Introduction

Kamel Louhichi, Laura Riesgo, and Sergio Gomez y Paloma

Abstract Food and nutrition security has become one of the most important items on today's international political agenda and a serious issue for governments around the world. Despite the availability of enough food globally, over a billion people continue to suffer from the lack of nutritious food. The prevalence of undernutrition and the increase in overweight and obesity continue to be major public health problems in many countries worldwide.

Food and nutrition security has become one of the most important items on today's international political agenda and a serious issue for governments around the world. Despite the availability of enough food globally, over a billion people continue to suffer from the lack of nutritious food. The prevalence of undernutrition and the increase in overweight and obesity continue to be major public health problems in many countries worldwide. Approximately 820 million people in the world still suffer from hunger, being the situation most alarming in Africa, where since 2015 the prevalence of undernourished people shows slight but steady increases in almost all sub-regions (FAO 2019); at the same time, approximately 2.4 billion people suffer from overweight (FAO 2019). In general, while very often hungry people live in developing countries and in poor economies, the majority of overweight and obese people live in developed countries and in rich economies. However, exceptions are more common than might be imagined, since hungry people are frequently also found in rich economies, while it is increasingly frequent to find relatively poor economies where obese and overweight people represent a non-negligible proportion of the

K. Louhichi (✉) · L. Riesgo · S. Gomez y Paloma
European Commission, Joint Research Centre, Seville, Spain
e-mail: Kamel.elouhichi@inrae.fr

K. Louhichi
INRAE-UMR Economie Publique, Thiverval-Grignon, France

L. Riesgo
Pablo de Olavide University, Seville, Spain

population. In summary, both relatively rich and poor economies are increasingly affected by the double burden of malnutrition.¹

Although poverty and hunger have been considerably reduced in the last decade, major progress is yet to be made in rural areas of Sub-Saharan Africa (SSA) and South Asia, where a large proportion of the population is extremely poor (52% of the rural population in SSA and 27% of the rural population in South Asia) and undernourished. Approximately one person in four in SSA is currently estimated to be undernourished (FAO 2015).

Despite the decline in the prevalence of hunger in SSA by around 30% between 1990 and 2015, substantial differences persist across SSA sub-regions and individual countries. Progress has been particularly remarkable in West Africa, which successfully reduced the proportion of its people suffering from hunger by more than half. Continued efforts are needed in Middle Africa, where the percentage of undernourishment increased by around 10% compared to 1990. There is thus an urgent need to improve food and nutrition security in SSA, particularly in the Middle Africa sub-region.

Most of the poor in SSA (82% according to Beegle et al. 2016) still live in rural areas, earning the majority of their income through agriculture. Around 92% of rural households in SSA are to some extent involved in farming, and a median African rural household earns about three quarters of its income from agriculture (Davis et al. 2017).

Despite farmers in SAA being the most vulnerable and the most food insecure, they can be the engine for growth and poverty alleviation. Empirical evidence shows that agricultural growth in SSA can be 11 times as effective in reducing extreme poverty as growth in other sectors (FAO, WFP and IFAD 2012). According to the FAO (2015), only countries that have managed to secure agricultural productivity gains have succeeded in reducing undernourishment. Other studies also showed that agricultural growth is essential for poverty reduction and leads to consumption and production linkages in the overall economy, particularly in countries where rural poverty accounts for the largest share of total poverty (Ravallion and Datt 1996, 2002; Hazell and Haggblade 1990).

Recognising the potential role of agriculture in SSA in spurring growth, overcoming poverty and enhancing food security, the question is whether smallholdings are still the key units to focus on to make progress in this direction, and to what extent the promotion and extension of large commercial farms could be an alternative in achieving these objectives.

