreneur and distributed to farmers. Although aimed at export clusters, the introduction of good agricultural practices (GAP) and traceability criteria such as grape-net and mango-net by Agricultural and Processed Food Products Development Authority (APEDA) brought about positive changes in these value chains. Innovations in packaging also had a positive impact on the marketability of grapes.

Productivity gains in bananas was achieved through the introduction of Grand Nain, a cultivar of the Cavendish variety imported by Jain Irrigation System Limited

(JISL) in 1994 and ready for adoption in the late 1990s-early 2000. Tissue culture technology was extensively used to produce disease free planting material in large quantities across the country. Grand Nain's potential was 200–240 fruits of standard size that is about 32 kg from one plant in about 250 days and yields up to 85 tons per hectare. Such high-productivity levels enabled farmers to earn much higher returns per unit of land. Ripening technologies in the banana sector has improved the quality of the fruit by slowing down the ripening process. Mango has been a traditional orchard crop in India. There was no major breakthrough in yields through the adoption of genetic technology in the case of mango. However, efficient management of orchards through ultra-density planting—a technology perfected by Israel—together with pruning of trees and access to micro irrigation improved productivity significantly.

Unlike in the case of wheat and rice (during the Green Revolution period), there was no varietal breakthrough in pulses, resulting in volatility in domestic production and increasing dependence on imports (with the exception of the year 2016–17). Efforts to enhance productivity of pulses date back to the National Pulses Development Scheme in the 7th five-year plan (1985–1990). Since then, pulses have been part of national technology missions, integrated schemes, National Food Security Mission (NFSM), *Rashtriya Krishi Vikas Yojana* (RKVY), accelerated pulses development program, etc. However, the impact of these program has not been studied adequately to enable an assessment of their role in increasing productivity. Increased production of pulses together with cheap imports resulted in poor price realization by farmers, making production unviable. This is an example of how the concern in agriculture has moved from boosting production to creating and strengthening market linkages for farmers to sell their produce at remunerative prices.

2.1.2 Institutions

Institutions led by government, private sector, and farmers have had their impact on the progress of Indian agriculture. It is interesting to note that each of these institutions have co-existed together with varying degrees of importance, specific to the value chains. Efforts have been made to revitalize institutions to realize higher economic gains as well as farmers' welfare. Institutions have enabled technology adoption and creation of market linkages as observed in the value chains studied here.

The success of Indian dairying is ascribed to co-operatives and, within that the success of the Gujarat Co-operative Milk Marketing Federation Limited (GCMMF) or Amul stands out as exemplary. The co-operative revolution in Indian dairy and the rise of Amul was rooted in the desire to put an end to the non-inclusive monopoly of Polson and tapping the big Bombay market. Support from leaders like Sardar Vallabhbhai Patel and Lal Bahadur Shastri, persistent ground work by local leaders like Tribhuvandas Patel and the innovative genius and technological prowess of Dr. Verghese Kurien shaped the dairy co-operatives. Transparency, trust and technology were the three pillars of the dairy co-operatives in India. The co-operatives were

structured on democratic principles; farmers had their rightful share in the value created and consumers received value for money in terms of safe pasteurized milk. The co-operatives also played an instrumental role in rendering the dairy value chain inclusive by linking the smallest milk farmer to the market. Milk farmers in co-operatives receive (75–80)% of the consumer price, which is the highest among other high value chains. However, the success of Amul could not be replicated by other dairy co-operatives and their role in leveraging technology, creating market access for farmers, and generating value addition in dairy has been limited. Designing farmer-owned institutions need careful thought, committed leadership and sustained nurturing, which for several reasons were missing in co-operatives in other states.

The case of poultry is an equally fascinating story of how private sector-led institutional architecture scripted a resounding success story. An integrator-led farmer participatory model allowed farmers to rear (3000–10,000) poultry birds on a contract basis. The integrators developed an unambiguous farmer-friendly contract that included conditional buyback arrangements. The integrator provided high-genetic merit day-old chicks, arranged for vaccines, trained farmers in administering vaccinations, provided feed and bought back the birds and, in some cases, eggs at pre-agreed prices. The farmer was paid for managing the birds subject to a limit on mortality and an agreed weight with premium on better management. Effectively, market and price risks were undertaken by the integrator. The production risks were substantially reduced by technology and veterinary support. The contract farming model worked well without the cumbersome legal arrangements envisaged in the erstwhile contract farming law. The National Egg Coordination Committee (NECC), set up in 1982, provided a major price incentive by setting prices through voluntary compliance which it claims to have structured in such a way that farmers received about 75% of the consumer price. The call '*my egg, my price, my life*' resonated well with farmers.

In the grape sector, Mahagrapes, a union of 16 grape growers' co-operative societies in Maharashtra, played a significant role in creating market linkages, ensuring farmers' participation in price discovery and gradually expanding exports. Mahagrapes was the first entity to venture into grape export. Subsequently, the private sector, with the help of APEDA and easy access to financing took over the export market and most recently, Sahyadri—a farmer produces organization based in Nashik has emerged as the leading exporter of grapes. The Maharashtra Grape Growers Association (*Maharashtra Rajya Drakasha Bagayatdar Sangh—MRDBS*) ensures that farmers have access to technology related to production and provide the required support to make the chains competitive and inclusive. This is a case where farmer led association created synergies with marketing organization and successfully delivered the benefits to the farmers. Set in the same geographical region in Maharashtra, unlike in the case of grapes, there has been no major institutional development in the case of pomegranates. In case of bananas, Mahabananas—a federation of 26 banana growers' co-operatives in Maharashtra comprising 8000 farmers—was set up on the same lines as Mahagrapes. However, it did not succeed in bringing about any significant transformation in the sector.

