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The sustainable intensification of smallholder farming systems

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Part 2 Agricultural production

Foreword I

One of mankind's greatest challenges is to achieve and maintain food security for all within 'planetary boundaries', avoiding irreparable harm to the natural resource base on which civilization depends. Agriculture's role in this endeavor is to produce the raw materials of food security – crops and farmed animals – sustainably, without further farmland expansion on high-carbon landscapes and in sufficient quantity to prevent price rises that could curb poor people's access to food. This is a monumental task to which both the fate of smallholder farmers in 'emerging markets' and low-income countries and the notion of sustainable intensification are intimately tied.

Smallholder farmers are the dominant producers of food in many countries. They work hard and are keen to adopt innovations, such as better seeds and agronomic practices, when these help them get their work done without adding too much risk. They understand 'sustainable intensification' intuitively without necessarily knowing the term. They know that taking care of soils and natural habitat is good for their farms. They know intensification and diversification into higher-value products are routes to improved lives and livelihoods as farmers. The problem is that the innovations they need may not be available for adoption when pre-conditions and supporting services go unfulfilled. Adoption depends on many factors – the suitability and relevance of the proposed innovation in users' eyes, the dependability of property rights over land and water, access to markets to procure inputs and sell farm products, financial resources, risk transfer options such as weather insurance, and farm services of different kinds. Even when all of this is favorably in place, incentive distortions from unhelpful policy and governance arrangements can interfere with adoption. Intensification and sustainability might then both suffer, with negative consequences for livelihoods and the environment alike.

Sustainable intensification is sometimes interpreted as 'growing more from less' but, in truth, it is about more than that. We can identify two dimensions – productivity enhancement and resource regeneration. The productivity dimension refers to raising yields of crops with market- and consumer-preferred characteristics with desired nutritional, processing and resilience traits, gender-intentional designs, and biotic and abiotic stress resistance. Productivity growth calls for high levels of use efficiency of all inputs. Wasting water, fertilizer, chemicals, fuel and other inputs and resources is not compatible with the notion of sustainable intensification. Yield gaps must be closed or in practice reduced to 'economically attainable' levels through scalable, producer-focused solutions by crop, farming system and geography over time. Given demographic pressures and urban food demand, the central principle of securing the harvest without converting new non-agricultural land is not achievable without very significant progress on this front.

The resource regeneration dimension of sustainable intensification serves the purpose of offsetting as much as possible of the inevitable environmental cost of farming – past and present. To this end, regenerative practices linked to crop rotations, agroforestry, the planting of cover crops, and no-till precision farming to restore and protect soils, biodiversity, waterscapes, and favorable microclimates must be part of the approach. Regenerative practices and appropriate fertilizer management can help reduce greenhouse gas emissions from farming. There is scope for the development of new activities and sources of income from paid-for environmental services.

Achieving productivity growth and effective resource regeneration can be challenging in smallholder farming settings. As well as local knowledge that farm operators and their families accumulate over generations, external science- and engineering-based knowledge must find its way to the farmer in ways she or he can absorb and put to use. This transfer works well in advanced farming systems, for instance in North America, Europe and parts of South America and East Asia. It works much less well in other parts of the world, in particular poorer countries where research-to-farmer linkages and agricultural extension are weak. How to address and overcome these challenges is the subject of this timely book.

Ensuring smallholder access to appropriate technologies and knowledge will be key to guarantee the continued capacity of farming systems to produce adequate and sufficiently nutritious food whilst also keeping agriculture's adverse effect on the environment and resource base under control. Ultimately, technological progress must reach every acre of farmland – be it through improved inputs, equipment, infrastructure, or knowledge.

The book *The sustainable intensification of smallholder farming systems* focuses on approaches to facilitate a scaled-up delivery and sustained uptake of innovation. It collects the knowledge of both academics and practitioners along agricultural value chains – from agricultural inputs to production to market linkages. In doing so the authors underline the need for demand-led interventions, focusing on farmer needs and preferences, and the creation of the necessary 'enabling environment' (policies, regulations and investment in rural infrastructure) to allow for a sustained and scaled-up impact.

I would like to congratulate the authors and editors of this book for contributing their experiences in a structured way to inform future initiatives in the agricultural research for development space to deliver scaled-up adoption of solutions that drive the 'sustainable intensification of smallholder farming systems'. Time is of the essence if we want to achieve food security for all without harming the planet irreversibly. Sustainably intensifying farming systems is the only recipe we have to get there.

