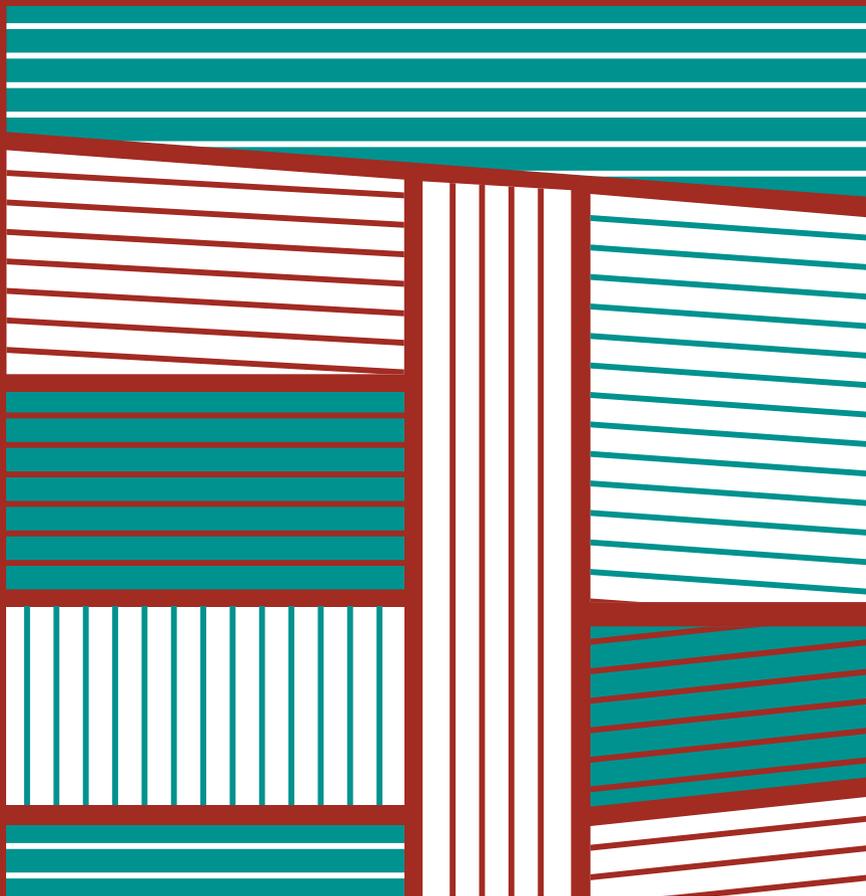


# Productive Diversification in African Agriculture and its Effects on Resilience and Nutrition



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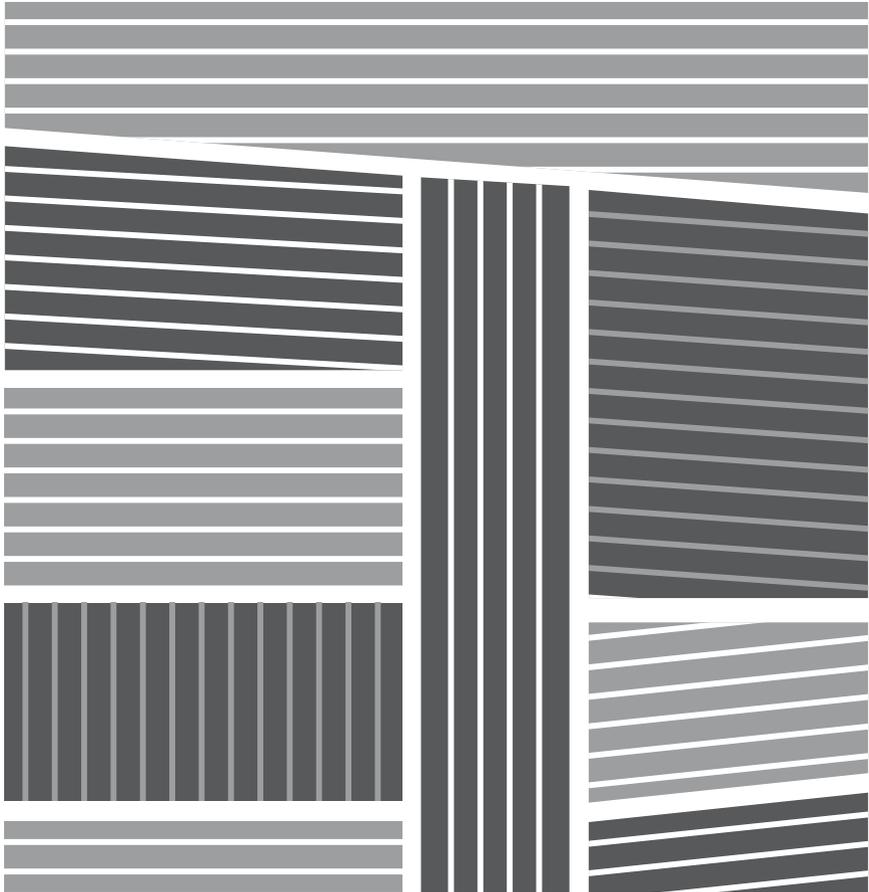
**Editors**

Christine Heumesser

Holger A. Kray



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# Acronyms

ABI	Agri-Business Incubation program (India)
ADMARC	Agriculture Development and Marketing Corporation (Malawi)
ADVANCE	Agricultural Development and Value Chain Enhancement project (Ghana)
AER	Agro-Ecological Region
AFAAS	African Forum for Agricultural Advisory Services
AGRIS	International System for Agricultural Science and Technology
AIDS	Acquired Immune Deficiency Syndrome
AISP	Agricultural input support program
ASWAp	Agriculture Sector Wide Approach
ATVET	Agricultural Technical Vocational Education and Training
AU	African Union
BCC	Behavior Change Communication
CAADP	Comprehensive Africa Agriculture Development Program
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Center for Tropical Agriculture
COMESA	Common Market for Eastern and Southern Africa
CRE	Correlated Random Effects
CSA	Climate-Smart Agriculture
CSO	Zambian Central Statistical Office
DFID	Department for International Development
DRC	Democratic Republic of Congo
EAC	East African Community
EBSCO	Elton B. Stephens Co
ECOWAS	Economic Community of West African States
EPZ	Export Processing Zone
EPA	Extension Planning Area
ES	Executive Summary
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FARMD	Forum for Agricultural Risk Management in Development
FGDs	Focus Group Discussions
FISP	Farmer Input Support Program (Malawi)
FMNR	Farmer Managed Natural Regeneration
FRA	Food Reserve Agency
FTC	Farmer Training Center

*continued*

# Acronyms *continued*

GAIN	Global Alliance for Improved Nutrition
GDP	Gross Domestic Product
GoM	Government of Malawi
HDDS	Household Dietary Diversity Score
IAPRI	Indaba Agricultural Policy Research Institute
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communications Technologies
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGAs	Income-Generating Activities
IHPS	Integrated Household Panel Survey
IITA	International Institute of Tropical Agriculture
KIIs	Key informant interviews
LSLBI	Large-Scale Land-Based Investment
LSMS-ISA	Living Standard Measurement Study-Integrated Surveys in Agriculture
MAHFP	Months of Adequate Household Food Provisions
MDG	Millennium Development Goal
MFI	Microfinance Institution
MGDS	Malawi Growth and Development Strategy
MIHFP	Months of Inadequate Household Food Provision
MT	Metric Ton
N/A	Not applicable
NAIP	National Agriculture Investment Plan (Zambia)
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Program of Action
NEPAD	New Partnership for Africa's Development
NGOs	Non-Governmental Organization
NRCRI	National Root Crops Research Institute
OECD	Organization for Economic Co-operation and Development
PPT	Push-Pull Technology
QMLE	Quasi-Maximum Likelihood Estimation
RAI	Responsible Agricultural Investments
RALS	Rural Agricultural Livelihood Survey
R&D	Research and Development
SACCO	Savings and Credit Co-operative Organization
SADC	Southern African Development Community

SAFI	School of Agriculture for Family Independence (Malawi)
SDG	Sustainable Development Goal
SDI	Simpson’s Diversity Index
SFR	Strategic Food Reserve
SLA	Sustainable Livelihoods (Assessment) Framework
SMEs	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Standards
SSA	Sub-Saharan Africa
SUN	Scaling Up Nutrition
TASAI	The African Seed Access Index
TTI	Timbali Technology Incubator (South Africa)
UN	United Nations
UNICEF	United Nations Children’s Fund
USAID	United States Agency for International Development
USD	US Dollars
WB	World Bank
WFP	World Food Program
WFS	World Food Summit
WHO	World Health Organization
WoS	Web of Science
WTO	World Trade Organization
WUAs	Water User Associations

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# Foreword

Agriculture remains the key economic sector for reducing poverty and boosting prosperity in Sub-Saharan Africa. Farming and agri-business represent a significant share of economic output in nearly all Sub-Saharan countries, and continue to provide employment to the vast majority of the population. Not surprisingly, income from agriculture is particularly important for the poorer rural households, where employment alternatives are scarce.

Agriculture is important for another—self-evident, but often overlooked—reason: it provides food. Approximately 80 percent of all farms in Sub-Saharan Africa are smallholder subsistence or semi-subsistence farms. Food consumption on these farms greatly depends on farmers' own production. In other words, their nutrition outcomes depend on how well they farm, what they grow, and what additional food they can access with proceeds from the sale of modest domestic production. More broadly, the availability and accessibility of food are powerful determinants of households' nutritional outcomes beyond rural areas.