Estimates of the number of small farmers and how much they contribute to food production vary according to the definition of a small farm, which in turn is context-dependent. The size of the landholding is often cited, but the scale varies tremendously from one country to another. Lowder et al. (2016) suggest that in most agro-ecological zones and socio-economic conditions, farm holders operating less than

¹The double burden of malnutrition (DBM) is the coexistence of undernutrition along with overweight, obesity or diet-related non-communicable diseases (NCDs), within individuals, households and populations, and across the life course.

two hectares can be considered as small. Using the two-hectare threshold, their estimated number is approximately 475 million, i.e. 84% of the total (570 million) farms worldwide (FAO 2014). They confirm that smallholder farmers represent the backbone of the farming sector, especially in low-income countries, where their average farm size decreased over the period 1960–2010.

There is quite broad agreement that small farms represent a high fraction of the world's agricultural labour force, that they do contribute considerably to the total production of food, that they are particularly important in relative terms in low- and middle-income countries and that their absolute number and weight within a given economy/country tend to be negatively correlated with economic growth.

A large body of empirical research argues that smallholders are still key to global food security and nutrition. Although these farms account for only 12% of the world's farmland, they provide livelihoods for more than 2 billion people and produce about 80% of the food in SSA and Asia (FAO 2015). They also represent the majority of the workforce in large portions of the developing economies. In SSA, smallholders are by far the major economic agent in the farming sector. They provide up to 80% of the food, occupy around 60% of the land and make up a large portion of the overall economy. In 2007–2017, smallholders contributed up to 18–25% of the gross domestic product (GDP) of SSA (respectively World Bank 2017; AGRA 2016) and employed 40–65% of the labour force (AGRA 2016).

Moreover, smallholders are embedded in rural livelihoods. As such, enhancing their viability could serve to reduce rural poverty, improve food security and nutrition at different levels, and contribute to the achievement of multiple Sustainable Development Goals (SDGs). According to FAO, WFP and IFAD (2012), growth in smallholder agriculture may have significant effects on the livelihood of the poor, through increases in food availability and incomes. According to FAO (2016), contrary to prevailing thinking up to very recent times, smallholders should be seen as an opportunity for economic development and no longer as the main obstacle: 'more resilient agriculture sectors and intelligent investments into smallholder farmers can deliver transformative change and enhance the prospects and incomes of the world's poorest while buffering them against the impacts of climate change'.

Dr. Correia, from Évora University in Portugal, found, after analysing 800 small farms across 25 regions in the EU and 100 small farms across five regions in Africa, that small farms produce more food than statistics show. This underestimation comes probably from official statistics which not accounting for food that is used on the farm to feed family, friends or animals. Food grown on farms often meets between 25 and 40% of that farm's own requirements. She also said that if the true value of small farms was better understood, then they could access more governmental and financial support (cited in Gillman 2019).

However, others have argued that smallholder farmers increasingly face barriers that hinder their profitability and prevent them from producing sufficient quantities to fully meet market demand and/or generating enough income to keep their households out of poverty. They claim that the future of smallholder farmers, especially but not only in SSA, is even more challenging given their increasing vulnerability, particularly for those operating in rainfed agro-ecosystems. There are multiple drivers

of their vulnerability; beyond climate change, these include limited access to inputs, weak institutional support and, more generally, inadequate socio-economic, political and governance conditions, which do not favour their capacity to adapt and in the end reduce their (potential to increase) productivity (Sieber et al. 2015; Misselhorn 2005; Pretty et al. 2006). Due to these challenges, they are unable to compete with medium and large farms which perform better due to economies of scale, lower transaction costs and ease of access to agricultural inputs, markets and credit.