Dr. Marco Ferroni
Chair, CGIAR System Board

Foreword II

Farming has always been a challenging profession and there are good reasons why this will continue to be the case in the future. On one hand, agricultural production has to respond to the needs of a **growing human population**, ensuring that there will be **enough sufficiently nutritious food** available and accessible in the future. On the other hand, a **degrading resource base in terms of soil health, water and biodiversity** render future productivity gains increasingly difficult to achieve. This will be even more difficult in the face of a **changing climate** as more extreme weather events threaten future production.

Smallholder farmers in developing countries are particularly exposed to these trends. They live in places where populations and urbanization are growing fastest, where yield gaps are highest, and where weather volatility is accelerating fastest. Smallholder farmers often operate from a very **limited resource base** in terms of human and financial capital, leaving them exposed to production shocks, and with limited desire to take on risks associated with new technologies and practices. Lastly, as a consequence of decades of extractive production practices, many smallholder farmers repetitively grow the same crops on **degraded soils** that are prone to erosion and have a low water retention capacity, locking them in low production cycles. Overlay increasing climate risks on this picture and their vulnerability is increasing, rapidly.

Given these challenges, it is not surprising to see a consensus that we urgently have to find ways to help smallholders improve how they farm. Agriculture has to be **sustainably intensified**, increasing the efficiency of resource use to increase food diversity, nutrients, and volumes, with fewer adverse effects on environment and society. Emerging concepts for sustainably intensified, climate-smart agriculture recommend a focus on three particular dimensions:

1. Agriculture has to become more **resilient** to shocks, in particular from shocks caused by a changing climate, as well as crises such as the COVID-19 pandemic. This will include developing and delivering appropriate solutions that limit the risk and severity of yield failures, and enabling 'building back better' to happen.
2. The negative impact of agriculture on the environment has to be **mitigated** as much as possible. Especially for smallholder farmers, this has to go beyond agriculture's impact on climate change but also include minimizing negative impacts on local ecosystems and communities through an increased resource-use efficiency (land, water, pesticides, fertilizers) and halting deforestation. Indeed agriculture

needs to move towards being regenerative, leaving more nutrients than it extracts. Farming needs to lead to healthier soils, animals and people.

3 Sustainably intensified farming has to be **productive and profitable**. This is particularly the case for smallholder farmers that often operate near poverty thresholds. Sustainably increasing their production, integrating into remunerative value chains and ensuring a conducive policy environment that will incentivize and reward sustainable farming will be key to ensure that farmers endorse the principles of sustainable intensification.

The **Syngenta Foundation for Sustainable Agriculture** has the mandate to help smallholders have a bright future by improving their livelihoods by improving their productivity. We seek to achieve this through helping farmers adopt **value-creating** innovations, practices and products and connecting them to sustainable and remunerative value chains. It is hence our ambition that all our work delivers benefits to farmers in terms **resilience, mitigation and profitability**. We believe that many such solutions already exist but are not yet available to and adopted by farmers at the scale necessary to achieve sustainably intensified smallholder farming systems.

It continues to be vital to ensure that new solutions provide sufficient monetary benefits to smallholder farmers, **creating value at farm and value chain level**. This will often depend on the overall farming ecosystem. Interested actors need to move from '**pushing out**' solutions to responding to needs and creating sufficient '**market-pull**'. This will allow for lasting delivery through the local private sector, be it seed companies, agro-dealers, insurance companies or providers of mechanized services; complemented, as needed, by a supportive public sector strengthening the enabling environment.

Creating such **conducive ecosystems** will require multi-disciplinary, **multi-stakeholder partnerships**, including the public, private and social sectors and spanning across agricultural value chains. This book is built on experiences of many partners the Syngenta Foundation has and continues to work with in supporting smallholder farmers efforts to improve themselves and their communities. I would thoroughly recommend this book to readers that seek to drive systemic change in order make sure that the agriculture and food system will be able to respond to the many challenges it faces today and achieve a thriving and viable future.

Dr Simon Winter,
Executive Director of the Syngenta Foundation
for Sustainable Agriculture

Introduction

Agriculture is a major driver for economic growth in developing countries. It is widely regarded as the most effective way to sustainably reduce poverty and food insecurity (de Janvry and Sadoulet 2010, Christiaensen et al. 2011). In Africa, the agricultural sector accounts for 65% of all employment, 35% of the continent's gross domestic product (GDP) and more than half of export earnings (Bank 2008). Smallholder farmers – defined here as producers who grow their crops on less than five hectares – produce a large part of the food eaten worldwide (Grain 2014). Their success or failure thus contributes significantly to global food (in-)security. Sadly, smallholder agriculture, particularly in Africa, has not benefitted much from innovation and technological progress (Pretty et al. 2011). While average yields of major crops have tripled since the 1960s, most smallholders' harvests have lagged far behind.