In case of tomato, onion and potato (TOP), any significant transformative role of institutions is yet to be observed. Production, value addition and marketing of TOP are undertaken largely in the traditional way. Although, Operation Greens launched in 2018 for TOP aimed at achieving price stabilization, and building efficient value chains to enhance farmers' share in consumer rupee. Similarly, for pulses, the value chain is managed and operated in a traditional manner and there have been no major institutional changes.

Dairy, poultry and grapes succeeded mainly on account of existence of one of the most important elements in a value chain, i.e., 'trust.' While the brands earned consumer trust, transparency in operations and processes helped earn farmers' trust and the models successfully integrated small farmer producers in the value chain. The Anand pattern of milk marketing did not succeed in large parts of eastern India. Issues related to lower animal productivity and very low access to veterinary services as well as political and administrative meddling prevented the co-operative model from being successful in the eastern region. The success of institutions in the grape sector has been limited to three districts in Maharashtra –Nashik, Sangli and Solapur. However, these models demonstrate the role of institutions in enabling successful adoption of technology, creating market linkages and delivering gains to marginal and small farmers.

2.1.3 Markets

Economic growth and population increase have led to an increase in the demand for food, particularly, milk, eggs, fruits, vegetables and pulses. The growth in the production of the commodities studied here has been largely in response to increasing market opportunities supported by technology and institutions. While increasing minimum support price (MSP) led to an increase in the production of pulses, failure of markets left large number of farmers unable to sell their products at remunerative prices. Markets played an important role in the success of dairy co-operatives. It was due to the Bombay market that Amul could expand its operations and share the profits with farmers. However, there have been times when co-operatives have delivered remunerative prices to the farmers, irrespective of market conditions. Inclusive market access also ensured that the growth of the dairy sector had a positive impact on the lives of the smallest milk farmers. In the poultry sector, markets helped farmers earn higher prices through integrators. In the case of grapes, tapping the export market by Mahagrapes was critical in making grape cultivation a profitable venture for farmers in a very inclusive manner. Similar market linkages are missing in mango, banana and pomegranate. These value chains reflect the significance of institutions in creating inclusive market access.

Weak market linkages in tomato, onion and potato explain the extreme price fluctuations that impact both farmers and consumers. While there are large markets for these commodities, there are not many examples of innovative marketing models that have enhanced market access for marginal and small farmers or have been

sustainable and scalable across geographies. The success of contract farming in potato and tomato has been very limited and has had a negligible impact on stabilizing prices. Onion being a notified commodity and politically sensitive is largely traded through regulated markets. Processing levels are quite low in these perishable commodities and for the value chains to be viable, the price points for fresh raw material are critical. Hence, any escalation in prices has a negative impact on processing capacities.

Agricultural markets have been admittedly imperfect, influenced by frequent central and state government interventions, most of them with an unambiguous consumer bias. Minimum export price (MEP) and export bans (as in the case of onions), and imposition of ad hoc ban on stocking and enforcing stocking limits (as observed in the case of onions and pulses) have been used quite frequently to ease price inflation. In addition, there are indirect controls like movement restrictions within and outside the state implemented under the ambit of various control orders promulgated under the Essential Commodities Act (ECA). Marketing through APMC markets attract dual levy of market fees when commodities move from one state to another. Traditional market chains no longer serve the farmers the way it was envisaged. Farmers have little opportunity to sell their produce outside regulated APMC *mandis*. Traders and middlemen operating in these *mandis* through licenses are found to have a stronghold and operate like cartels influencing price discovery in the market. Over time, the monopoly power of the APMCs has had a negative impact on market efficiency as well as on protecting the interests of the farmers. Often dairy co-operatives have to seek state government's approvals to fix the sale price of milk, which often is not based on market demand, but political pressure. The only exception is the GCMMF (Amul), which has a larger consumer base outside Gujarat, unlike other co-operatives, which operate within the state. With respect to international trade, it is observed that even where export competitiveness is established, exports have actually not taken place. This is on account of a policy environment that sacrifices export potential to protect the interests of domestic consumers. OECD-ICRIER (2018) estimated the Producer Support Estimates (combined effect of input subsidies and output pricing) for the period 2000 to 2016 at -14%. This implies an implicit taxation of agriculture and a pro-consumer bias driven by distortions in trade and marketing policies.

Agricultural marketing reforms have been directed towards improving efficiency of markets and delivering higher gains to the farmers, but implementation has been inadequate. The Farm Laws 2020¹ have the potential to strengthen agricultural value chains and render these chains profitable for the farmers by ensuring direct marketing linkages, contract farming, rationalization of marketing costs, incentivizing storage, and aggregation of farmers through farmer producer organizations (FPOs).