In many parts of Sub-Saharan Africa, the natural environment is challenging: arid, with limited water availability, poor soils and harsh weather conditions—with climate change exposing farmers to further risks. Markets are not always well developed and accessible: transport and energy infrastructure is often poor, and market price fluctuations can be devastating. In addition, the policy environment is not always supportive: public policy measures often favor larger farms and the production of staple crops, while public expenditure is often directed at fast-growing urban centers at the expense of rural areas. While some of these factors curtail potential agricultural growth, others represent sources of risk for farmers or entire farming communities, which test their resilience one growing season after another.

Which brings me to the rationale of this report. The World Bank, along with other organizations engaged in the field, has been systematically analyzing issues affecting agriculture development in Sub-Saharan Africa for many years. Yet, mindful of the growing risks arising from climate change and instability in regional and international markets, as well as persistently high levels of malnutrition and stunting in Sub-Saharan Africa, we considered it timely to look at how different production choices in agriculture impact

ecosystem and farmers' *resilience*—to climate, production and market risks—as well as *nutritional outcomes*. More specifically, we wanted to explore how the diversification or specialization of agricultural production impact resilience and nutrition, and what drives farmers in their production decisions. In other words, are more diversified farms more resilient to shocks and are they also better fed? Or are more specialized—and often richer—farms better able to cope with shocks and to put more nutritious food on the table?

The analysis in this report highlights that although these questions can be formulated in relatively simple terms, they certainly do not have simple answers. In fact, the two main conclusions that can be drawn from our research both highlight this point.

First, the specific context in which a farm operates matters. If a farm is located in a natural environment characterized by good soils and a climate that supports the growth of different crops in different seasons—but is far from markets where it could sell its produce, then diversification is highly likely to improve both resilience and nutrition outcomes. If, in contrast, the farm is located in a natural environment that favors the production of one, or few, staple crops—due to the soil composition or a particular rainfall and temperature pattern—and is at the same time connected to well-functioning markets where it can both sell its own produce and purchase diverse and nutritious foods, then specialization might be a better option. Many combinations are possible in between these two examples, however. To make policy planning even more challenging, evidence shows that individual farms might not be the best level of analysis, as diversification at community or regional level can be more important for positive resilience and nutritional outcomes. In other words, specialization at the level of individual farms *can* be beneficial if diversification is achieved at higher levels.

Second, in terms of policies, there is no one-size-fits-all solution across Sub-Saharan countries or agroecological zones. Policies need to take into account the diversity of conditions in which farmers operate, if they are to nudge them towards resilience and nutritional diversity—be that through on-farm diversification, off-farm diversification, value addition, or specialization. Governments should aim at creating an enabling environment for agriculture where diversification *and* specialization are complementary, and where resilience and nutrition are considered alongside greater economic efficiency. Within this space, public policy should aim to find balance, mindful of important implications that

production decisions have for resilience and nutrition, as well as acknowledge the fiscal constraints that might at times favor alternative interventions. Backed by a thorough literature review, the report outlines policy options that should help governments build the right mix, considerate of specific conditions in their respective countries.

We hope our work contributes to two concrete developments, bearing in mind the importance of local context and policy design. On the one hand, we believe that considerations of nutritional diversity and resilience need to be built into policies beyond those directly affecting agriculture, namely education, trade, or environment, among others. On the other hand, we hope that the report gives sufficient evidence to support a shift away from traditional agricultural policies that have for long, especially in Sub-Saharan Africa, provided production incentives which often work against the poor.

A handwritten signature in black ink, appearing to read "Simeon Kacou Ehui". The signature is fluid and cursive, with a horizontal line underneath.

**Simeon Kacou Ehui**

*Director*

Global Food and Agriculture Global Practice

World Bank Group



# Executive Summary

## AGRICULTURE IN SUB-SAHARAN AFRICA IS KEY FOR POVERTY-REDUCTION AND NUTRITION

**The agriculture sector in Sub-Saharan Africa (SSA) remains the backbone of national economies, sustaining rural and urban livelihoods alike, and providing food and income for the majority of households.** The agriculture sector in SSA contributes 15 percent of Gross Domestic Product (GDP) on average, and accounts for almost 60 percent of employment (OECD/FAO 2016). The vast majority of farming households in SSA are small; in fact, smallholders account for approximately 80 percent of all farms (World Bank 2018b). The importance of agriculture for food security and poverty reduction thus cannot be overstated. On the one hand, farming households largely rely on own production to meet their dietary needs. On the other, the produce they sell often provides the main source of household income.

**Recent agriculture growth in Sub-Saharan Africa has been solid and has supported improvements in nutrition outcomes and poverty rates.** Between 2001 and 2014, the average annual growth of agricultural output in SSA—excluding South Africa—was around 3.3 percent, and hence only slightly below the 3.7 percent of South Asia. While most of the increase in output stemmed from land expansion rather than increased productivity, the sector performance proved to be strong enough to lower poverty rates and improve nutrition outcomes (Goyal and Nash 2017). The headcount poverty ratio declined from 55.6 percent in 2002 to 41 percent in 2013 (Barrett et al. 2017), while the proportion of undernourished people declined from 28.1 percent in 2000 to 20.8 percent in 2015 (FAO 2015a). As a result, by 2015, seven Sub-Saharan African countries achieved both the Millennium Development Goal (MDG) target 1.C of halving the proportion of population suffering from hunger and the World Food Summit (WFS) target of halving the number of undernourished people by 2015, while another twelve countries had achieved the MDG target alone.

**Despite some relative gains, food insecurity and malnutrition in absolute terms continue to be major public health challenges in most African countries south of the Sahara—and most recent data are cause for concern.** While the proportion of undernourished people in SSA has decreased, the absolute number

of those suffering from chronic food deprivation has continued to rise: from an estimated 175.7 million during 1990-92 (three-year average) to 256 million in 2017—a staggering 23.2 percent of sub-Saharan Africa’s population. Children are particularly affected: the number of those stunted has grown from 50.1 million in 2010 to 58.7 million in 2017 (FAO et al. 2018). Most Sub-Saharan African countries are increasingly experiencing what is called the “triple burden” of malnutrition—persistently high levels of undernutrition and micronutrient deficiencies (particularly in rural areas) occurring in tandem with increased prevalence of over-nutrition and obesity (particularly in urban areas).

**Many countries are still highly reliant on the production of one crop for national food security, which largely determines the total caloric intake of the rural population.** Agricultural production is an integral part of the food environment, or the conditions that shape people’s dietary choices and nutritional status, respectively, and thus affects nutrition outcomes and food security. While different crops characterize agricultural production across regions in Sub-Saharan Africa, maize is the dominant crop in many SSA countries, covering the greatest share of total agricultural area harvested (e.g., 61 percent in Lesotho, 51 percent in Zimbabwe, 49 percent in Zambia and South Africa, and 42 percent in Botswana and Malawi) (FAO 2018). At the same time, evidence shows that staple crops account for a large share of food consumption (e.g., maize accounts for 46 percent of food consumption in Zambia, rice for 70 percent in Madagascar), and in particular among poor and vulnerable farmers. (Ecker and Quaim 2011; FAO 2013)

**Farmers in Sub-Saharan African are vulnerable to market risks, weather-related risks and shocks. Decisions on whether to diversify or to specialize production impact farmers’ resilience, and thus their capacity to cope with and adapt to these risks.** Farmers in SSA are increasingly exposed to climate variability and climate change-induced natural hazards—mainly droughts, floods, cyclones, and livestock and crop pests and diseases; as well as to market risks such as crop price volatility and shocks which are frequently transmitted to consumers (FAO 2016). The exposure to these risks is exacerbated by the fact that national agri-food systems in SSA in general, and of individual communities in particular, are not sufficiently diversified and hence highly reliant on just one or a few staple crops. Low productive diversification, alongside a frequent lack of assets to buffer against risks, exposes farmers to risks of income variability, crop failure, and resulting malnutrition, among others.

**Market- and climate-related risks to smallholders in SSA are compounded by predictions that both the suitability of crop area for staples such as maize, and crop nutrient content could be substantially lowered with rising average temperatures.** In most extreme cases, disturbances in production will lead to severe food insecurity since poor farming households have low purchasing power to compensate for loss of income or own production (World Bank 2013). Unsurprisingly, poor undiversified farming households also struggle to recover after shocks as they have limited savings, production assets, and limited opportunities for generating off-farm income. This can also be considered as a low level of resilience, which can broadly be described as the ability of ecosystems, households or communities to anticipate, respond, and recover from environmental, socio-economic, or political disturbance in a timely manner and without compromising essential system structures and functions (Walker and Salt 2012; Tanner et al. 2015).

**The pertinent and likely aggravating challenges of malnutrition and vulnerability to climate change in Sub-Saharan Africa are the starting point for this report.** The report investigates how production decisions towards on-farm productive diversification or specialization can affect the resilience of agricultural systems and rural livelihoods as well as nutrition outcomes; which environmental, policy, socio-economic or institutional drivers are found most critical to affect production decisions; and which policy recommendations can be drawn. While the analysis includes off-farm diversification and vertical diversification where appropriate, the main focus lies on productive diversification on-farm. Findings are based on the review of evidence on a continental scale, as well as two in-depth country case studies of Zambia and Malawi where maize production is predominant and highly supported by national agricultural policies.

## **UNDERSTANDING THE LINKAGES BETWEEN PRODUCTION DECISIONS, NUTRITION, AND RESILIENCE**

**Both diversification and specialization of agricultural production can improve a farming household's welfare, but their impacts on both resilience and nutrition are not fully understood.** Farmers often diversify *on-farm* and *off-farm* to better manage agriculture-related risks. A larger number of diverse crops and/or legumes produced on the farm—especially when combined with livestock—can increase the capacity of both farmers and agroecosystems to mitigate the impacts of shocks, as the production system (a) has diverse levels of

susceptibility and response mechanisms to these shocks, and (b) usually provides food for household consumption or sale through more than just one season per year. However, a high extent of on-farm diversification can also reduce the potential of reaping benefits of economies of scale<sup>a</sup> or expose the household to new risks which are implicit when adopting new varieties and breeds. Off-farm diversification allocates labor to other income-generating activities which have a different risk profile and thus provides additional income, thereby reducing income volatility in times of distress. Specialization on fewer commodities, with the aim of increasing productivity and competitiveness through increased efficiency and economies of scale, has also shown to bring welfare improvements, mainly by increasing income (Klasen et al. 2016; Barghouti et al. 2004).