Global improvements in agricultural productivity have gone hand in hand with substantial increases in resource use. Since the 1960s, water extraction for irrigation, use of mechanized equipment and application of synthetic nitrogen fertilizers have risen by a factor of two, two and seven, respectively. Use of pesticides has increased to a substantially (Pretty and Bharucha 2014). There is widespread agreement that intensification to date has been accomplished – at least in part – at the expense of natural resources such as water, land and biodiversity. The general consensus is that this erosion of the resource base threatens to make future production systems less efficient and resilient (Dobbs and Pretty 2004). Smallholder farming systems already tend to lack resilience to shocks and stresses; this situation looks likely to deteriorate further.

The continued pressure on agricultural production from population growth, changing dietary patterns, climate change and environmental degradation is believed to be particularly prevalent in Africa (Haggblade and Hazell 2010). To respond to these challenges, a next wave of agricultural intensification is needed. This time, crop production will have to increase while agriculture's adverse impact on environment and society is reduced. This means maximizing output per unit of resource used (Society 2009).

The track record of African agriculture has been mixed in terms of overall sustainability and productivity gains. Most increases in crop production have come from expanding agricultural land rather than improving productivity. This remains the case despite numerous donor- and public sector-led investments in developing and delivering technological solutions to sustainably intensify smallholder farming systems across the continent (Stevenson and Vlek 2018). The urgent need for solutions to increase African agricultural production and the challenges in deploying technical solutions to smallholder farmers at scale form the background to this book. Academics and practitioners present lessons in designing and deploying initiatives to sustainably intensify smallholder production whilst reducing adverse impacts on environment and society. The authors aim to inspire and advise donors, implementers and other public and private stakeholders.

The concept of sustainable intensification

A finite and degrading resource-base and a changing climate will make it more difficult to deliver productivity increases that keep pace with population growth and shifting dietary patterns. Moreover, there are often tensions between political and donor-led initiatives and practical, effective solutions on the field. Part of this disconnect is based on ideological perceptions on what is considered as 'good' in agriculture (e.g. small vs. large farms, organic versus conventional production, land sharing vs. land sparing, amongst others). These perceptions also tend to influence decisions in agricultural research for development (AR4D). We deliberately included the term 'sustainable intensification' in the title of this book. It avoids position-taking on technologies and interventions. Instead, the term focuses on desirable ends that can be achieved through a variety of means, emphasizing the desired outcomes at farm or systems level rather than the tools used to get there (Pretty and Bharucha 2014).

Sustainable intensification is built on four guiding principles (adapted from Society 2009, Vanlauwe et al. 2014):

1. Increased **production** per unit of land, labour and capital;
2. **Preservation** of ecosystems and soils;
3. Increased **resilience** of farming systems to shocks and stress; and
4. Improved or maintained **profitability** at farm-level.

Key attributes for sustainable intensification include the use of more productive crops and varieties, judicious application of external inputs, harnessing of existing biological processes (where possible), minimization of adverse effects on the environment, and productive use of human capital.

There is a frequent misconception that sustainable intensification promotes a net reduction of input use. In fact, successful intensification processes are centered on more efficient resource use rather than a reduction (Tilman et al. 2011). Especially in the context of smallholder farmers in Africa, this will likely mean *increased* use of external inputs, to release farmers and production systems from the low input/low output cycles that limit their productivity and profitability for years (Tittonell and Giller 2013). For instance, most protocols for Integrated Soil Fertility Management (ISFM) promote the use of synthetic fertilizers to reverse soil nutrient depletion and sustainably increase the productivity of farming systems on more fertile soils (Vanlauwe et al. 2014).

Drivers of sustainable intensificationInitiatives in sustainable intensification tend to focus on developing and deploying solutions that increase agricultural productivity per area or unit of inputs such as water, fertilizer or crop protection chemicals. These solutions traditionally include seeds of new crops or improved varieties, better crop nutrition and crop protection products and more sustainable agronomic practices. However, particularly in smallholder farming systems, productivity increases tend not to translate automatically into increased on-farm profitability (Stevenson et al. 2019). Initiatives that aim solely to intensify agricultural production can expose farmers to increased financial risk (Morton 2007).