For strengthening CISS-F of agricultural value chains, it is important for technology, institutions and markets to work in tandem. It is difficult to segregate the

¹The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020. Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020. Essential Commodities (Amendment) Act, 2020.

impact of these factors on the value chain. As the value chain matures, the relative importance of these factors changes, but each continues to be relevant for the development of the value chains. For instance, in the absence of the institution of co-operatives or FPOs, it is difficult to assess if the dairy and grape sectors could have leveraged technology for inclusive market access. Without the Bombay market for milk and export market for grapes, institution and technology could not have been as effective.

2.2 Competitiveness of Value Chains

2.2.1 Domestic Competitiveness

Table 2.1 illustrates the farmer's share in consumer rupee for different value chains. Farmers' price realization in horticulture value chains is lower than that in the dairy value chain. Milk, despite being more perishable than horticulture products, has been more profitable for farmers. The levels of processing and value addition are much higher in dairying than in horticulture, extending shelf life and economic returns. Assured procurement and market linkage through both co-operatives and the private sector have contributed to the competitiveness of the dairy sector. Traditional value

Table 2.1 Domestic competitiveness of value chains

S. No.	Commodities	Domestic Chain	Farmer's share in consumer price (%)
1	Tomato	Producing Regions to Delhi	32.4
2	Onion	Producing Regions to Delhi	29.1
3	Potato	Producing Regions to Delhi	26.6
		Nalanda to Patna	(40–42)
4	Grape	Nashik to Delhi	43
5	Pomegranate	Nashik to Delhi	45
6	Banana	Jalgaon to Delhi	35.5
7	Mango	Malihabad to Delhi	21
8	Dairy–Milk	Co-operatives (All India average)	75
		Bihar Co-operative—Sudha	76
		Pune Private Dairy	70
9	Poultry	Eggs	75
10	Pulses—Pigeon Pea/ <i>Tur</i>	Maharashtra to major cities	(49–66)
11	Pulses—Gram/ <i>Chana</i>	Madhya Pradesh to major cities	(46–67)

Source Value chain studies

chains of fruits and vegetables are too fragmented and suffer from a long chain of intermediation that reduces the farmers' share in the consumer rupee. However, contract farming in potato or public sector led marketing chains like Mother Dairy have delivered much higher prices (63.5%) to farmers compared to regular value chains. Farmer producer companies (FPCs) and/or targeted markets like exports have also been successful in delivering higher returns to farmers.

With a massive glut of pulses in India for the last few years, prices have crashed at all levels. In several markets, wholesale market prices have dived below the minimum support price, leaving farmers in a situation where they are unable to cover the costs of cultivation. Farmers have a very limited window of participation in the pulses value chain (limited to the arrival season after harvesting), unlike other stakeholders (millers and traders) who trade in the commodity throughout the year. On an average, the wholesale price of pigeon pea/*tur* has been about (49–66)% of the retail price in the selected cities for the years 2014–2018. In the case of gram/*chana*, wholesale price was about (46–67)% of the retail price in the selected cities. With markets failing to clear the supply of pigeon pea/*tur* and gram/*chana*, government intervened through public procurement to help farmers, which had limited impact. Domestic competitiveness of value chains is not only restricted to increasing the share of farmers' income in the consumer price but also ensuring that the prices received by the farmers render farming a profitable venture.

2.2.2 Global Competitiveness

Figure 2.2 summarizes the trade adjusted nominal protection coefficients (NPCs). Except pomegranate, mango and milk (Gujarat co-operative), all other commodities have average value of NPC less than 1. The analysis suggests that tomato, onion and potato are export competitive. However, frequent distortions in Indian trade

Fig. 2.2 Trade adjusted average nominal protection coefficients (NPC)-2002–03 to 2017–18. *Note* For pulses, average NPC value is NPC values of gram (kabuli chana) between 2004–05 and 2013–14
Source Value chain studies

policies lead to substantial fluctuations in actual exports. India accounts for 3% of global tomato exports, occupying the 8th position in the world. However, it is a net importer of processed tomatoes. Despite being export competitive in fresh tomatoes, India is not a major player in processed tomatoes owing to high-input costs. China is the global leader in tomato paste exports, attracting Indian ketchup manufacturers, who find it cheaper to import Chinese tomato paste than to procure from India. Infrastructure constraints, the time of supply to export markets and quality differences, have affected efforts to increase exports. Policy uncertainties vis-à-vis our largest market, viz., Pakistan has compounded the problem. Variability in the export of onions has been moderate. Onion is included in the Essential Commodities Act (ECA), and its export is governed by a minimum export price (MEP) fixed by the government from time-to-time. These discretionary steps have often made it difficult to create a reliable and consistent export market for onions, lowering price realization by farmers. There has been high variability in the export of potatoes, which are competitive and the competitiveness has increased after 2014–15.

After 2011–12, exports of grapes became competitive and this is reflected in the growth of exports. According to primary research, farmers get 71% of f.o.b price. In the case of pomegranates, export became competitive after 2013–14. Farmers get nearly 80% of the f.o.b price in case of exports, which is much higher than that received in the domestic value chain. Competitiveness was created by planting high-yielding planting material, undertaking disease control measures, incorporating market requirements in the production cycle, and including small growers in all these processes.