The debate as to whether large commercial farms are more efficient than smallholder farms is long-standing. It has been extremely animated during recent decades, plausibly due to its relevance for the economic development of the poorest economies and countries worldwide, including in SSA, following the success of the Green Revolution half a century ago, especially in Asia (see Chapter “[Importance of Smallholder Farms as a Relevant Strategy to Increase Food Security](#)” by Peter Hazell). It was first broached during the industrialisation of Western Europe, between the second half of the eighteenth century and the early twentieth century, when the question of what type of farmer could best support the emerging industries becomes highly significant. While some eminent opinions supported the idea of the solid role that small farming units could play in food production (Smith 1776), other equally prominent voices advocated the supremacy of the large farm over the traditional and small one (Marx 1976 [1867]; Barrett et al. 2010). Other views later emerged, especially at the time of the transformation of the farming sector in Russia during the first decades of the Soviet period, highlighting the advantages of small and subsistence-oriented farms compared to large state-owned farms, especially due to the higher resilience of the small farm—and its family labour force—in facing adverse economic conditions (Chayanov 1966). More recently, subsequent thinking and empirical evidence have further supported arguments in favour of the higher efficiency of traditional and small farming units compared to large ones, and more generally on the persistence of the inverse tendential relationship between farm size and factor productivity (see among others: Schultz 1964; Sen 1975; Kutcher and Scandizzo 1981; Binswanger et al. 1995; Jayne et al. 2003; Hazell 2011; Scandizzo and Savastano 2017).

Other economists have claimed that not all smallholders are the same, and assistance strategies need to differentiate between smallholders who should be ‘moving up’ into more productive systems and those who should be ‘moving out’ of farming. Smallholders should be encouraged to move up when commercialisation is feasible and when they have the means to improve links to global and urban markets. However, they should be encouraged to move out of agriculture where non-farm sectors are expanding, such as in urbanised economies, and they could increase their incomes by engaging in non-farm activities (Fan 2014). They have argued that even in the most successful cases, the Green Revolution did leave behind some of the smallest and poorest among the small farmers. These were the worst equipped in terms of resources, who could not catch up with the ongoing changes and invest in redirecting their production mix from the marginalised or ‘orphan’ crops (millet, sorghum, cassava, etc.; mostly those adapted to rainfed agriculture in water-scarce areas) to ones whose yield was growing due to technical change promoted by the Green Revolution (FAO 2000: 188–189; Mazoyer 2001). These ‘smallest among the smallest farmers’

explain part of the decline of the agricultural population—in relative terms—during the Green Revolution period in developing countries (especially between the 1930s and 1960s).

The future dynamics for small and subsistence-oriented farmers in the developing world, especially in SSA, may be similar to those undertaken by the same type of producers during the nineteenth and twentieth centuries in the vast majority of the now industrialised economies, i.e. like them, most will be pushed out of the sector and rural areas by the growth of manufacturing and services, and will concentrate in and around urban areas. This process started several decades ago in parts of the developing world; however, in some areas, mainly the poorest ones, it has only just started. Yet, there are now two additional issues that may make industrialisation of the poorest developing economies an imperative; these are their strong demographic growth and the highly negative effects of climate change on vast areas between the tropics. The above implies that support for small and subsistence-oriented farmers—to modernise, to redirect their surplus towards markets, to integrate into non-farming activities, etc.—will become even more crucial in the near future than it has been in the recent past (Collier 2009).

In the light of this debate on the potential role of smallholders in developing countries in food security and poverty reduction, the Joint Research Centre of the European Commission organised a workshop in September 2015 in Seville, Spain, gathering international experts to share experiences and discuss the role of smallholders in rural development strategies (Riesgo et al. 2016). This book builds on some of the main findings from that workshop, by providing an in-depth analysis of the current importance of smallholder farmers and by discussing the main challenges to be addressed for them to best contribute to food security and poverty reduction.

The key message is that enhancing smallholders' production capacities and their economic and social resilience may have a positive impact on food security and nutrition at various levels. However, not all smallholders are in the same situation and in a position to seize the opportunities offered by market. A clear distinction should be made between smallholders who should be 'moving up' into more productive systems and those who should be 'moving out' of farming (Fan 2014). The choice should depend on the type of constraints smallholders face. In addition to the role of small farmers as food suppliers, the analysis considers smallholders' role as consumers and their level of nutrition security. The link between agriculture and nutrition is analysed, to understand how agriculture affects human health and dietary patterns. Given the importance of smallholder farms, strategies to increase productivity in agriculture are essential to improve food and nutrition security, as is food diversity. Finally, synergies and trade-offs between economic, environmental and social objectives and outcomes are analysed through an overview of the methods and tools used to assess food security on small farms at household level. Models at country level are usually focused on long-term conditions, but short-term analyses would also be welcome. Developing global models to assess food security is also relevant, to include trade issues in the analysis. This overview of methods and tools for food security analysis is published in Riesgo et al. (2016), and, thus, not included in this book.