Rather than sustainability, smallholders' main concern is typically profitability, as many of them operate close to the poverty threshold. Many initiatives that raise on-farm productivity end in failure when farmers are unable to market their surplus production (Pretty et al. 2011). New technologies need to be low-risk and ideally provide a rapid return on modest initial investment. Factors such as reliable offtake markets, access to finance and credit and the creation of social infrastructure are at least as important as productivity increases (Pretty et al. 2011). Creating the right 'enabling environment' for sustainable intensification requires additional on-farm, value chain, finance and policy interventions (Klauser and Negra 2020 – https://www.frontiersin.org/articles/10.3389/fsufs.2020.576606/abstract). This book provides an overview of the pre-conditions for holistic and sustainable intensification. Figure 1 displays them along the farm value chain.

Implications for initiatives that aim to deliver sustainable intensification

Successful delivery of initiatives to drive sustainable intensification of smallholder farming systems depends to a large extent on an enabling environment. Important enablers include remuneration for more sustainable farming practices and technologies, help to farmers in accessing resources when they are needed and sufficient safety nets for farmers to invest in new technologies.

Creating the right environment often requires a change in conditions at a higher, more systemic level that can then generate a self-organized dynamic referred to as 'pull-scaling' (Schut et al. 2020). Historically, scaling has tended to be based on 'push', the delivery of improved technologies and practices (Wigboldus et al. 2016). Successful pull-scaling requires practitioners to understand and embrace the multidimensional, multi-level and multi-stakeholder nature of agriculture.

Many initiatives have failed to do sufficient justice to the complex nature of innovation and scaling (Schut et al. 2020). This shortcoming can be mitigated in several ways. Firstly, projects aiming for sustainable intensification of smallholder

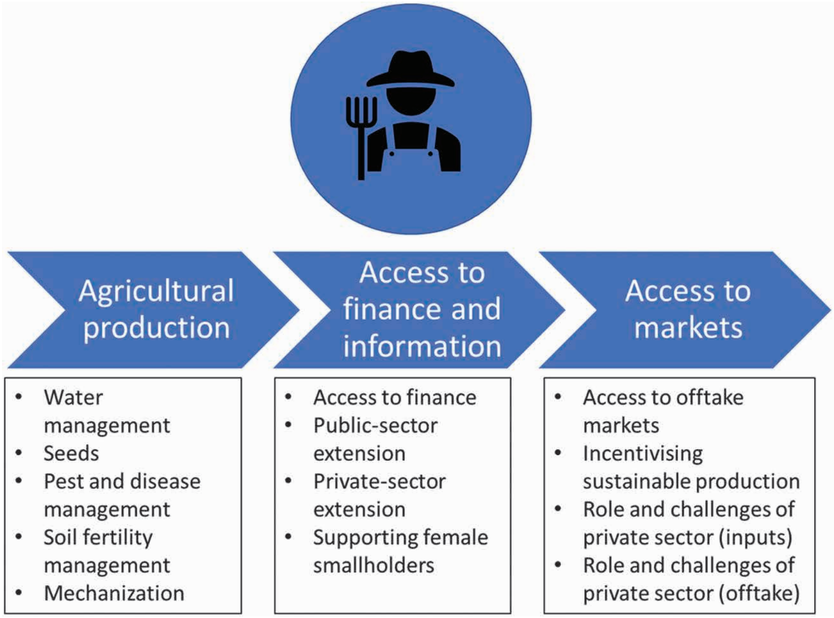

Figure 1 Depiction of dimensions needed for sustainable intensification of smallholder farming systems. These can be clustered into inputs and production equipment (first pillar), access to appropriate financial and risk management tools as well as knowledge (second pillar) and access to reliable and remunerative offtake markets (third pillar). Each chapter of this book covers one of these aspects. Other equally important factors and parts of the enabling environment are discussed within particular chapters. These factors include rural infrastructure (e.g. roads, education, healthcare) and a reliable framework of agricultural policies, land tenure and incentive systems for sustainable farming practices.

farming typically make most sense when using a multi-sector, programmatic, outcome-based approach to address the multi-dimensional challenge (Woltering et al. 2019). Secondly, there is a need to foster more cross-sectoral partnerships, bringing in the private sector for sustained delivery of innovation and to ensure value creation at farm level. Currently, most project budgets only cover proof of concept, but not the costs of shaping the enabling environment and creating the necessary market pull (Spicer et al. 2014, Gillespie et al. 2015). Thirdly, innovation at scale should be regarded as a part of a package. The combination of a core innovation (a product, technology or practice) with complementary innovations (e.g. delivery channels, pricing, marketing) helps create the conditions for successful pull-scaling (Schut et al. 2020).

The call for more holistic programmatic approaches runs against the trend in AR4D of the last 20 years. The number of projects has doubled during that time, but their duration and budgets have halved (Cooley and Howard 2019). This redistribution reflects major donors' desire for more oversight, more (thematic) prescription, more reporting, strategic reviews and changes (Lobell

2020) and their increasing demand for fast and visible impact at scale (Glover et al. 2016).