Since 2006–07, the export competitiveness of bananas has been increasing as NPC values have been declining. Indian farmers are selling bananas at a much cheaper rate and there is a dearth of trade policies that support banana farmers. It means even though bananas are export competitive in the international market, Indian farmers are unable to benefit due to weak market access. Lack of pre-harvest techniques results in poor quality of bananas not suitable for exports and improper handling during post-harvest results in wastage to the tune of (20–24)% (NRCB 2015). Mangoes have been export competitive between 2002–03 and 2017–18. However, India's mango export is based on the brand value of varieties like Alphonso, Kesar and Totapuri. Therefore, price comparison with other competing varieties may not give the right picture. This is evident from continuing exports of mangoes in spite of NPC being above one.

The export competitiveness of the dairy sector varies across states, co-operatives and private sector players, as well as liquid milk and processed products. This reflects that competitiveness has been attained at the cost of inclusiveness. The private sector in Uttar Pradesh (mostly unorganized) and Maharashtra has been competitive for a greater number of years (15 out of 17 years) compared to co-operatives in Maharashtra (9 out of 17); Gujarat (5 out of 17); and Uttar Pradesh (11 out of 17). The highly volatile global prices of SMP and the commitment of co-operatives to pay higher prices to farmers make the model uncompetitive. Co-operatives could explore exporting processed dairy products to open up marketing opportunities. Unless global prices are really high, as was the case in 2012–13, co-operatives cannot compete in

global markets. Unlike the private sector, co-operatives are not in a position to adjust procurement according to market demand, which leaves them with stocks that cannot be sold off at competitive rates due to the highly volatile global price scenario.

Currently, India accounts for less than 0.4% of the global trade in poultry and poultry products. India has proven to be competitive in egg exports (comprising of hen eggs in shell, eggs dried and eggs-liquid). Japan and Gulf have been the major export destinations. Eggs have been export competitive since 2003, but have lost the competitive edge since 2014. India is yet to find a place in chicken meat exports due to rising production costs, which have doubled since the Avian Influenza (AI) struck the country in 2006. Poultry meat has been competitive from 2003–04, but was able to find a place in the global market only after 2010.

India has been consistently importing pulses, primarily yellow peas and chickpeas, which together account for 44% of pulses import (TE 2017–18). Import of pigeon pea/*tur* shot up in 2013–14, when domestic production fell. India is dependent on very few countries for pulses import—53% of yellow peas are imported from Canada and 81% chickpeas from Australia, which makes it vulnerable to production and price fluctuations in these countries. Nearly, 53% of the pigeon pea/*tur* is imported from the African countries and the rest from Myanmar. In terms of trade competitiveness, Saini and Gulati 2017 estimate that India's *kabuli chana* has been a net exportable commodity since 2006–07, except for the years 2004–05 and 2005–06. Since 2005–06, nominal protection coefficients (NPCs) have been consistently below 1, except in 2012–13 when NPC was 0.96 due to rising domestic prices following a bad crop in 2011–12. India has been consistently dependent on imports to meet the domestic consumption of pulses and hence incentivised imports by (0–10)% import duty (basic custom duty), although there exists bound duty rate of 100%. With a glut in pigeon pea and gram/*chana*, the government raised tariff levels and brought about quantitative restrictions on the import of these pulses in 2017 onwards.

2.3 Inclusiveness of Value Chains

Nearly 70% of farmers growing fruits and vegetables are small and marginal (operating on less than 2 hectares) (Fig. 2.3). Small farmers have a comparative advantage in the production of horticulture commodities, which are highly labor intensive and short duration crops. Most of the trade takes place at APMC markets, which are accessible to all farmers, but has a monopolist nature and is dominated by a few large traders and commission agents. Although farmers are inclusive by way of participation, they have no role in price determination due to their low-bargaining power. Contract farming models such as those of McCain and PepsiCo for potato and Jain Irrigation for onion have benefitted participating small and marginal farmers. The number of farmers engaged in such contract farming differs from company to company. PepsiCo has been working with around 12,000 farmers, spread over 6400 hectares across Punjab, Uttar Pradesh, Karnataka, Bihar, West Bengal, Gujarat and Maharashtra (Bayer CropScience 2010). Nearly 700 farmers were engaged in contract farming by McCain, covering an area of 7000 acres in Mehsana, Gujarat

Fig. 2.3 Share of small and marginal farmers in production process of selected commodities. *Source* Agricultural Census 2015–16

(Field Visit, 2017). For onions, Jain Irrigation Systems Limited has been working with 5000 farmers from Aurangabad and Jalgaon in Maharashtra and the nearby districts of Madhya Pradesh.

However, there has been an increasing preference for large farmers due to the ease of backward linkage and control over the quality and quantity of produce required for niche markets and uses. Onion production is largely concentrated in the Nashik region of Maharashtra, and the two principal markets of Pimpalgaon & Lasalgaon are located in that region. Large farmers have some influence on onion prices, which are subject to recurring policy restrictions, and movement and storage restrictions. The low-cost onion storages at the farm level promoted by NHRDF have enabled farmers to sell later during the year. In contrast, although there are large cold storage capacities for potatoes, marginal and small farmers are unable to access these through the warehouse receipt system. Cold store owners are the major price arbiters (often financiers) in the value chain and farmers have no direct access to such infrastructure. However, pockets where large companies like PepsiCo and McCain have entered into contract farming agreements, farmers are protected from price risks, besides getting quality inputs and technical support.