**Unsurprisingly, the specific context in which the farmer operates, that is, the geographic location, the natural and enabling environment such as policies and market accessibility will importantly determine the outcome.** The task of evaluating which production strategy—diversification or specialization—is more effective in achieving greater livelihood and agroecosystem resilience to environmental or economic disturbances, as well as better nutrition outcomes is not straightforward and has not been well understood to date, especially in complex environments like SSA. With the aim of fostering the understanding of these linkages and of providing policy guidance, this report explores both the impacts of diversification and specialization on resilience and nutrition in SSA, as well as the drivers and constraints that facilitate one or the other production model.

**Diversified production at the farm level up to a certain threshold strengthens livelihood resilience and improves nutrition outcomes; but diversification of agricultural production at the community, landscape, and national level is critical for agroecosystem resilience and nutritional diversity.** More diversified on-farm production can lead to better nutrition outcomes and greater resilience to environmental and economic disturbances at the local level, as it provides a greater variety of foods available to households and local markets, and lowers production risks. Yet, on-farm specialization resulting in a diverse range of commodities at the landscape level can lead to a diversified food system at the national level, and is often a result of diverse geographical areas within a given country, heterogeneous actors, and value chain activities. In fact, on-farm diversification and specialization should be seen as complementary. On the one hand, individual farms and value chains often increase productivity and competitiveness through specialization, enhance efficiency and economies of scale, while on the other hand, at the

community, landscape or national level, the heterogeneity of actors, diversity of farm production and value chain activities provide access to diversified nutritious food products, income streams, and employment opportunities. Evidence also shows, however, that these impacts ultimately depend on a range of factors such as access to functioning markets or infrastructure (e.g., storage, transportation, processing) (Sibhatu et al. 2015; Klasen et al. 2016).

## IMPACTS OF DIVERSIFICATION: WHICH PATHWAYS LEAD TO IMPROVED RESILIENCE AND NUTRITION?

**The report identified three main *pathways* through which diversification or specialization impact livelihood and agroecosystem resilience and nutrition.** Diversification and specialization of agriculture in Sub-Saharan Africa generate numerous different impacts on livelihood and agroecosystem resilience as well as nutrition. These can be organized into specific development categories or pathways which, in turn, can be linked to a set of policy measures. This report builds on three groups of pathways: (i) Natural resources and ecosystem pathways; (ii) Income pathways; and (iii) Food environment pathways.

### Natural Resources and Ecosystem Pathways: Finding the optimal level of diversification

**Both on-farm diversification and specialization can contribute to improved resilience to climate-related risks, but agroecosystem resilience is higher in diversified production systems.** Productive diversification leads to greater diversity of crop and animal genetic resources and soil biota on the farm and across the wider agroecosystem. Biodiversity increases the resilience of agroecosystems to climate-related stressors and shocks by providing a variety of traits such as drought- or cold-tolerance, and by generating key ecosystem services such as nutrient cycling, soil carbon sequestration, or biological pest and disease control, among others (Kremen and Miles 2012; Altieri et al. 2015). Diversification thus contributes to improved agroecosystem functioning and health, which leads to enhanced agricultural productivity, reduced variability in production, and a greater provision of diverse vitamins, minerals and micronutrients essential for a healthy diet.

**Conversely, agricultural specialization at the household and community level is found to weaken ecosystem functions and related services, thus making**

**agroecosystems more susceptible to shocks, and households more vulnerable in the absence of other risk-buffering assets—the key is to find the right balance that reflects local conditions.** Evidence suggests that it is the balance between diversification and specialization that matters most, since on-farm specialization also has the potential of supporting agroecosystem and livelihood resilience, provided that (a) it is pursued through sustainable or ‘climate-smart’ practices that nurture natural resources, and (b) that diversification is achieved at the community or landscape level (Klasen et al. 2016). There is a threshold in terms of farm size and number of crops grown, among others, beyond which benefits of diversification start to flatten or diminish, while other considerations become more important, for example incomes and savings (Cardinale et al. 2012; Waha et al. 2018).

### **Income Pathways: The crucial importance of market access to enhance income opportunities**

**The majority of farming households in SSA are income-poor and highly vulnerable to commodity price fluctuations.** Any activity that can increase and stabilize their incomes, or generate savings, can thus lead to improved livelihood resilience and, arguably, nutrition. While specialization can lead to higher incomes, evidence shows that households in SSA use on-farm productive diversification as precautionary self-insurance strategy (e.g., introduction of more drought-resistant crops) and as a form of risk mitigation (e.g., accumulation of livestock in integrated crop-livestock systems) to stabilize income in the face of stress or shocks (e.g., Mortimore and Adams 2001; Barghouti et al. 2004). Similarly, households diversify off-farm by allocating labor to activities that are less vulnerable to agriculture risks, thereby ensuring (a) additional income that is often re-invested on-farm, but also (b) an alternative source of income in times of distress. Evidence also shows, however, that on-farm specialization can generate higher incomes—and thus potentially savings—and can lead to increased spending on other food items and to improved livelihood resilience to shocks (e.g., Twine 2013).

**An important conclusion from the income pathways is that the context (e.g., environmental, institutional) will largely determine to what extent diversification and specialization are likely to increase incomes and employment opportunities.** The most often-cited exogenous factor is the access to functioning markets. For example, the more distant the farm is from the market,

the more likely is it for farms to diversify, and the greater are the positive impacts of diversification on a farm's resilience and nutritional status (e.g., Mofya-Mukuka and Hichaambwa 2016). The diversified production system for own consumption is more important for these outcomes than income-generating production. Conversely, the closer the farm is to a market—especially if it is a well-supplied and diversified market—the greater are the benefits of specialization both in terms of livelihood resilience and, arguably, nutrition since economies of scale will lead to higher income and thus purchasing power. At the same time, proximity to diversified markets and food systems can increase the availability of employment and income-generating opportunities (Sibhatu et al. 2015).

### **Food Environment Pathways: The importance of food availability and nutrition awareness**

**On-farm diversification provides greater dietary diversity for direct household consumption.** Ensuring a favorable food environment where a range of nutritious and safe foods is available, affordable, convenient, and desirable is vital for improving nutrition outcomes at the household, landscape, and national level (e.g., GLOPAN 2016; FAO 2016c). On-farm productive diversification has an immediate positive effect as food for own consumption is directly available and utilizable (Lorenzo and Tasciotti 2014). Evidence from SSA shows that on-farm diversification can have a particularly strong positive impact on children's nutritional status (Kumar et al. 2015). The empowerment of women has shown to impact as positively on dietary diversity as on-farm diversification (Malapit et al. 2015).

**Proximity to well-supplied retail markets becomes especially important for nutrition when the benefits of on-farm diversification start to flatten or even diminish, for example due to foregone income resulting from farm diversification beyond optimal levels.** One important condition is that prices are sufficiently stable and awareness about the nutritional value of different foods is high. On-farm diversification can, in fact, realistically only secure a certain number of foods for own consumption. Smallholders will likely still need to access markets to source food items for a sufficiently nutritious diet (Sibhatu et al. 2015). However, when dramatic fluctuations in prices occur, food sourced through retail markets might become unaffordable, exposing those relying on market purchases to risks of malnutrition or hunger. Research further indicates that well-functioning agri-value chains—supplied by both diversified and

specialized individual farms—make nutritious food more consistently available in urban and rural markets, leading to better nutritional outcomes. Evidence also reveals that awareness about the nutritional value of food is key in generating better nutrition outcomes, especially when farms specialize and greater shares of food consumed are purchased. Without nutritional awareness, excess income may be used to purchase unhealthy and less nutritious foods, hence leading to other forms of malnutrition such as obesity (e.g. Fanzo et al. 2013).

## **DRIVERS OF DIVERSIFICATION: WHICH FACTORS LEAD FARMERS TOWARDS GREATER DIVERSIFICATION OR SPECIALIZATION?**

**Farmers’ decision to diversify or to specialize does not only rest on their understanding of the resulting impacts but is influenced by the specific context in which the consideration is made.** Farmers—in SSA, but also elsewhere—are constrained by the realities of the environment around them, by changing public policies and market infrastructure, and by factors specific to the organization of society and economy in which they live and operate. These conditions generate drivers of production decision and nudge the farmer towards either diversification or specialization. These drivers are of particular importance to policy-makers since they can be influenced by policy decisions and the set-up of institutions. It is important to note that more often than not, individual drivers will interact dynamically. This report groups drivers into three broad categories: (i) Environmental drivers; (ii) Policy and market drivers; and (iii) Socio-economic and institutional drivers.