Pressure to show rapid results can tempt implementers to overpromise on immediate impact. It can also lead them to focus on quick wins rather than investing in development of greater structural capacity for innovation and scaling (Leeuwis et al. 2018, Hall and Dijkman 2019). Moreover, the notion of "reaching many" can be problematic. It can create inappropriate incentives for short-term achievements and rapidly reportable numbers rather than development of sustainable mechanisms and partnerships that can catalyze long-term systemic change (Woltering et al. 2019, Sartas et al. 2020). As a consequence, many organizations in AR4D try to deliver innovations themselves rather than embed them in systems and partnerships that could ensure sustained delivery and address the complexity of pull factors (Schut et al. 2020). In agricultural development – in contrast to medical aid, for example – focusing impact reports on direct beneficiaries is generally misleading. This is because it does not consider changes in the enabling environment or efforts to ensure a sustained delivery of benefits after the project ends (Woltering et al. 2019).

Other misconceptions related to AR4D impact include the idea that more resources bring more impact. In fact, scaling through replication alone and the mere transfer of best practices from one area to another is expensive and unsustainable. It also often hardly addresses the actual problems on the ground. (Woltering et al. 2019).

Potential strategies to tackle these challenges bring us back to the original definition of sustainable intensification, which emphasizes the desired outcomes and evaluates the appropriate means for achieving them. A more structured approach, as proposed by Schut et al. (2020) for a systems-focused and outcome-oriented framework, can be based on the following sequential steps:

1 Map the livelihood and development challenges in a specific context and location;
2 Make an inventory of innovations and initiatives with high potential to address the challenges identified whilst also ensuring alignment with targets in terms of production, resilience, conservation and profitability;
3 Develop a vision/idea of the context-specific measures and conditions through which innovations could be accessed by end users; and
4 Identify key bottlenecks in the enabling environment and develop strategies and partnerships to address them.

The structure of this book

This book aims to provide an overview over different parts that need to be in place to allow for a successful intensification of smallholder farming systems, clustering them along the farming value chain. Throughout the respective chapters of this book, there will be re-occuring themes that highlight the preconditions for successful interventions to sustainably intensify farming systems. They are aligned with many of the statements listed in the previous paragraphs and include the need for a sufficiently attractive enabling environment to attract the adoption of sustainable farming practices and create sufficient pull for investment (such as the need for rural public goods and infrastructure). Furthermore, they emphasize the complexity and heterogeneity of farming systems and the need for the sustained value creation at farm and value chain level to ensure the sustained adoption of tools and practices that sustainably intensify smallholder farming systems. It has to be noted that there are a variety of components that generally contribute to creating a favorable environment for most of the interventions listed in the respective chapters, such as conducive policies and regulations as well as public investment in rural infrastructure, be it social, physical or economic. These generically conducive factor are not featured as separate chapters, but included in the respective chapters on specific actions along the smallholder farmer value chain.

The **first section** consists of two chapters that describe the challenges and economics of smallholder farming to set the context. They highlight the heterogeneity of farming systems in terms of crops, demographics, cultural context, resources, market linkages and other factors, demonstrating the limitations of approaches that solely rely on the replication of existing models and initiatives. Prof. Steve Wiggins (the challenges of smallholder farming) also underlines the need for a functional, enabling environment, e.g. through investment in rural infrastructure (roads, education, health care) and the need to ensure a favorable investment climate and rural public goods to overcome three basic challenges that smallholder farming systems face, namely: i) the need for functional rural institutions, ii) the need to overcome market failures in rural farming systems (especially in terms of access to finance, knowledge and inputs), and iii) the need to efficiently and sustainably generate and disseminate agricultural technology and knowledge.

David Eagle (the economics of smallholder farming) then re-emphasizes the need for investment in rural infrastructure as (physical) access to value chains greatly influences farmer profitability. David Eagle furthermore offers solutions to be identified from several domains, such as public sector initiatives (policy, finance and infrastructure), innovation, digital tools and catalytic investment to support the development of rural markets.