Both grapes and pomegranates are grown largely by small and marginal farmers. Traceability through Grapenet and Anarnet has enabled greater participation of farmers. However, the inclusiveness of the grapes value chain in terms of export opportunities is much stronger than pomegranate, owing to the role played by Maha-grapes. Pomegranate is a resilient crop, which is able to withstand 3–4 weeks of dry spell, poor quality coarse soil, and is intercropped. This crop was introduced under the Employment Guarantee Scheme (EGS) of Maharashtra that enabled the participation of small and marginal farmers. Pomegranates are sold through auction in *mandis* and there is a private *mandi*-perfect market, dealing exclusively in pomegranates located in Nashik. In the case of grapes, about 50% of cold storages are owned by farmers, farmers' groups and proprietary concerns, with high inclusivity.

Mango, a less water intensive crop that is widely intercropped, provides seasonal income to farmers. Mango is cultivated both as orchards and homestead gardens, but the bulk of production comes from the latter. Out of 2.1 million banana growers, nearly 87% are marginal and small. Small farmers have a comparative advantage in growing fruits as these are labor intensive, short duration crops and the returns are much higher than in the case of cereals. However, farmers' participation in the value chain is limited to the farm gate which deprives them of playing an active role in price determination.

In dairying, co-operatives have been the most inclusive. All farmers who are members of co-operatives have ownership rights, participate in decision-making, have access to markets, are eligible for a share in profits based on the milk they supply, and have a vote in co-operative elections. With about 18% of the co-operative members being women, the model is gender inclusive as well. In the case of private domestic and multinational players, milk procurement is driven by market demand. Many of the players are into value added products rather than in liquid milk, and their linkage with dairy farmers is supposedly somewhat limited.

The Indian poultry sector has attracted large and small farmers alike to improve their livelihoods. Backyard poultry which includes small growers comprise of 20% of the poultry operations. The non-governmental organization model of poultry farming provides opportunities to small backyard poultry growers to participate in the poultry value chain. The integrator model driven by economies of scale, and stringent food safety standards that are required for catering to fresh and processed export markets, have provided market linkages to poultry farmers.

Pulses are less water intensive, more climate resilient, and require less crop care. These factors make it easier for resource poor smallholders to cultivate the crop. About 18.1% of the area under pulses was irrigated in TE 2013–14 and about 4% and 35.1% of area under pigeon peas and gram, respectively. Participating in production is the first step of the value chain and as one goes up the pulses value chain, it is observed that it is not as inclusive and smallholders do not benefit from the way it is structured. At an aggregate level, (32–53)% of different types of pulses produced are marketed. In pulses, about 79% of *moong*, 63% *urad*; 50% of lentils (*masur*); and 44% of *tur* are marketed through local private traders, which restricts farmers' direct interface with the wholesale market and hence, their chances of higher price realization. General awareness about minimum support price (MSP) and procurement agency is as low as (5–18)% among farmers growing pulses.

2.4 Sustainability of Value Chains

Tomato, onion and potato (TOP) form an integral part of the staple food in India, and their increasing production levels are capable of meeting export demand as well. These crops are also environmentally sustainable as these are not water intensive. Tomato is amenable to intensive cultivation on small plots of protected or open land including homestead gardens. An improved *kharif* production technology (raised bed

with micro irrigation) doubled the productivity of onion. The uptake of micro irrigation for cultivation of tomato, onion and potato is possible under contract farming arrangements.

While these crops are environmentally sustainable, the financial sustainability of these chains is quite fragile. Extreme price volatility, high perishability and price sensitivity of these crops are some of the issues that affect farm incomes negatively. There have been recurrent periods when farmers have been saddled with production, but were unable to find markets, forcing them to dump the crops. This is commonly observed in the case of tomato and potato. Moreover, potato cold chains, where all price arbitrage opportunities are controlled by cold store owners, offer farmers barely any opportunity to realize the actual market price. Financial sustainability is not an issue specific to farmers, but affect other stages of the value chains. For instance, the onion dehydration industry (partly financed by government subsidy) in Mahuva has been facing a serious crisis with only 15–17 out of 110 units being operational and the others on the verge of closure (as in 2018).

Grapes and pomegranate cultivation are environmentally sustainable as these crops require 200 L (litres) and 180 L of water per kg of crop compared to 4000 L required for rice cultivation. Unlike grapes, pomegranates are more susceptible to pest attacks and diseases, which require the use of chemicals. Consequently, it adversely affects both environmental and financial sustainability (adverse effect on exportability) because of the presence of pesticide residue. Grapes cultivation is a profitable activity, but requires high investments and intense supervision. The rate of return on investment is high compared to many similar activities. There are large production risks as well. The accounting rate of return (ARR)² is threatened by the issue of non-payment by exporters. About (50–60)% of export value is paid in advance to farmers and the rest of the payment is uncertain. Improvement in varieties is likely to enhance ARR significantly. Pomegranate farmers get a high return on investment in the case of exports, while the variability in domestic market prices affects their profitability. The biggest threat to financial sustainability comes from water stress. The crop is unviable in water stressed years and the farmer often ends with a negative return.