### **Environmental Drivers: Farmers pursue on-farm and off-farm diversification to adapt to or reduce risks arising from climatic or biophysical factors**

**Agroecological zones, climate, natural resources, the prevalence of pests or diseases and shocks are key environmental drivers of agricultural production decisions in SSA.** Factors such as the quality of soil, water availability, temperature, rainfall, and the length of the growing season importantly determine which areas and regions in SSA are well suited for the specialized or diversified production of specific crops and livestock breeds (Iizumi and Ramankutty 2015). Farmers tend to focus on one crop which is adjusted to the agro-climatic condition. For example, tea, wheat, oats, and barley are grown in cool, wet areas, and rice in valleys of hot and wet regions such as swamps and marshlands. In Zambia, for instance, proximity

**Table ES.1** Relative importance of different drivers for production decisions

Driver	Impact			
	On-farm diversification	On-farm specialization	Value chain diversification	Off-farm diversification
<b>Environmental Drivers</b>				
Long growing season	●	●	●	●
Poor environmental conditions and soils	●	●	●	●
Climate shocks and other agricultural risks	●	●	●	●
<b>Policy and Market Drivers</b>				
Subsidies and incentives	●	●	●	●
Price volatility and regulatory changes	●	●	●	●
Market infrastructure	●	●	●	●
Access to services and technologies	●	●	●	●
<b>Socio-economic and Institutional Drivers</b>				
Availability of labor	●	●	●	●
Small land size or tenure insecurity	●	●	●	●
Lack of education and gender equity	●	●	●	●
Knowledge and nutritional awareness	●	●	●	●
Reliable market access through vertical coordination	●	●	●	●
Community support and power structures	●	●	●	●

*Note: a green dot (●) denotes a positive driver, a red dot (●) denotes a negative driver, whereas a gray dot (●) indicates that the linkage is unclear.*

to wetlands and humid agroecological conditions was found to provide suitable conditions for on-farm diversification due to water availability for irrigation (see Chapter 4). Conversely, extensive livestock rearing and the production of more drought-resistant crops such as sorghum and millet is common in the (semi-) arid areas of SSA (Pell 1999). Farmers are aware of the risks and environmental

stressors they face, and use on-farm and off-farm diversification to hedge risks. In Ethiopia, for example, the variability of rainfall in spring is a crucial determinant for crop choice and leads to greater diversification to guard against risks. Poor environmental conditions were found to be a driver of on-farm diversification (e.g., Di Falco et al. 2010). In fact, it is the exposure to environmental stressors and shocks, and the resulting need to reduce risks, that feature as most prominent environmental drivers of diversification, as Table ES.1 shows.

### **Policy and Market Drivers: Policy measures and public expenditure can stimulate both specialization and diversification, but in SSA they have largely supported the former**

**Policy measures aimed at promoting national food security, productivity enhancement, and commercialization, as well as regulatory measures that condition market access are key institutional drivers of agricultural specialization.** Policies and regulations are important drivers of agriculture production decisions through their impact on economic profitability, and by facilitating or hindering trade in specific products. Evidence from SSA shows that policies drive agricultural specialization both directly and indirectly through market interventions and public expenditure such as subsidies and trade barriers, infrastructure, prices, and services. The most common market interventions are food reserve purchases and agricultural input support programs—most often in the form of subsidies—which incentivize the production of a few staple crops (Gebremedhin and Jaleta 2012). An in-depth analysis for both Zambia and Malawi, for instance, revealed a negative relationship between food reserve purchases and crop diversification (see Chapter 4). Trade restrictions often lead to similar effects. Market interventions and subsidies for specialized production usually come along with ecological and socio-cultural trade-offs through reduced ecosystem functions and related services, including cultural services such as landscape aesthetics and traditional cuisine (e.g., Lin 2011). Alternative approaches have been tested. For example, the introduction of vouchers valid for purchases of inputs for a larger selection of crops and livestock products can support diverse production systems. Similarly, other regulatory measures, most prominently the removal of market-entry barriers, have also led to diversification (Jayne and Rashid 2013; DANIDA 2011).

**Beyond market intervention, public expenditure on infrastructure and on the provision of services (e.g., energy, extension, water, credit) can be an**

**important driver of specialization or diversification.** On the one hand, good infrastructure—in a broad sense of access to input and output markets and the actual functioning of markets—allows farmers stable access to markets and strengthens trade ties, thus stimulating them to commercialize, often via specialized but also diversified production systems. On the other hand, when infrastructure is poor—and markets imperfect or missing—farmers tend to diversify to better manage their risks and to ensure basic food security (e.g. Mofya-Mukuka and Hichaambwa 2016). The provision of services such as energy, extension, water, and credit can also influence production decisions (World Bank 2008). For example, strengthening agricultural research and development, and farmers’ capacity through extension are key factors for the adoption of improved technologies and practices, and were a key driver for diversification in Zambia and Malawi (see Chapter 4). Limited access to electricity hampers value chain diversification, as more energy-consuming operations remain prohibitive. Similar considerations can be made for water and credit. However, the interplay of this diverse set of factors is often complex, and their impact on determining the degree of diversification and specialization will ultimately depend on other factors such as land and labor availability, as well as the country context.

### **Socio-economic and Institutional Drivers: The importance of rules, factor endowment, power distribution, and education**

**Socio-economic and institutional drivers—encompassing rules (e.g., on contracting, on land tenure), practices and broad conditions within the community (e.g., availability of labor, levels of education, gender roles and the distribution of power)—have important impacts on production decisions.** Farmers take production decisions within a specific socio-cultural context, that is, within a specific community with its own rules, norms, and conditions. For instance, evidence from Madagascar and Uganda shows that farmers are more likely to specialize in situations where their market access can be improved through vertical coordination with agribusinesses (e.g., contract farming), as this reduces the risk to their investments in commercial operations (Minten et al. 2009; Balya 2007). Similarly, farms will more likely specialize where access to (seasonal) labor is abundant and stable (Klasen et al. 2016). The Zambia case study shows that labor availability on farm, in particular family labor, can drive diversification. The security of land tenure or ownership also affects investments and production decisions. Evidence shows, for example, that a shift

from usufruct rights to full ownership increases incentives for soil conservation and productive investments such as in trees—both important features of diversification (e.g., Deininger and Ali 2008). Larger land plot size was found to positively affect on-farm diversification in Zambia and Malawi (see Chapter 4).

**There are also important considerations in relation to the distribution of power and educational attainment within a community.** The preferences of powerful groups, for example well-connected land owners, for a specific model of production can influence a wider community (Klasen et al. 2016). Education matters, too. A higher level of education increases the ability of farmers to successfully adopt innovative farming practices, but can also foster the likelihood of household members to engage in off-farm employment. Specific knowledge and awareness about the nutritional value of various foods influence consumer food choices, and ultimately affect the range of crop and livestock products available and produced for local markets. Consumers with enhanced knowledge about the nutritional value of foods and the importance of dietary diversity will stimulate productive diversification into more nutritious crops. (Fanzo et al. 2013)

## **POLICIES FOR PRODUCTIVE DIVERSIFICATION IN AGRICULTURE**

**Policies can have a decisive impact on whether farmers decide to diversify or to specialize. Large-scale agricultural input support programs as prevalent in Sub-Saharan Africa have mainly resulted in increased specialization.** While some of the drivers analyzed in this report, especially those rooted in biophysical conditions, are very important in determining farmers' productive decisions, policies often have a decisive impact. An in-depth literature review of agriculture policies across ten SSA countries and empirical studies for Zambia and Malawi undertaken for this report have shown that most governments recognize the value of diversification for nutrition and resilience outcomes. However, some consider the pursuit of agricultural specialization and intensification as important for national economies, deserving extensive policy and financial support. Others advertently or inadvertently promote specialization under the pretext of improving national food security. In practice, though, the experience from SSA shows that the tool most often used—agricultural input support programs—has resulted in increased specialization, often at the expense of agroecosystem resilience and nutritional diversity.

## There is no one-size-fits-all solution

**This report highlights that there is no one-size-fits-all solution in fostering productive diversification and provides policy suggestions that can promote diversification.** What emerges from existing research on diversification and specialization in SSA is that there is no quick fix: production decisions are driven by an extensive number of drivers with diverse impacts. When considering how to improve resilience and nutrition most effectively and efficiently, policy-makers have to take into account the context—at the farm, landscape, and national level—and how it interacts with specific policy measures. Considering evidence from SSA, this report groups policies into six broad categories: (1) Subsidies and agricultural public expenditure; (2) Rural infrastructure and markets; (3) Agricultural research, and seed systems; (4) Agricultural advisory services, skills development, and agripreneurship; (5) Natural capital, land and water tenure; (6) Nutrition, health, and social protection. Naturally, the allocation of oftentimes limited fiscal resources to any of these measures needs to take into account the local context and emerge from evidence-based research. Policy interventions that aim to address resilience and nutrition through agriculture may reduce funding and positive development outcomes in other public areas.

### (1) Subsidies and agricultural public expenditure

- *Rather than promoting the production of a single or few crops, governments need to address agricultural input market failures — through support programs where necessary — to avoid exacerbating inherent market distortions.*
- *Governments should—in consultation with the private sector, development partners and farmers, among others—design agricultural programs that allow for the acquisition of a broader range of inputs and services. These programs should be complemented by public expenditure focusing on the provision of public goods such as extension and research.*
- *Governments should limit their direct market interventions in sales and purchase of staple crops. Government interventions should only be allowed for the purpose of maintaining strategic reserves.*
- *More efforts should be directed towards creating an enabling environment for market functioning by putting the right institutions and regulations in place (e.g., on standardization, provision of weather and price information, competition, trade finance, or dispute settlement mechanisms).*

**Subsidies have been a key component of government policy in Sub-Saharan Africa for the last decades, with a focus on seed and fertilizer subsidies for staple crops such as maize and rice.** However, these policies have largely contributed to reduced crop and nutritional diversity among households participating in these schemes. Evidence suggests that agricultural input support programs have been effective in raising fertilizer use, average yields and agricultural production; however, the impacts of such programs on rural poverty, equity, nutrition, and resilience have rarely been studied (Mason et al. 2016; Goyal and Nash 2017). While subsidies in countries such as Zambia and Malawi, for instance, have fostered growth in cereal production and, arguably, improved national food security, they may have come at the expense of nutritional diversity and ecosystem resilience.