This book is divided into three parts. Part 1 analyses the role played by smallholders in reducing hunger and achieving food security, as well as the emergence of medium-sized farms as a new case which may change the vision of the traditional analysis based on small versus large farms. Part 2 focuses on various policy options allowing smallholders to overcome some of their limitations and improve their performance. Part 3 considers how agricultural growth contributes to food and nutrition security and how off-farm activities at household level may contribute to increasing food security.

Part 1. In the chapter ‘The Role of Smallholder Farms in a Changing World’, Shenggen Fan and Christopher Rue emphasise the importance of differentiating among smallholder farmers in policymaking, particularly between those with and without profit potential. The former should be supported to increase their farming business, while the latter may need support to move out of the sector and seek non-farming opportunities. The challenge in achieving multiple SDGs lies in revisiting policy measures that differentiate among the heterogeneity of smallholder farmers.

In the chapter ‘Importance of Smallholder Farms as a Relevant Strategy to Increase Food Security’, Peter Hazell recalls that the focus on development of small farmers results from their success during Asia’s Green Revolution. This was due to their efficiency compared to large farms, as well as because of their importance in economic and social terms: most of them are poor, so supporting them implies fighting poverty. Although large variations between countries are reported, in general the number of small farms is increasing, whereas their physical and economic sizes are decreasing. This chapter also highlights that a successful economic policy should consider the existing diversity of small farms, as well as their specific role in increasing diet quality and diversification.

In the chapter ‘Rural Development Strategies and Africa’s Small Farms’, Donald Larson, Rie Muraoka and Keijiro Otsuka develop and discuss arguments, and provide evidence, for the idea that African rural development strategies need to focus on small farms. The authors argue that, in the specific case of SSA, among the varieties of rationales behind the improvement of smallholder farm productivity, the strongest is that it enhances the use of (abundant) natural resources, which are available to smallholder farms to feed the growing population of the future, while contributing to the reduction of current rural poverty. However, given the high variety of agro-climatic, economic and market settings and potential technologies in SSA, boosting the African Green Revolution today is harder than it was for the Asian Green Revolution over than half a century ago.

Part 2. In the chapter ‘Inorganic Fertiliser Use Among Smallholder Farmers in Sub-Saharan Africa: Implications for Input Subsidy Policies’, Jacob Ricker-Gilbert reviews recent literature on access to and use of inorganic fertilisers promoted by input subsidy programmes. Evidence shows that, as a consequence of such programmes, the use of inorganic fertiliser in SSA has increased although the efficiency of fertiliser use remains low. The chapter discusses the main factors that explain why this occurs and also suggests some policy recommendations to make input subsidy programmes more cost-effective, sustainable and beneficial to smallholders.

In the chapter ‘Global Change and Investments in Smallholder Irrigation for Food and Nutrition Security in Sub-Saharan Africa’, Munir A. Hanjra and Timothy O. Williams present several case studies, showing that investments in irrigation may contribute to reducing poverty and enhancing food security among smallholder farmers in SSA. However, future needs may include the development of a broader framework for irrigation investments, including nutrition-sensitive approaches. Strategic priorities include investing in rural irrigation schemes for smallholders and integrating peri-urban and urban agriculture into food systems, as well as supporting measures such as the use of solar energy for irrigation development.

In the chapter ‘Smallholder Farmers’ Access to Inputs and Finance in Africa’, Augustine Langyintuo reviews the major challenges farmers face in accessing the main productive farm inputs (land, seeds and fertiliser) and finance. Land tenure insecurity, low use of improved agricultural technologies and dysfunctional input and output markets are key issues to be addressed as a primary step in helping to reduce poverty and increase wealth among smallholder farms in Africa. The lag between investment needs and expected revenues, the high transaction costs and the small size of farms are some of the reasons quoted by financial institutions to justify the low rate of commercial loans in the farming sector. The chapter also discusses alternative approaches that can be used to improve access by farmers to these resources.