Unlike the staple TOP vegetables, where price stability has been a major concern for both farmers and consumers, banana prices have been less volatile. The benefit cost ratio (BCR) comes out to be 1.6, meaning bananas have been a profitable crop.³ Banana is a water intensive crop and needs timely irrigation, almost 70–75 times annually. The annual water intake of banana is estimated to be 1800–2000 mm. This is greater than the 900–1300 mm water requirement of rice for 3–4 months. However, the adoption of drip and sprinkler irrigation systems reduces the water intensity of the crop. Field visits showed that almost the entire area under banana

²Accounting rate of return (ARR) is the rate of return calculated using present year revenues and recurring costs. This is in contrast to Internal rate of return (IRR) IRR which uses costs incurred and revenues earned over the lifetime of the project.

³For every rupee incurred on the production and marketing of bananas, banana farmers get a return of INR 1.6. BCR values of less than 1 will mean cultivation is not profitable.

cultivation in the Jalgaon region in Maharashtra is under drip irrigation. Drip and sprinklers supplied by Jain Irrigation Systems Limited (JISL) are most suitable for tissue cultured banana plants, reducing water intake by 45%, and increasing yield by up to 52%. Bananas are one of the safest fruits for consumption in terms of pesticide residue. However, according to Banana Link, since Cavendish is the single most traded variety in the world, it has become prone to pests, fungi and diseases.⁴ Due to this, large quantities of insecticides and pesticides have to be sprayed on the plants. High dosage of fertilizers and pesticides has a huge environmental impact affecting the soil, water, animals and humans. Banana fiber can be an excellent substitute for other water intensive natural fibers like cotton as these can be manufactured using banana pseudo stems which are usually discarded by farmers, and burnt.

Mango cultivation is a seasonal activity as India's peak mango season is April–June. Mango trees do not need water throughout the year. Being a seasonal fruit, it does not require irrigation immediately after the harvesting season. As farmers grow mango as part of an inter-cropping system, water requirement is much lower than other horticultural crops such as banana. Mango grows well in region when there is rainfall of 750–2500 mm during June–September. For zones receiving rainfall of less than 750 mm, orchards must be irrigated two to three times after they begin to fruit. In terms of financial sustainability, growers who maintain their orchards well and market produce themselves find mango cultivation highly feasible. Commercial cultivation of Kesar has fetched 2.25 as return on investment, making it a highly profitable.

The Environment and financial sustainability of dairy sector are impacted by the contribution of animals to greenhouse gas (GHG) emissions in the form of enteric fermentation (methane emissions), water footprint of animal population, cost of feed and fodder, and the overall financial condition of co-operatives and other players. Within agriculture, livestock accounts for 54.6% GHG emissions as enteric fermentation. Within livestock, buffaloes account for 40.2% of methane emission followed by indigenous cattle at 36.4%, crossbred cattle at 15.8%, and the rest at 7.6% (2016 data) (MoEFCC 2021). The ration balancing program under the National Dairy Plan launched in 2012 has demonstrated reduction of enteric methane emissions per kg of milk in dairy cows and buffaloes by 13.7% (NDDDB n.d.). Balanced rations have been effective in reducing the water footprint of milk by 14% (1236 to 1062 litre/kg). Scientific feeding practices and use of water efficient fodder in the form of Total Mixed Ration (TMR) can further reduce the water footprint of milk. Feeding accounts for (60–70)% of the cost of milk production and adequate availability of quality feed has been a challenge. Balanced rations have also helped farmers reduce the cost of feeding animals by 16.3%. The financial viability of dairy co-operatives is a matter of concern. Data from 175 dairy co-operatives suggest that about 58% co-operatives accumulated losses, primarily because of governance issues. If the co-operatives are unable to sustain themselves financially, and large milk producing regions are left uncovered, despite the preferential, concessional

⁴Banana Link is a not-for-profit co-operative based in Norwich, which works for fair and sustainable banana and pineapple trade.

finance, and subsidies provided to the sector, the growth of the sector across regions is unlikely to be equitable.

For poultry sector to be sustainable, availability of high quality and affordable feed is crucial. About 47% of maize consumption in India is on account of poultry feed. Both productivity and price of maize affect the industry. Studies show that poultry is the most environmentally efficient of all livestock (Sluis 2007). This could be used to great advantage in promoting the sector. The environmental sustainability of the poultry sector is challenged by frequent disease outbreak that affects small growers much more. With the wet market accounting for 90% of the domestic market, these pose real environmental risks. The outbreak of Avian Influenza (AI) caused major losses to farmers because of production losses and sudden fall in demand and price. AI resulted in a major blow to layer and broiler producers in Manipur in 2007. With (43–79)% of their total household income generated from poultry farming, producers lost about INR 316 lakh, and received only INR 99 lakh, about 31% of the financial loss (Kumar et al. 2008). While the Prevention and Control of Infectious Disease in Animals Act 2009 provides the basic legal framework to control such events, poor compliance in culling, disposal and quarantine remains a major issue and can threaten the financial sustainability of the poultry sector.