The **second section** then continues with aspects needed to be in place for intensified **agricultural production**, such as water management tools, quality planting material as well as tools for pest and disease management, soil fertility management, and mechanization. Focusing on rainfed smallholder production, Prof. Christoph Studer (smallholder access to water management tools) describes potential options for water management in a smallholder context. Prof. Studer also highlights the fact that smallholder farmers, focusing on immediate returns on investment in terms of finance and labor, tend not to always see the direct benefits of water management tools that increase the resilience of their production. Hence, Prof. Studer promotes the idea of changing how new solutions are introduced to farmers, focusing on attractiveness and profitability rather than technical novelty, hence stressing the need for monetary incentives/disincentives for more resilient and resource-efficient farming. Drs. Ian Barker, Richard Jones and Dominik Klauser (smallholder access to seed) highlight the importance of seed systems to deliver improved genetics and clean, disease-free planting material. This is followed by a text from Dr. Ulrich Kuhlmann (tools for pest and disease control) that describes new approaches for pest and disease identification and control, leveraging digital technologies to multiply impact exponentially by going beyond replicative processes. Being at the heart of the theme of 'Sustainable Intensification', Dr. Bernard Vanlauwe describes the concept of Integrated Soil Fertility Management (ISFM) in a smallholder farming context and the challenges that smallholder farmers face when attempting to access the necessary knowledge and inputs needed for the sustainable intensification of their production. He also highlights the opinion that sustainable farming systems can only be achieved through an intensification of production (at least in the context of smallholder farming in Africa) and the need for research to shift away from purely focusing on extensive, low input systems. Lastly, Dr. Fatunbi Oluwole makes a case on how appropriate mechanization solutions can increase the productivity of African smallholder farming systems by allowing for timely and labor-efficient planting, harvests and better soil preparation. This will also allow releasing the scarce rural work force towards more productive and remunerative jobs in agricultural value chains. He also describes the current challenges in the mechanization sector, such as a lack of skilled workforce to maintain equipment and the lack of supply chains for spare parts. Lastly, he calls for more public investment to establish the relevant local infrastructure needed to ensure appropriate access to mechanization, such as technical training, local manufacturing and maintenance, and transport linkages.

In the **third section**, aspects of **access to finance and information** are discussed. First, Nikesh Ghimire writes about the need for appropriate financial tools to allow farmers to invest in production as an avenue to realize higher incomes. Mr. Ghimire also highlights the fact that interventions to improve farmer access to finance should always result in improved income, a better quality of life and/or a reduced exposure to risks. This becomes ever more important in the context of digital tools where an emphasis has to be on delivering technological disruption in a way that directly benefits smallholder farmers.

Felister Makini and Matthew Freeman then discuss the need to provide reliable extension services to farmers in order to ensure that innovation gets translated into actual benefits 'on the field'. They discuss several models from both the public and the private sectors to deliver such services, as well as the respective motivations of the sectors to engage with smallholder farmers. Finally, Dr. Margaret Adesugba describes the challenges of female smallholder farmers based on a number of case studies from Nigeria. Her work highlights the need to understand and tackle the underlying, structural and societal barriers female smallholder farmers face, rather than just designing interventions that only curate the symptoms.

The **fourth section** describes different ways on how to **include smallholder farmers into markets and value chains**. Firstly, Dr. Yanyan Liu provides an overview of six major factors that determine farmer access to markets, namely infrastructure, ICT, market intermediaries, farmer organizations, contract farming systems and government procurement. The chapter also highlights the existing evidence of the beneficial impact of investment in rural infrastructure on market access and incomes of smallholder farmers. Dr. Yiu also highlights that so far, most innovation in the digital space have benefitted traders and intermediaries. However, there is a substantial, yet mostly unmet potential for digital tools to facilitate farmer access to markets through an improved information flow on offtake demand and pricing. In the subsequent chapter, Dr. Christine Negra describes potential monetary incentives for farmers to adopt more sustainable production practices, such as changes in policy, markets and finance. Dr. Negra again highlights the heterogeneity of farming systems and hence the need for locally tailored and validated incentive packages. In Chapter 14, Mr. John Derera shares his experiences on the role and challenges of the private sector working with smallholder farmers from the input supply side. Highlighting the complexity of these fragmented and mostly underdeveloped markets, John Derera emphasizes the need for a reliable and sufficiently enabling environment in terms of conducive policies, rural infrastructure and farmer capacity. Lastly, he also highlights the importance of public sector and donor led investment not to compete with or distort existing private sector activities (for instance by giving away free inputs). John Logan then changes the perspective from providing inputs to sourcing from smallholder farmers from a private sector perspective. He stresses pertinent challenges, such as small transaction volumes, unreliable supply and varying product quality and discusses models to deal with them, be they deeply inclusive (contract farming) or on a more transactional base. John Logan then also discusses new opportunities through digital tools that will allow for a better traceability of smallholder grown products, potentially catalyzing smallholder access to remunerative offtake markets and sourcing schemes.