In the chapter ‘Policies for Improved Food Security: The Roles of Land Tenure Policies and Land Markets’, Stein T. Holden provides an overview on farm size distributions, emphasising the expansion of medium-sized farms observed in many SSA countries. The emerging land markets, the role of tenure systems and land policies are also analysed as ways of distributing increasingly scarce land resources, with implications for livelihood opportunities for the large rural populations on the continent. While there is a need to absorb further population growth in rural areas, rural–urban migration is inevitable and careful tenure reforms would be needed to smooth the transition towards more intensive land use.

Part 3. In the chapter ‘Transforming Smallholder Agriculture to Achieve the SDGs’, Mathew Abraham and Prabhu Pingali discuss the main costs that smallholder farmers face regarding access to factor and production markets, credit and insurance. Policy interventions are crucial to address these issues, by reducing transaction costs and promoting commercialisation. Past efforts were focused on increasing productivity of staple grains and on improving nutrition at local level. At present, linking small farms to urban food value chains is seen as a promising opportunity for rural development. The chapter includes initiatives to improve smallholders’ welfare, such as crop-neutral policies as an alternative to crop-specific subsidies, gender-sensitive approaches, and support for farmers grouping to overcome scale disadvantages in access to markets.

In the chapter ‘Impact of Casual and Permanent Off-Farm Activities on Food Security: The Case of India’, Alwin D’Souza, Ashok K. Mishra and Tadashi Sonoda highlight the importance of off-farm income, both casual and permanent, in reducing poverty for rural households in India. The chapter analyses the dynamics when the household head, the spouse or both are involved in off-farm activities. Results show

that casual off-farm work by either the household head or spouse increased food security, whereas food security diminished if both had casual off-farm work.

In the chapter ‘The Superior Role of Agricultural Growth in Reducing Child Stunting: An Instrumental Variables Approach’, Sebastien Mary and Kelsey Shaw contribute to the open debate on how economic growth, and particularly agricultural growth, contributes to reducing child stunting. By analysing 86 developing countries over a time span of 20 years, this chapter estimates the impacts of agricultural and non-agricultural growth on child stunting. Results show that, although any economic growth contributes to reducing child undernutrition, agricultural growth is found to be more effective than non-agricultural growth. Finally, chapter provides concluding remarks.