Pulses are environmentally more benign, less water intensive and more climate resilient as compared to many other crops. Hence, increasing the production of pulses in an environmentally sustainable manner is feasible. In 2017–18, inflation in pulses was at an unprecedented low of (–)26.7% compared to 34.6% in 2015–16 and 18.3% in 2016–17 which have a serious impact on the supply and demand situations. With wholesale market prices below the MSP, farmers have been unable to recover their costs of cultivation, which makes pulses cultivation financially unsustainable.

2.5 Scalability of Value Chains

Scalability of production of TOP is likely to come more from increase in yield levels rather than increase in area. Given the current yield levels, there is scope for increasing production with the aid of technology—high-yielding seeds, micro irrigation and soil management. Besides, enhancing processing levels and increasing shelf life of fresh produce can add to the scalability of these value chains. Export opportunities can also help scale up production.

Production of tomatoes increased from 7.2 million tonnes in 2000–01 to 20.7 million tonnes in 2016–17. Between 2010 and 2017, production increased at a CAGR of 1.3% despite a decrease in cultivated area by 2.7%, owing to a CAGR in yield of 4.1%. Similarly, onion production grew at 4.9% during the same period with the area under the crop increasing at 4% and yield growing at only 0.9%. Potato production increased at a rate of 2.4% with 2.2% coming from an expansion in area under the crop and 0.2% coming from yield. Scalability of the onion value chain can be achieved through increase in exports. Although onion accounts for 50% of exports of fruits and vegetables, onion exports as a percent of production declined from about

24% in 2005–06 to about 10%, in recent years. However, unless farmers have direct access to export markets, it is unlikely that farmers will be able to benefit from higher price realization as these markets are controlled by traders and commission agents. In the context of the potato value chain, one of the interesting developments is the emergence of Banaskantha, a water stressed district in Gujarat, as the largest potato producing district. Here, yields have improved substantially with the adoption of micro irrigation promoted by large potato processing companies like McCain and Balaji wafers.

Production of grapes went up from 1 million tonnes in 2000–01 to 2.9 million tonnes in 2017–18, registering a CAGR of 5%. About 75% of the area under grapes is in Maharashtra, followed by 20% in Karnataka. Grape farming in Maharashtra is concentrated in three districts (Nashik, Sangli, Solapur), mainly due to climatic factors. Production is scalable vertically (economies of scale) provided it is confined to areas suitable for grape farming. However, horizontal scalability (economies of scope) across different related products (raisins and arils) needs induction and nurturing. Given the competitiveness in production, scalability of exports is feasible with more emphasis on pressed and dried categories, and the introduction of high-yielding red grape varieties. Production of pomegranates improved since 2007–08, primarily due to increased exports, and increase in domestic prices. The availability of tissue cultured planting materials from sturdier varieties has contributed immensely to the growth in area and productivity. Cultivation of pomegranates expanded to Gujarat, Andhra Pradesh, and Rajasthan. Scalability is possible in areas that are climatically suitable for the crop. However, vertical scalability is possible only if there is a serious effort to make investments in technology for processing and export of arils (pomegranate seeds).

India's banana production increased from 10.1 million tonnes in TE 1993–94 to 30.6 million tonnes in TE 2018–19. As bananas have proved to be a profitable crop, area under banana cultivation increased. Also, farmers have shown keen interest in newer technologies that yielded productivity increase. The introduction of tissue culture cultivars, especially Grand Nain variety, has demonstrated significant increase in yields. Other reasons that triggered this quantum jump in banana production were adoption of micro irrigation, precision farming, and high-density planting.

There has been not much change in the mango production pattern in key producing states. On the new varietal development front, there has not been a major breakthrough in the last decade or so. The last mango variety (Arunika) was developed by Central Institute for Subtropical Horticulture (CISH) in 2008. The old variety, Amrapali remains a favourite. Without varietal developmental, scalability of the mango value chain will remain limited. There is a need for development of long shelf life mango varieties without compromising on the taste or flavor. Due to its short shelf life, export opportunities for mango are limited. Lack of standardisation of production technology and extension of technical knowledge to farmers has been responsible for the slow pace of adoption of high-density planting (HDP) technology in mango plantations in the country. A reduction in the cost of HDP can improve scalability. There is hardly any advance estimates of production or sowing data available for mangoes, unlike those available for cereals, pulses, oilseeds, potato, and onion crops.

These factors result in lower price discovery, which impede the scaling up of mango production.

Birthal et al. (2006) estimated that 37% of the growth in milk production was on account of increase in productivity of in-milk animal. The average yield of indigenous cows are 2.8 kg per day while it is 7.5 kg per day for exotic/crossbred cows and 5.2 kg per day for buffaloes (for 2016–17). The strategy for increasing production primarily through an increase in bovine population is neither sustainable nor scalable. Increase in productivity on a continuous and sustainable basis is the only option, which can be achieved through genetic improvement with adequate emphasis on genomics, Artificial insemination (AI) and the use of sex sorted semen. Processing of milk, which is 21% of production (2017–18), is likely to increase given the rising demand for dairy products.