**Input subsidies, if necessary, need to be well designed and complemented by services such as extension and research.** Evidence shows that for subsidies to bring positive results for nutrition and resilience, they need to encourage the development of input and output markets and bring innovations in (a) design (e.g., greater range of inputs), (b) targeting (e.g., use of vouchers and smart cards), and (c) the composition of stakeholders, for instance through the inclusion of marginalized groups. For better effectiveness, subsidies should be combined with complementary services such as agriculture extension and research to raise or sustain farmer demand for and efficient use of a variety of inputs (e.g., DANIDA 2011; Chapoto et al. 2016; Goyal and Nash 2017).

**Market access opportunities have become a key factor for growth in the variety and quality of agricultural products produced by farmers.** While access to well-functioning input, output, and factor markets tends to stimulate specialization, improving opportunities for farmers to access and serve growing agricultural markets is also quintessential to promoting agricultural diversification. Evidence suggests that well-functioning markets can be just as important, if not more, than the diversity of local production for food security, nutrition and livelihood resilience. Three policy considerations are key in this respect. First, subsidies, food reserve policies and agencies often constrain agricultural diversification, as they are predominantly targeted at staple foods or 'cash crops', and thus stimulate specialization in the production of those. Such market interventions should be curbed as much as possible. Government interventions should only be allowed for the purpose of maintaining strategic reserves and for purchases from remote areas that cannot be reached by private traders. Second, instituting export

bans on strategic commodities is relatively common among some SSA countries. These have, however, in some cases shifted production focus to crops other than the export restricted staple: consideration should be given to their phasing-out. Third, governments should focus on improving the institutions and regulations underpinning agricultural markets and trade. Measures could address, among others, product standards, provision of information, competition, trade finance, or dispute settlement mechanisms.

## (2) Rural infrastructure and markets

- *Enhance investments in connectivity: (i) rural-rural and rural-urban transport connections and services; and (ii) Information and Communications Technologies (ICT) access and infrastructure in rural areas.*
- *Enhance investments in electricity and irrigation infrastructure and services.*

**Transport infrastructure plays a crucial role in the timely delivery of agricultural inputs to farmers and of farm produce to markets, while ICT networks facilitate the flow of critical market price and climate-related information.** Farmers need to have predictable access to markets to purchase inputs and to sell their produce. Well-functioning markets can support diversification, as farmers can respond to demand for a diverse range of agricultural products. Transport connectivity is a key factor underpinning efficient agricultural markets, and thus deserves more investment (OECD/UN 2011; World Bank 2017). ICT infrastructure and access to ICT in SSA has been growing rapidly, opening new markets for different agricultural products and enabling access to a broad range of production and climate-related information for farmers. These, in turn, can help farmers to anticipate environmental or economic disturbances and to adapt accordingly (World Bank 2015, 2018a). Governments should ensure the continuation of these positive trends.

**Water scarcity and limited access to electricity are often cited as major constraints to agricultural production in SSA.** Investments in irrigation infrastructure and services—alongside water conservation practices—have the potential to boost agricultural yields and to facilitate agricultural diversification in SSA throughout the year, thereby increasing the resilience of farmers to increasingly erratic rainfalls. At present, agricultural production in the region is almost entirely rainfed. In addition, less than 18 percent of the rural population in SSA has access

to electricity, which is essential for agriculture along the value chain. Electricity is required for irrigation, mechanization, cold storage, agricultural processing and access to information, among others—all key requirements for improving the productivity and diversity of agricultural production.

### (3) Agricultural research and seed systems

- *Invest more in agricultural research and development focusing on practices, technologies and services that are gender, climate and nutrition-sensitive.*
- *Support smallholders to participate in diverse value chains, including for export; strengthen farmers organizations and cooperatives as a means of facilitating farmers' access to a diverse range of inputs at lower costs and better output markets, better agricultural contracts, and participation in more lucrative value chains.*
- *Ease seed laws and regulations regarding the storage, registration, certification, exchange and sale of indigenous or farmer produced seed; and enact laws to protect Sub-Saharan Africa's livestock diversity.*

**Investing in research dissemination can lead to significantly positive nutritional and resilience outcomes.** Both agricultural research and extension should be prioritized, alongside greater support to farmer organizations. Evidence shows that returns on investment in agricultural research are substantial—this is confirmed by multiple success stories from SSA (Goyal and Nash 2017). Investment in research needs to be strengthened both at the level of improving the knowledge about the interaction between diversification, nutrition, and resilience, as well as at the level of development of new varieties or revitalization of traditional varieties that can generate better nutrition outcomes. Biofortification of staple crops is one visible success story amid investments in research: it is a cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions (e.g., Bouis and Saltzman 2017).

**Although improved varieties and hybrid seeds have led to substantial yield increases in many SSA countries, ensuring a diversity of seed varieties and seed sources is critical for farmer nutrition and resilience to shocks.** The focus of governments has largely been on improving access to formal seed markets. Yet informal seed systems can be crucial in providing a rich genetic diversity

of seeds, including locally adapted varieties that are often more resilient to changing weather conditions and hazards than seeds found in formal seed markets. At present, seed laws that are meant to protect farmers from low quality seeds by establishing rules regarding seed registration and certification are often impeding farmer access to a diverse range of seeds, and even punish the possession or trade of traditional varieties. A loss of genetic diversity can however dramatically reduce agroecosystem resilience to environmental or economic disturbances (Alteri 2002). In addition, while the policy focus has largely been on seed, the importance of livestock for food security and livelihoods in SSA warrants greater focus on the genetic diversity of livestock and the role of breeding systems on livelihood resilience and nutrition.

#### **(4) Agricultural advisory services, skills development, and agripreneurship**

- *Provide timely and relevant information through agricultural advisory services and training tailored to different types of farmers.*
- *Ensure that knowledge is accessible on a range of agricultural products, technologies and practices that support diversification, particularly in the context of a changing climate and uncertain markets. Positive outcomes in terms of nutritional diversity can be achieved through farmer training such as in farmer field schools that includes or even focuses on nutrition-messaging.*
- *Enhance the skills and capacity of rural youth to enable them to obtain decent off-farm employment or set up/ engage in agricultural value addition enterprises.*

**In addition, while farmers and farming households require appropriate skills and knowledge to engage in agricultural diversification, the same is true for their ability to find off-farm employment, to pursue vertical value chain diversification, and to consume nutritionally diverse diets.** At present, extension services in most SSA countries and programs such as the Agricultural Technical Vocational Education and Training (ATVET) are not sufficiently developed, but represent a source of untapped potential also for the integration of nutrition-related messages (NEPAD 2013). Finally, farmer organizations and cooperatives can also serve as platforms for knowledge exchange, empowerment of farmers, value addition, and ultimately livelihood resilience, but have remained underdeveloped to date. Supporting their establishment

or development and strengthening the vertical coordination of farmers is an important mechanism to enable farmers to access inputs at lower costs and better output markets, to negotiate better agricultural contracts, and to participate in high-value supply chains (AGRA 2017).

## (5) Natural capital, land, and water tenure

- *Review land and water tenure policies and laws, with the aim of ensuring equitable access and tenure security over these productivity-increasing natural resources for smallholder farmers.*

**Sub-Saharan Africa is still widely characterized by often undocumented customary land tenure, which significantly impacts agricultural investment and production.** Tenure security needs to be strengthened through the recognition and formalization of customary rights; in addition, smallholders' access to water needs to be improved. Land tenure legislation should acknowledge and secure customary land tenure to protect farmers from conflicting claims and expropriation, while encouraging them to invest in resilience-building measures such as soil conservation or agroforestry. Smallholders in SSA also face barriers in accessing and paying for irrigation water with preference often given to large-scale commercial farms and irrigation schemes. Decentralized governance mechanisms—such as Water User Associations (WUAs)—are required to facilitate smallholder access to irrigation water, to manage irrigation infrastructure, and to solve water-related disputes. Ensuring effective and equitable management and regulation of land and water resources can be crucial for facilitating agricultural diversification (Codjoe and Owusu 2011; World Bank 2016).

## (6) Nutrition, health, and social protection policies

- *Intensify nutritional awareness advocacy, training and educational programs to maximize consumption of nutritious foods from both own production and market purchases.*
- *Develop further the focus on nutrition within food assistance policies, including in schools.*

**Nutrition features prominently in food security, health, and resilience strategies of SSA countries.** Yet more can be done to improve nutritional awareness, for instance through food assistance programs, nutrition-sensitive agriculture, or school curricula and meals. Knowledge and awareness on nutrition and indeed all forms of malnutrition are increasingly recognized as a key factor in achieving food security, nutrition and health objectives in SSA countries. Resulting demand for more diverse food can consequently drive diversification. Social protection policies have also become an important component of support to the poorest and most vulnerable people, often incorporating cash transfers or food assistance, and with an increasing focus on nutrition. If effectively implemented, these measures can lead to increased demand for more diversified foods, too, and also increase livelihood resilience to shocks. However, nutrition outcomes are not always met, especially when money is spent mostly on staple cereals or processed food, and when food assistance is similarly comprised largely of staple cereals. These measures need greater focus on dietary and nutritional diversity. Social protection programs that incorporate school feeding or nutrition-sensitive agriculture in school curricula, or otherwise mainstream nutrition into their interventions would see greater success in achieving desirable nutrition outcomes (Omilola and Kaniki 2014).