References

- AGRA. (2016). *Africa agriculture status report 2016: Progress towards agriculture transformation in Sub-Saharan Africa*. Alliance for a Green Revolution in Africa (AGRA). <https://agra.org/aasr2016/public/assr.pdf>.
- Barrett, C. B., Bellemare, M. F., & Hou, J. Y. (2010). Reconsidering conventional explanations of the inverse productivity/size relationship. *World Development*, 38(1), 88–97.
- Beegle, K. G., Christiaensen, L., Dabalen, A. L., & Gaddis, I. (2016). *Poverty in a rising Africa: Overview (English)*. Washington, DC: World Bank.
- Binswanger, H. P., Deininger, K., & Feder, G. (1995). Power, distortions, revolt and reform in agricultural land relations. In H. Chenery & T. N. Srinivasan (Eds.), *Handbook of development economics* (1st ed., Vol. 3, Chap. 42, pp. 2659–2772). Elsevier.
- Chayanov, A. V. (1966). *The theory of peasant economy* (D. Thorner, B. Kerblay, & R. E. F. Smith, Eds.). Homewood, IL: Richard Irwin for the American Economic Association.
- Collier, P. (2009). Africa’s organic peasantry: Beyond romanticism. *Harvard International Review*, Summer, 62–65.
- Davis, B., Di Giuseppe, S., & Zezza, A. (2017). Are African households (not) leaving agriculture? Patterns of households’ income sources in rural Sub-Saharan Africa. *Food Policy*, 67, 153–174.
- Fan, S. (2014). Economics of food insecurity and malnutrition. Ethics, efficiency and food security: Feeding the 9 billion, well. *Proceedings of the Crawford Fund 2014 Annual Parliamentary Conference*, August 2014, pp. 23–31.
- FAO. (2000). *The state of food and agriculture. Lessons from the past 50 years*. Rome: FAO. <http://www.fao.org/3/x4400e/x4400e.pdf>.
- FAO. (2014). *The state of food and agriculture. Innovation and family farming*. Rome: FAO. <http://www.fao.org/3/a-i4040e.pdf>.
- FAO. (2015). *The state of food insecurity in the world (SOFI) 2015: Meeting the 2015 international hunger targets: Taking stock of uneven progress*. Rome: FAO. <http://www.fao.org/policy-support/resources/resources-details/en/c/469455/>.
- FAO. (2016). *The state of food and agriculture*. Rome: FAO. <http://www.fao.org/3/a-i6030e.pdf>.
- FAO. (2019). *The state of food security and nutrition in the world 2019. Safeguarding against economic slowdowns and downturns*. Rome: FAO. <http://www.fao.org/3/ca5162en/ca5162en.pdf>.
- FAO, WFP and IFAD. (2012). *The state of food insecurity in the world. Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition*. Rome: FAO. <http://www.fao.org/3/a-i3027e.pdf>.

- Gillman, S. (2019). Small farms produce more food than statistics show. *Horizon: The EU Research & Innovation Magazine*.
- Hazell, P. (2011). *Five big questions about five hundred million small farms*. Paper presented at the IFAD Conference on New Directions for Smallholder Agriculture, Rome, IFAD HQ, January 24–25. https://www.researchgate.net/profile/Peter_Hazell2/publication/265580640_Five_Big_Questions_about_Five_Hundred_Million_Small_Farms/links/54da4420cf261ce15cc447a/Five-Big-Questions-about-Five-Hundred-Million-Small-Farms.pdf.
- Hazell, P., & Haggblade, S. (1990). *Rural-urban growth linkages in India* (PRE Working Paper Series No. 430). Washington, DC: Agriculture and Rural Development Department, World Bank.
- Jayne, T. S., Yamano, T., Weber, M. T., Tschirley, D., Benfica, R., Chapoto, A., et al. (2003). Smallholder income and land distribution in Africa: Implications for poverty reduction strategies. *Food Policy*, 28(3), 253–275.
- Kutcher, G. P., & Scandizzo, P. L. (1981). *The agricultural economy of Northeast Brazil*. Baltimore; Washington, DC: John Hopkins University Press; World Bank.
- Lowder, S. K., Skoet, J., & Raney, T. (2016). The number, size, and distribution of farms, smallholder farms, and family farms worldwide. *World Development*, 87, 16–29.
- Marx, K. (1976 [1867]). *Capital: Volume 1: A critique of political economy*. London: Penguin Classics.
- Mazoyer, M. (2001). *Protecting small farmers and rural poor in the context of globalization* (Vol. 2). Paper presented at the World Food Summit 2001. Rome: FAO. <http://www.fao.org/docrep/007/Y1743E/Y1743E00.htm>.
- Misselhorn, A. (2005). What drives food insecurity in southern Africa? A meta-analysis of household economy studies. *Global Environmental Change*, 15, 33–43.
- Pretty, J. N., Noble, A. D., Bossio, D., Dixon, J., Hine, R. E., Penning De Vries, F. W. T., & Morison, J. I. L. (2006). Resource-conserving agriculture increases yields in developing countries. *Environmental Science & Technology*, 40(4), 1114–1119.
- Ravallion, M., & Datt, G. (1996). How important to India's poor is the sectoral composition of economic growth? *The World Bank Economic Review*, 10(1), 1–25.
- Ravallion, M., & Datt, G. (2002). Why has economic growth been more pro-poor in some states of India than others? *Journal of Development Economics*, 68(2), 381–400.
- Riesgo, L., Louhichi, K., Gomez y Paloma, S., Hazell, P., Ricker-Gilbert, J., Wiggins, S., et al. (2016). Food and nutrition security and role of smallholder farms: Challenges and opportunities. In *JRC Conference and Workshop Reports*. <https://doi.org/10.2791/653314>. <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC101229/ipts%20jrc%20101229.pdf>.
- Scandizzo, P. L., & Savastano, S. (2017). Revisiting the farm size-productivity relationship. New evidence from Sub-Saharan African countries. In P. Pingali & G. Feder (Eds.), *Agriculture and rural development in a globalizing world challenges and opportunities*. London and New York: Routledge Taylor & Francis Group.
- Schultz, T. W. (1964). *Transforming traditional agriculture*. New Haven: Yale University Press, Science B.V.
- Sen, A. (1975). *Employment, technology, and development*. Oxford, UK: Clarendon Press.
- Sieber, S., Tscherning, K., Graef, F., Uckert, G., & Gomez y Paloma, S. (2015). Food security in the context of climate change and bioenergy production in Tanzania: Methods, tools and applications. *Regional Environmental Change*, 15(7), 1163–1168.
- Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations*. Digireads.com Publishing.
- World Bank. (2017). *World development indicators*. Washington, DC. <http://wdi.worldbank.org/table/4.2>.