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Part 1

Understanding smallholder farming

Chapter 1

The challenges of smallholder farming

Steve Wiggins, Overseas Development Institute, UK

1 Introduction

The great majority of the world's farms are operated by families, rather than commercial firms or cooperatives. Most of these farms are small-scale as well: if area operated is considered, less than five hectares. Defining 'small-scale' precisely is elusive, but the concept of the family farm, where the household takes decisions and provides most of the labour, captures the essence of small-scale farming – a scale where the advantages of self-supervising household labour outweigh any further economies of scale for most farm enterprises.

Among smallholdings, however, considerable differences exist, above all along two dimensions. One is geographical, consisting of access to land and water, both in quantity and quality, and to urban markets. The other comprises the economic and social circumstances of the household. From these considerations, several schemes have been developed to classify smallholdings. The key point is that while a minority of small farms may have sufficient resources and advantages to generate living incomes from agriculture, many do not. For the less-advantaged smallholdings, non-farm incomes can make the difference between poverty and a decent livelihood.

Challenges faced by smallholders include those faced by all farmers – bad policy, underinvestment in rural public goods, climate change and the need to make farming environmentally sustainable, and the historic reality that in real terms, farm prices tend to fall. In addition, some challenges apply particularly

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strongly to small farms: failures in rural markets for inputs and financial services; and meeting the requirements of emerging supply chains dominated by supermarkets, processors and exporters for bulk deliveries, on time, and to exacting standards.

From these considerations, a policy agenda for small-scale family farms is proposed: one that begins with policies that benefit all farmers – an enabling rural investment climate, rural public goods, making agriculture environmentally sustainable and climate smart, and then it deals with those that apply especially to smallholders, above all resolving or mitigating failures in rural markets. Finally, policies needed for marginalised smallholders, including social protection, are set out. The conclusion argues that much of what needs to be done to promote agriculture in general and small-scale farming in particular is relatively straightforward and feasible – given the political will and funding.

2 Defining small-scale and family farms

Most of the world's more than 570 million farms are small, operated by families. More than 475 million farms have two or fewer ha (Lowder et al. 2014). Updating these estimates, Graeub et al. (2016) report:

> We find that family farms constitute 98% of all farms and at least 53% of agricultural land, thus producing at least 53% of the world's food. Our work identified 475 million family farms out of 483 million farms in our sample, supporting the SOFA estimate on the existence of at least 500 million family farms (out of a total of 570 million farms) in the world.

Looking at the developing world, minus North Africa, the Near East and Central Asia, Samberg et al. (2016) found:

> By our estimates, 918 subnational units in 83 countries in Latin America, sub-Saharan Africa, and South and East Asia average less than five hectares of agricultural land per farming household. These smallholder-dominated systems are home to more than 380 million farming households, make up roughly 30% of the agricultural land and produce more than 70% of the food calories produced in these regions, and are responsible for more than half of the food calories produced globally, as well as more than half of global production of several major food crops.

Because agricultural censuses are infrequent in many countries, and owing to differences in definitions, a precise estimate of the numbers and significance of small-scale farms cannot be obtained easily. That said, the exercises reported in these studies agree that they constitute the bulk of the world's farms, especially in the developing world.

The eagle-eyed will have spotted, however, that sometimes reports refer to small farms, and at other times to family farms. As will be argued, since these two categories largely overlap, this is less problematic than might be imagined. But to justify this, we need to first review some definitions.

What is meant by a small farm? No single definition exists. The most commonly used criterion is area, either owned or operated. Small farms then become those whose area lies below a defined threshold, with 2 ha, 5 ha and 10 ha being typically adopted, although no universally agreed threshold exists. Defining 'small' by area alone, however, raises questions when classifying farms across agroecological zones, since to call a 1.9 ha farm in a high-potential zone 'small', but a 10.1 ha farm in a semi-arid zone, 'medium', seems odd. The physically smaller farm in this comparison may well produce more, and employ more labour, than the physically larger one. It becomes clear that additional criteria may define small – in this case, scale of output and labour use.

Because defining 'small-scale' by area alone seems too restrictive as well as problematic, the concept of the 'family farm' is often used to capture qualities of smallness. Not that changing terms makes definition any more precise. Reviewing definitions of family farms, Garner and de la O. Campos (2014) found no less than 14 criteria, most of which can be summarised in four sets, as follows:

- Physical area;
- Family management, in which the family decides on the use of farm and its produce, provides most of the labour even if it hires in additional help at peak times, and is a prime source of any capital invested;
- Role of the farm, in which the family farm may directly provide much of the food the family consumes, or is the main source of income; and,
- Social and cultural dimensions, in which the family usually resides on the farm, has inherited the land and will pass it on to their heirs as both physical and cultural patrimony, and where running the farm marks the family as belonging to a local community.