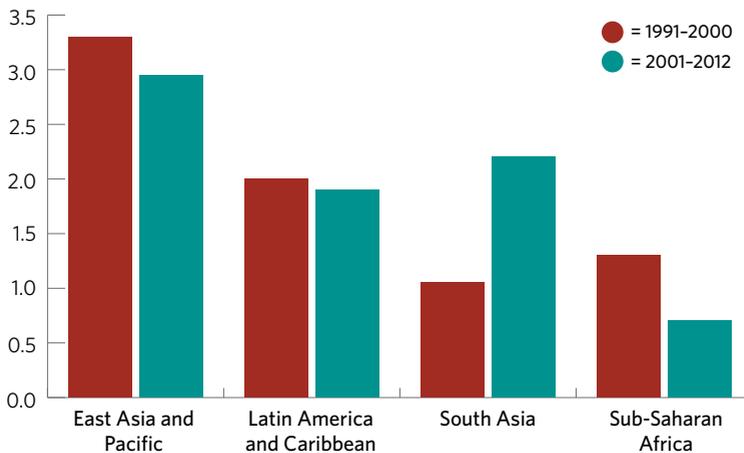
# 1. Introduction

## WHY A REPORT ON PRODUCTIVE DIVERSIFICATION IN AFRICAN AGRICULTURE?

### Despite solid agriculture sector growth, the levels of poverty, food insecurity and malnutrition in Sub-Saharan Africa remain of concern

Agriculture in Sub-Saharan Africa remains the backbone of its economy and sustains the livelihoods of the majority of its poorest households. The agriculture sector in the countries of Sub-Saharan Africa (SSA) contributes on average 15 percent of Gross Domestic Product (GDP) and accounts for around 57 percent of employment.<sup>1</sup> Developments in agriculture are of particular importance to the region's poorest households, as the majority of poor reside in rural areas where employment alternatives are scarce. Empirical evidence confirms that growth in the agriculture sector is one of the most effective ways to reduce poverty (Goyal and Nash 2017; Cervantes-Godoy and Debre 2010).

**Figure 1** Total Factor Productivity Growth in Africa between 2001 and 2012 lagged behind other developing regions



Source: Goyal and Nash (2017)

**Recent agriculture growth in Sub-Saharan Africa has been solid but continues to lag behind other developing regions in terms of productivity.** The overall *economic* growth in SSA during 1995-2013 has been robust with 4.5 percent growth in GDP annually (Barrett et al. 2017), but much of the growth was driven by higher production of mineral and hydrocarbon resources—sectors which are not known to absorb labor force or support inclusive growth (Goyal and Nash 2017). The growth in agriculture output has also been robust recently: between 2001 and 2014 the average annual growth of *agricultural* output in SSA—excluding South Africa was around 3.3 percent, slightly below the 3.7 percent of South Asia.<sup>2</sup> However, as Goyal and Nash (2017) highlight, output growth in agriculture in SSA was not driven by productivity growth but was largely the result of expanding the area under cultivation. This is shown in Figure 1: agricultural productivity growth in SSA during 1991-2012 remained very low in comparison to the other developing regions of the world, especially the East Asia and Pacific region.

**The impacts of overall economic and agriculture sector growth on poverty reduction and food security are, however, mixed: despite relative gains, the absolute number of those suffering from poverty, food insecurity, and undernourishment continues to rise.** The share of people in SSA living below the international poverty line of US\$1.90 has declined from 54 percent in 1990 to 41 percent in 2013, yet the absolute number still increased from 276 million to 389 million (Barrett et al. 2017; World Bank 2016a). Similarly, while the proportion of undernourished people in SSA has decreased, the absolute number of those suffering from chronic food deprivation has continued to rise: from about 176 million during 1990-92 (three-year average) to 256 million in 2017—a staggering 23.2 percent of the population sub-Saharan Africa’s (FAO et al. 2018). Within this period, an increase in the prevalence of undernourishment has been observed in all sub-regions of SSA except for Eastern Africa. Children are particularly affected: the number of those stunted has grown from 50.1 million in 2010 to 58.7 million in 2017, while wasting threatens the lives of an estimated 14 million children (ibid.). Most Sub-Saharan African countries are increasingly experiencing what is called the ‘triple burden’ of malnutrition: persistently high levels of undernutrition and micronutrient deficiencies (particularly in rural areas) occurring in tandem with increased prevalence of over-nutrition and obesity (particularly in urban areas) (IFPRI 2016).

**The persistent prevalence and even increase in food insecurity and malnutrition in SSA is concerning for multiple reasons.** Food insecurity exists whenever the

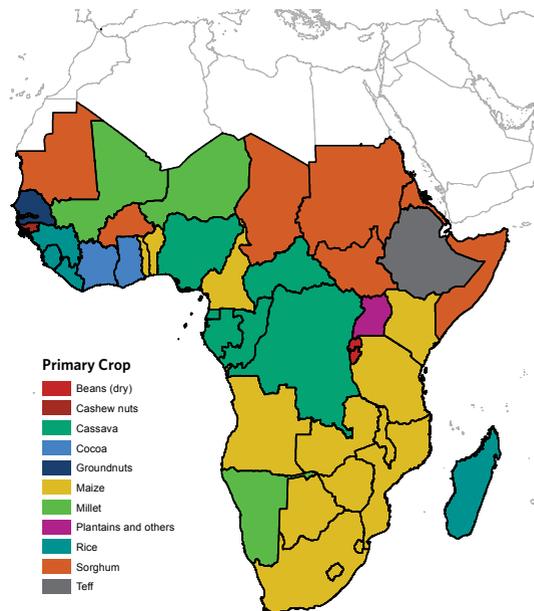
ability to acquire foods in a socially acceptable manner or the availability of safe and nutritionally adequate foods is limited or uncertain (Life Sciences Research Office 1990). Potential consequences include lower nutrient intakes and suboptimal nutritional outcomes such as physical impairment (e.g., wasting, stunting), behavioral and psychological instabilities (e.g., anxiety, stress, depression), lower vocational and academic performance, and even social stigma and isolation (Campbell 1991; Ihab et al. 2013). Evidence abounds that children which suffer from malnutrition during critical phases of their mental, physical and functional developments during the first 1,000 days of their life are likely to bear irreversible, debilitating effects during adulthood. Stunted girls are more likely to give birth to undernourished children, thereby perpetuating the cycle of undernutrition, impeded earning capacity, and ultimately poverty. Low birth weight and stunting in children are also associated with higher risk of overweight and obesity later in life (AU 2015). These social and psychological effects from food insecurity and malnutrition have marked consequences for overall health and well-being, as well as negative economic implications on individuals, households, communities, and countries (FAO et al. 2018). Policy interventions in food and nutritional security are hence critical to reduce poverty and foster economic development in SSA.

### **Agriculture production in Sub-Saharan Africa remains focused on few commodities, exacerbating the challenges of food insecurity and climate change**

**Agriculture sectors in many countries in Sub-Saharan Africa are dominated by the production of only one or few crops.** Globally, 75 percent of the global food supply is derived primarily from 12 plants (mainly maize, wheat, and rice) and 5 animal species (mainly cattle, pigs, and chicken) (Bermejo and Leon 1994). In many of the SSA countries, it is often the case that one single crop accounts for the majority or almost all of the cultivated land. Figure 2 illustrates the distribution of primary crops across SSA: maize dominates in most countries, followed by groundnuts and cassava. In fact, maize accounts for the use of around half of the cultivated land in six countries: Lesotho (61 percent), Zimbabwe (51 percent), Zambia (49 percent), South Africa (49 percent), Botswana (43 percent), and Malawi (43 percent).

**The narrow production base is reflected in food consumption; unsurprisingly, the dominant crops represent a large share of caloric intake.** Globally, only 30 crops supply 95 percent of the calories people obtain from food, and only

**Figure 2** Maize, groundnuts, and cassava most often feature as primary crops in Sub-Saharan Africa



Source: FAOSTAT data for 2009-2014

four crops (maize, rice, wheat and potatoes) supply over 60 percent of the world population (Cook 2018). In Zambia, for example, maize accounts for over 50 percent of the caloric intake of the average household. In Malawi, maize provides for 46 percent of total food consumption, more than 60 percent of energy, and almost half of protein consumption (Ecker and Qaim 2011). Furthermore, studies show that there is a strong correlation between low income and an above-average reliance on maize as the main source of calorific supply (Mason and Jayne 2009). A study in six countries in Southern and Eastern Africa shows that for rural households—classified as poor, vulnerable, or lower-middle income—with around 50 to 60 percent the value of food consumed stems overwhelmingly from their own production. In contrast, the value of food consumed of upper class rural households is ca. 30 percent, and thus equal to the share spent on highly processed foods (GLOPAN 2016).

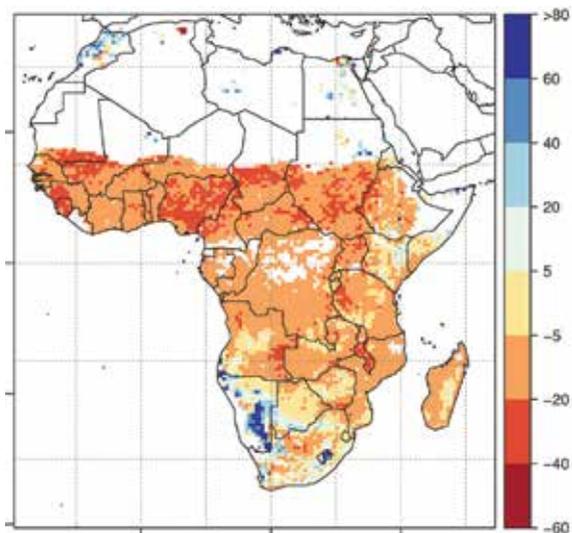
**This heavy reliance on a narrow range of staple crops, or even just one, exacerbates the multiple risks for agricultural production, rural livelihoods and nutrition**

**arising from climate-related stressors and market volatility.** The fact that national agri-food systems in SSA—as well as individual farms and communities—are not sufficiently diversified leads unequivocally to greater exposure to environmental and economic risks and disturbances. Low productive diversification, alongside a frequent lack of assets to buffer against risks, exposes farmers to risks of crop failure, income variability, and consequently malnutrition. In most extreme cases, disturbances in production will lead to severe food insecurity or hunger since poor farming households have low purchasing power to compensate for loss of income or own production. Unsurprisingly, poor undiversified farming households also struggle to recover after shocks as they have limited savings, production assets, and limited opportunities for generating off-farm income.