Despite there being favorable domestic and global demand conditions, issues related to inadequate infrastructure, inefficient marketing linkages, and price instability of poultry feed pose challenges to the scaling up of poultry farming. The Innovative Poultry Productivity Project (IPPP) launched in 2017 proposed to upgrade the subsistence model of backyard poultry farming (comprising of 45 chicks per beneficiary) to an entrepreneur model with up to 600 broilers in a year and 400 low-input technology (LIT) birds in about three years. The LIT birds model would help in the transition and subsequently, scaling up to (1000–2000) birds, towards larger commercial scale poultry farming (DAHD 2017). Scalability could be further achieved through the introduction of broilers in (about 200–500 birds) backyard poultry clusters, to cater to a large number of small markets. Development of indigenous varieties to capture the new niche market for free range chickens is another option. Environmental and food safety concerns will create large opportunities for processed meat, particularly white lean chicken meat. Animal welfare activism could also affect the current poultry farming and marketing models. This will require large investments in processing facilities and the development of a cold chain right up to the retailer.

There is scope for increasing production of pulses through increase in productivity in the leading producing states. Nearly 60% of *tur* is produced by Maharashtra, Madhya Pradesh and Karnataka. Gram is predominantly produced in Madhya Pradesh accounting for about 40% of total production. In order to scale up production, pigeon pea and gram can be promoted in states such as Andhra Pradesh and Gujarat, respectively that have lower production, but higher yield levels. Besides, diversifying to other types of pulses such as *urad*, *moong* and *masoor*, among others, can provide greater consumption choices. Scaling up pulses production is somewhat constrained by the import of cheaper pulses, which bring about immediate relief in the event of high inflation.

2.6 Access to Finance in the Value Chain

Various stakeholders such as farmers, traders, processors, exporters, and retailers access both formal and informal sources of finance. It includes government intervention in the form of particular schemes, subsidies, price support or interest subvention schemes. The usual financing patterns for processors, exporters and traders in the value chain in many ways determine the control of these stakeholders over the prices and risks involved.

Farmers with *kisan* credit cards (KCCs) are able to access formal credit, but are forced to approach informal money lenders, friends and relatives because of their inability to repay the loans. This has been observed in the case of potato farmers in Bihar and grape farmers in Maharashtra. The interest rates charged by informal credit agents are exorbitantly high—(2 to 5)% per month. Field visits confirm that about 80% of the TOP farmers depend on informal credit sources. In the comparatively developed region of Nashik, onion farmers have access to institutional finance and have been able to get KCC. A pledge loan scheme (at 6% interest per annum with an interest subsidy of 3%, if repayment is made within 180 days) of warehouse receipts is also implemented by Maharashtra State Agricultural Marketing Board (MSAMB) for all farmers growing different crops. The district co-operative bank is a major source of financing. In Mahuva, Gujarat, bank credit is not available to small farmers. Co-operative dairy farmers have better access to finance than those working with private players. In the poultry sector, the credit requirement of the farmers is very limited because of the integrator model, which takes care of all investment related activities in the chain. However, poultry farmers can avail the re-finance scheme offered by NABARD.

There are several government schemes that extend financial support towards development of commodity value chains. The Pradhan Mantri Kisan SAMPADA Yojana (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters) of Ministry of Food Processing Industries (MOFPI) provides a subsidy of 35% for setting up of onion cold chains and processing units and similar support is available for potato. There are subsidies from National Horticulture Board (NHB) and National Horticulture Mission (NHM) for setting up grape gardens. APEDA provides financial support for post-harvest management and export infrastructure. There is need to design a risk hedging instrument for farmers for export or market related risks. Investments are required in cold chains for pomegranates and in technology for processing of arils. Government schemes like Mission for Integrated Development of Horticulture (MIDH), which provide subsidies for ripening chambers and pack houses, and the SAMPADA Yojana, which provides loans for processing units and cold chains, are some of the financing sources for intermediaries. To promote banana exports, APEDA provides export promotion schemes. Subsidies under NHB and NHM are available to mango farmers. APEDA provides assistance for setting up pack-houses and vapor and hot water treatment facilities exclusively for exports. State governments have their own schemes to support farmers. The other major financiers are cold storage owners who see arbitrage opportunities in the market.

Despite provision of the warehouse receipt system (WRS), farmers have not availed it to the desirable extent.

Financing of dairy co-operatives has been possible with support from Government, NCDC, NDDDB, World Bank and NABARD. However, private dairy processing units have not been provided similar benefits though their share in processing is almost the same as the co-operative sector. Given the increasing demand for processing, financing options for the private sector need to be strengthened. Also, large number of retailers will need to invest in the consumer end of the cold chain for effective compliance with quality standards, and will require financing. In the pulses sector, milling, processing, and marketing of pulses is financed by stakeholders through bank loans and/or personal capital. Depending on the scale of business and relationship between millers, traders and commission agents, credit is available at market determined interest rates.

2.7 Conclusion

The above synthesis provides a snapshot of how the selected value chains have performed in terms of the CISS-F framework and the role of technology, institutions and markets in achieving key milestones. As Indian agriculture diversifies increasingly toward high-value commodities, value chains will have to be strengthened in terms of CISS-F. Efficient market linkages will be important not only to match demand and supply, but also ensure that quality standards are maintained throughout the chain. For India, the issue of inclusiveness remains central to value chain efficiency. Hence, making agriculture profitable for small and marginal farmers through higher realization of the value of output, and greater risk mitigation, without distorting markets, will require more pragmatic policy interventions.

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