Kamel Louhichi is a senior researcher at the French National Institute for Agriculture, Food and Environment (INRAE). From 2011–2019, he has been seconded as Scientific Project Officer at

the Joint Research Centre (JRC) of the European Commission (EC), Seville. He is an agricultural economist specializing in quantitative analysis of agricultural and environmental policies. He has extensive experience in mathematical programming models and in bio-economic modelling approaches, integrating biophysical and economic models. He has been involved in several ongoing national and international projects on assessing the impact of technological innovation and agricultural policies, mainly the EU's Common Agricultural Policy. In recent years, he has specialized in food security and poverty analysis in developing countries, mainly in Africa. He is the author and co-author of several peer reviewed scientific articles and numerous contributions to scientific conferences related to this field.

Laura Riesgo is associate professor at Pablo de Olavide University and currently a researcher at the Joint Research Centre (JRC) of the European Commission (EC), Seville. Previously she was a researcher in agricultural economics at the University of Valladolid, Spain (2001–2002) and at EC-JRC (2009–2011). Her research interests fall in the areas of agricultural economics and natural resource economics, with a specific interest in agricultural water use, agricultural sustainability, socioeconomic impact of genetically modified crops, modelling of farmers' behaviour and, more recently, development economics. She has participated in many research projects funded by the European Union and the Spanish Ministry of Science, and has published in several peer-reviewed scientific journals.

Sergio Gomez y Paloma is a senior researcher and scientific officer at the Joint Research Centre (JRC) of the European Commission (EC), Seville. He studied Agricultural Sciences and Agricultural Economics (B.S., M.Sc., and Ph.D.) at the universities of Bologna, Milano and Napoli (Italy), and Agro Paris Tech (France). In 1991–1996 he was a lecturer at Roskilde Universitetscenter Department of Economics and Planning (Denmark), where he was co-director for the European Master ESST (Society, Science and Technology). He has been an advisor to the EU Economic and Social Committee, Brussels (1992–1995). Since 1996 he has worked at the EC-JRC, where he has coordinated the Project on Mediterranean and Regional Perspectives and the Action on Sustainable Agriculture and Rural Development. He is currently coordinating activities related to quantitative analysis of the farming sector in Sub-Saharan Africa. In 2011–2014 he was a member of the editorial board of the journal *Applied Economics Perspectives and Policy* (Oxford University Press). He is 2015-to date Associate Editor of *Agricultural Economics*, the journal of the International Association of Agricultural Economists (Blackwell/Elsevier). He has published on agricultural economics, transition and development economics.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.