**Climate change projections for Sub-Saharan Africa are of particular concern.** Climate change affects agriculture and food security already today. While impacts on agricultural yields, crop nutrient content and livelihoods will vary across countries, it is expected that they become increasingly adverse over time. The intensity and frequency of extreme events and extreme dry or wet years is expected to increase (FAO 2016). Reflecting the expected worsening conditions, projections show near-term yield *decreases* of 5 percent, potentially rising to 15–20 percent across all crops in SSA by the end of the century (World Bank 2013). The impacts on cereals, especially maize, are expected to be most severe. Figure 3 indicates how the suitability of crop area for maize is expected to decrease—by up to 50 percent in some parts of SSA.

**Often, the focus on only one or a very narrow range of crops has been, intentionally or unintentionally, promoted by public policy and expenditure.** Input subsidies targeted at providing fertilizer and seed inputs for specific crops dominate agriculture expenditure in many SSA countries, accounting for at least a third of overall spending on agriculture in a sample of 6 countries in Eastern and Southern Africa—ranging from 30 percent in Kenya to 70 percent in Malawi (Goyal and Nash 2017). Input subsidy programs are often combined with support to strategic food reserves which provide a secure market for selected staple crops. For instance, in Zambia between 2008 and 2016, on average, 79 percent of the annual agriculture budget was allocated to input subsidies through the Farmers Input Support Program (FISP) and the Food Reserve Agency (FRA) (World Bank 2017); with the food reserve agency in some years purchasing as much as 80 percent of the maize sold by farmers—a factor which has contributed to about 80 percent of Zambian smallholder farmers producing maize (FEWSNET 2013).

**Figure 3** Projected percentage change in maize production by 2050, relative to the mean production of 1971-2000



Source: Ramirez-Villegas and Thornton (2015)

Note: The map was developed for a high-end emissions scenario and Representative Concentration Pathway (RCP) 8.5.

## PROBLEM STATEMENT

### **Agricultural diversification has the potential to boost the *resilience* and *nutrition* outcomes of farming households and communities**

**Diversification towards on-farm, but also non-farm activities has the potential to enhance resilience of rural livelihoods and agroecosystems to environmental and economic disturbances, as well as to improve household food security and nutritional outcomes.**<sup>3</sup> Diversification is a traditional risk management strategy, a form of self-insurance, to mitigate production, market, or enabling environment risks. It functions both as ex-ante and ex-post strategy to anticipate and cope with shocks, by producing different agricultural products (*horizontal diversification*), engaging in multiple value-added activities (*vertical diversification*), or exit the agricultural sector and engage in non-farm employment (*off-farm diversification*) (Barghouti et al. 2004). By boosting livelihood resilience to environmental and economic disturbances, diversification also has the potential to improve nutritional outcomes. Better nutrition, in turn, can reinforce livelihood resilience,

since well-nourished individuals are usually healthier, can work harder, and have greater physical reserves. Key terms are defined in Appendix A.

**This report explores (a) how productive (on-farm) diversification and specialization in Sub-Saharan African agriculture impact resilience and nutrition at the farm, community, and national level, and (b) which drivers influence farmers' decisions on production strategies.** The report refers to *productive diversification* as the shift from the dominance of production of one crop or livestock type to the production of a wider range of agricultural commodities on a farm (Asante et al. 2017). It acknowledges that farmers' production choices are made according to their socio-economic, environmental, and geographical context and their implicit constraints and opportunities. The report investigates how production decisions towards greater on-farm diversification or specialization can affect agroecosystem and livelihood resilience as well as nutrition outcomes. The report looks at how different drivers—those inherent to the natural environment, as well as those stemming from policy, market and socio-economic circumstances—stimulate production decisions, and which policy recommendations can be derived.

**While the focus of the report is on on-farm productive diversification and specialization, the importance of landscape-level diversification and specialization is also explored.** Farmers may choose to embrace diversification as a key livelihood strategy to reduce risks and uncertainties on their farm with their individual choice resulting in aggregate land use patterns, affecting the extent of diversification in a community, landscape, or region. Thus, at the community level, diversification “implies establishing a dynamic optimal mixture of farm production alternatives capitalizing on between-farm heterogeneity in terms of resource availability and qualities” (Barghouti et al. 2004: 2). Specialization at the farm level does not necessarily lead to landscape-level specialization but can lead to landscape-level productive diversification, with the resulting need of analyzing impacts at levels beyond the farm.

## THE CONCEPTS OF 'FOOD ENVIRONMENT' AND 'RESILIENCE'

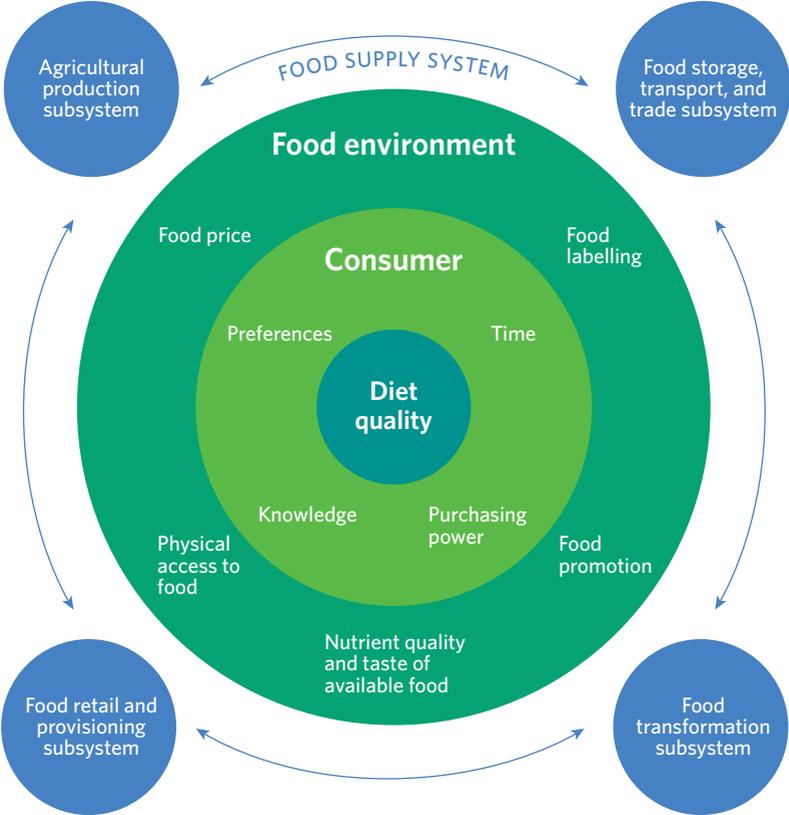
**Food choice and consumption are driven by the food environment, that is, the physical, socio-economic, cultural or political factors influencing the availability, accessibility, acceptance, and affordability of food (e.g., Rideout et al. 2015).** To address the problem of malnutrition, understanding the role of the

different components in the food environment is crucial. A food environment is composed of the physical presence or *availability* of food—through well-developed local value chains or through regional or international trade, a person’s proximity or *access* to local markets or food stores; whether different food items are *affordable*, and to what extent they are culturally and socially *acceptable* (Swinburn et al. 2013; GLOPAN 2016; FAO 2016c). This implies that food production and on-farm availability of food are critical determinants for food security and nutritional outcomes particularly of people without immediate market access.

**The food environment is largely shaped by the surrounding food system, that is, the processes and infrastructure involved in feeding people, from farm to fork** (Figure 4). Elements of the food system that impact the availability of nutritious and affordable food in the food environment are (a) agricultural production, (b) food transformation (e.g., processing), (c) food storage and transport, and (d) retail and provisioning (e.g., informal markets, supermarkets). In light of market and climate-related risks and changes, it is these elements that need to become resilient to meet food and development needs over the short and longer term. A resilient food system, then, can form the building block of a healthy food environment. The extent to which this can materialize in practice is conditional on the individual consumer context where consumption preferences, knowledge, purchasing power and time availability importantly shape individual food choices. Food preferences, in turn, are forged through information and awareness raising (e.g., marketing, advertising, and nutrition messaging).