For the 2014 International Year of the Family Farm, the FAO adopted this definition:

> Family Farming … is a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labor, including both women's and men's. The family and the farm are linked, co-evolve and combine economic, environmental, social and cultural functions. (FAO 2013)

While one might have a long debate on exactly how to define a family farm, bearing in mind that differing criteria may be appropriate for different purposes, it is easy to see what is not a small or a family farm. The typical characteristics of estates, plantations and large-scale commercial farms are readily rehearsed: much of their labour comes from farmworkers; many are managed by hired professionals; they usually can access working and investment capital from banks; they produce largely for the market; and the farm is usually primarily considered an economic asset to be bought and sold as such.

All that said, one feature of the family farms stands out, and that is the operation and management of the holding by the family. That does not preclude some hiring in of labour, some recourse to professional services for technical and business advice, or contracting in machine operations: it just means that most decisions are made by the family, most operations are managed by them, and often it is the family members that provide most of the labour needed.

Now, if family farms are defined by family operation and management, most farms across the world are family farms. Admittedly family farms with machinery may be able to operate tens, hundreds and even thousands of hectares, but they remain family-run entities. If a definition that allows a 300-hectare wheat farm in Cambridgeshire to be similar to a half-hectare coffee smallholding in Kenya seems too liberal, then the implications need to be appreciated. The point is this: while so much economic activity, above all in high- and middle-income countries, is undertaken by firms operating at large scale, so large that in many industries much of the sector's output comes from a handful of large corporations, most farming remains atomised – rural districts and counties usually contain hundreds of farms, while nationally farms are counted in the tens and hundreds of thousands. Exceptions can be seen. In high-income countries pigs and poultry, horticulture is an increasingly industrial activity, carried out by large enterprises; in the developing world some crops that require prompt and precise processing may best be produced on estates. But these are exceptions.

Why is so much farming atomised? Few economies of scale apply to most agricultural enterprises: indeed, diseconomies may apply once farm operations expand beyond the ability of the farm household to manage them. Diseconomies arise first and foremost in labour. Family labour can work flexibly to provide the time and effort to suit the varying, and sometimes unpredictable demands of agriculture – for example, planting times that depend on the rains, and control of pests and diseases whose incidence varies. Above all, family labour is self-supervising and motivated to work diligently. In contrast, farms depending largely on hired labour incur (transactions) costs in recruiting, supervising and motivating labour. Diseconomies of scale explain in part the often-observed inverse relation between the size of farm and yields per hectare: smaller farms commonly have higher land productivity than larger ones, see Box A.

Box A The higher land productivity of small farms

Surveys of farms of different sizes in developing countries frequently show small farms producing more per hectare than large farms, with an inverse relationship between farm size and production per unit of land (Cornia 1985; Eastwood et al. 2004; Larson et al. 2014).

At least four sets of explanations have been suggested to explain this:

- measurement errors of land size and production;
- variations in soil quality, in which the most productive land has been divided into small plots so that their yields are higher than large plots on less productive land;
- small plots having a higher proportion of land close to the plot edge that typically has higher yields than the centres of plots – which may arise from more sunlight, nutrients and water being available towards the plot edges, and perhaps even from farmers who know this and hence work their plot edges more intensively than the plot centres (Bevis and Barrett 2020); and, the most commonly cited reason; and,
- factor market imperfections in which smallholders work on their fields intensively because the shadow cost of their labour is lower than applies to hired labour on larger farms, and in which difficulties in land renting prevent farmers equalising their labour use by renting land.

Conclusive evidence on the reason is elusive, even if the inverse ratio is observed time and again. Reasons may vary by context, and combinations of these factors may apply.

See Barrett et al. (2010) for a discussion of potential causes and testing of them in Madagascar.

Further advantages apply to family-scale operations when farmers know the conditions of their fields – variations in fertility, drainage, etc. – in detail; or know their livestock and can readily see when individuals are ill, in heat, or suffering from some ailment. Family farms may also be able to ride out times when prices are low, since members may accept lower returns to their labour. As compared to commercial farms where pay is agreed, fixed wages to farmworkers might lead to bankruptcy.

Not that small-scale operations do not face disadvantages compared to larger-scale operations. Economies of scale commonly apply to procuring inputs, formal finance and technical advice, to marketing produce and providing certification (Poulton et al. 2010). The most efficient scale of farming is thus the balance between economies and diseconomies of scale,

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