**To foster resilience in the food system, the adaptive and coping capacities of farmers and agroecosystems must be considered.** Agroecosystems are, wider spatial units of agriculture activity in which resource users interact with the natural environment (Cabell and Oelofse 2012). To account for this intricately linked human-environment or social-ecological system and the impacts of production decisions and risks on both producers and agriculture activity, this report distinguishes between ‘*livelihood resilience*’ of smallholder farmers and rural households whose use and management of land and livestock affects ‘*agroecosystem resilience*’ (BOX 1). Agroecosystem resilience, in turn, relates to the ability of the agriculture system to ensure the provision of critical ecosystem services such as food, pollination or biological pest control in the face of disturbance (TEEB 2015). It is hence a critical component of the food environment, ensuring *food availability* and *affordability* on-farm and through markets. In both

**Figure 4** The linkages between the *food system* and the *food environment*



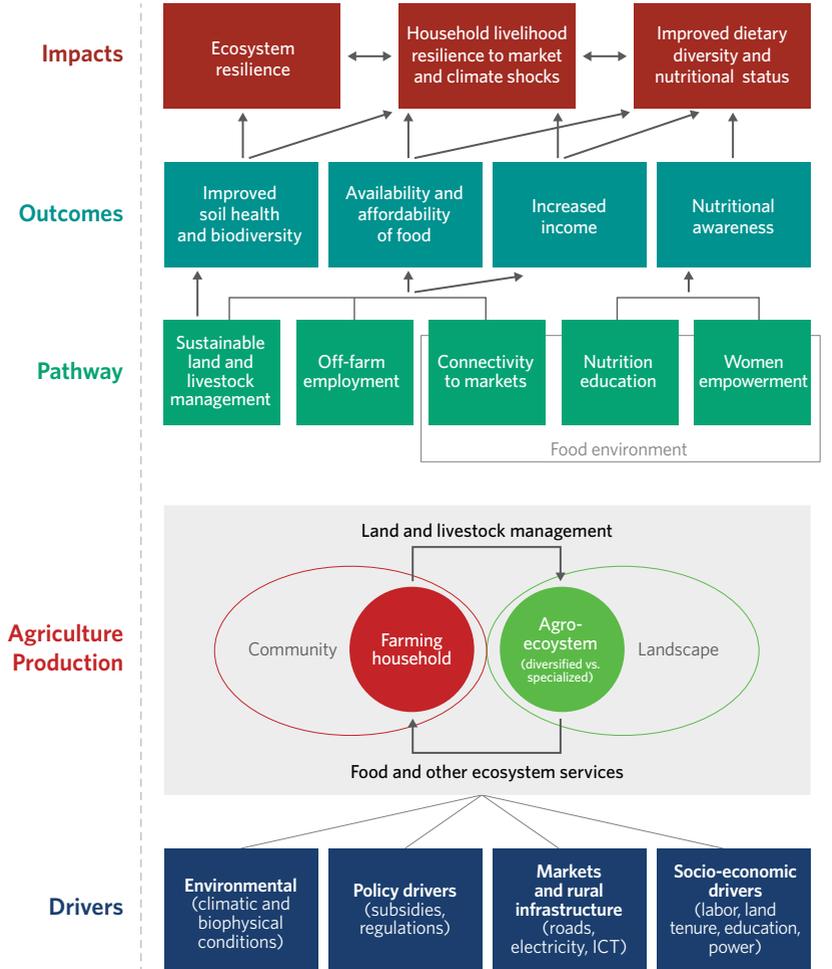
Source: GLOPAN (2016: 27)

cases, resilience is assessed from how effectively farmers and agroecosystems are adapting to and coping with risks from climate change, natural hazards or socio-economic shocks (Altieri et al. 2015; FAO 2014). Common indicators to approximate the achievement of livelihood resilience may relate to stable household income in the face of a shock; the adoption of agricultural practices or technologies to buffer against risks; or knowledge, information and skills that determine people’s capacity to anticipate, respond to, and recover from shocks.

**Figure 5** provides a stylized representation of the interplay between agriculture production and its impact on resilience and nutrition, mediated through different channels or pathways. Since agriculture production is a function of

the dynamic interaction between human activity (that is, land and livestock management at the household and community level) and the benefits to human wellbeing (in the form of food and other ecosystem services), they are presented as coupled human-environment or social-ecological systems. These systems are embedded in a landscape and ultimately a country, and are influenced by a number of drivers, both internal and external to the system.

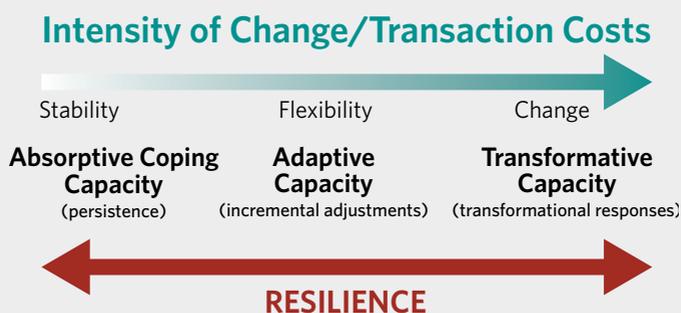
**Figure 5** Stylized pathways between agricultural production and resilience and nutrition



Source: Authors

## BOX 1 UNDERSTANDING RESILIENCE IN THE AGRICULTURE SECTOR

There is no standard definition of resilience. Resilience is a concept originating from ecology and is used today in many fields such as international development, health, community planning, and disaster management. Thus, there is no standard definition of the term. Definitions of resilience tend to center on the ability of systems and its components, which entails people or assets, to anticipate, respond, and recover from stresses or hazardous events in a way that maintains, if not improves, essential system structures and functions (e.g., Walker and Salt 2012). Resilient communities or systems hence possess three specific capacities, namely (1) the ability to prepare for or prevent negative impacts of hazards (*coping or absorptive capacity*); (2) the ability to adjust, modify or change characteristics and actions to moderate potential future impacts from hazards (*adaptive capacity*); and (3) the ability to create a fundamentally new system to avoid negative impacts from hazards (*transformative capacity*) (e.g., de Weijer and McCandless 2015).



Source: Béné et al. (2012)

This report distinguishes between *livelihood* and *agroecosystem* resilience. Livelihood resilience can be understood as “the capacity of people to sustain and improve their livelihood opportunities and well-being despite environmental, economic, social, and political disturbances” (Tanner et al. 2015). Central to livelihood resilience are the coping strategies used by households during times of stress. Livelihood resilience means that a household is better prepared to cope with the impacts of a disturbance, to navigate uncertainty, and to adapt to changing conditions (Quandt et al. 2018). A resilient agroecosystem, that is, “an ecosystem managed with the intention of producing, distributing, and consuming food, fuel, and fiber” (Cabell and Oelofse 2012) has a greater capacity to continue providing vital ecosystem services such as food production that support livelihoods, while being subjected to a shock such as a drought or a severe reduction in rainfall (e.g., Walker and Salt 2006; Quandt et al. 2018.)

## METHODOLOGY

**This report is the result of a set of quantitative and qualitative approaches.** Chapter 2, 3 and 5 on impacts, drivers, and policies are based on an extensive, semi-systematic literature review of academic and gray literature as well as of policy documents. Systematic methods require a structured approach to assess literature and the use of clear inclusion and exclusion criteria for literature selection. The data collection and distillation process is described in Appendix B.

**Though not exclusively, the literature review was centered on 10 countries of Sub-Saharan Africa.** Literature was selected based on a number of criteria related to agricultural diversification, nutrition, resilience, and policy. Amongst the criteria were, for instance, the Simpson’s Diversity Index (SDI), which indicates the degree of diversification in agricultural production value and area covered by specific crops on national level, and which was used to select a mix of countries with differing levels of diversification at national level. The Economist’s food security indicator was used to select countries with moderate to high food security based on food availability, quality, and safety. Regional composition played a role, and countries selected for case studies and literature review were Senegal, Ghana, Nigeria, Democratic Republic of Congo, Ethiopia, Kenya, Rwanda, Madagascar, South Africa, and Mozambique. The criteria for country selection, as well as the number and type of papers, are provided in Appendix B.

**Zambia and Malawi were selected for in-depth quantitative and qualitative analyses of drivers and impacts of diversification as they show a particularly high dependency on one staple crop—maize—which is heavily supported by public funds.** The quantitative analyses were based on an econometric analysis of household-level panel data sets. To complement the quantitative analysis for Malawi, a qualitative study was performed in two districts, aiming at expanding and deepening the understanding of household and community level decision-making processes and results. Focus group discussions, key informant interviews, and in-depth household studies were used to obtain experiences, perceptions, and opinions of main areas of inquiry for the report.

## REPORT STRUCTURE

The report is structured as follows:

- **Chapter 2** analyzes the impacts of production decisions—and in particular diversification or specialization—on livelihood and agroecosystem resilience. The analysis for this section was guided by the following questions, among others: Under what conditions and at what spatial scale (household, landscape, national) is agricultural diversification or specialization most beneficial for nutrition and resilience outcomes? What are the pathways for agricultural diversification or specialization to be beneficial to households, communities and national economies in terms of nutrition and resilience?
- **Chapter 3** turns to the analysis of drivers of agricultural diversification and specialization, exploring how different factors influence production decisions. Factors included the environment, policies, markets and institutions, among others.
- **Chapter 4** is dedicated to in-depth country analyses of Zambia and Malawi with the aim of assessing agriculture production impacts and drivers within a concrete bio-physical, socio-economic, and institutional context. The chapter is built around quantitative econometric analyses of productive diversification in Zambia and Malawi, and the results of a qualitative study undertaken in selected districts in Malawi.
- **Chapter 5** presents an overview of policies and regulations that have been found important to incentivize farmers' production—and to some extent consumption decisions— in Sub-Saharan Africa countries.
- **Chapter 6** concludes with policy recommendations.



## 2. Diversification and Specialization: Impacts on Nutrition and Resilience

*Chapter 2 provides a literature review on the impacts of on-farm productive diversification versus specialization on nutrition and resilience at the household, landscape, and national level. As the impacts are varied and numerous, they are grouped into three ‘pathways’ or channels through which production decisions influence resilience and nutrition outcomes. First, resilience or nutrition impacts of diversification and specialization can be achieved through the ‘natural resources and ecosystem’ pathway or, more broadly, the natural environment a household and community interacts with. Second, impacts can be channeled through ‘income’ pathways. In this case, the focus is on whether changes in production strategies result in higher incomes, off-farm employment, and resilience and nutrition outcomes. Finally, the impacts of diversification and specialization can pass through ‘food environment’ pathways, whereby socio-economic, physical, and cultural factors determine food access, availability, and affordability. Two observations emerge from the review: (i) both diversification and specialization can lead—under certain conditions—to improved resilience and nutrition outcomes; and (ii) the existence and access to well-functioning and well-supplied markets is a very powerful factor.*

### IDENTIFYING IMPACTS OF DIVERSIFICATION AND SPECIALIZATION THROUGH ‘PATHWAYS’

**Production diversification and specialization influence livelihood and agroecosystem resilience and nutrition through three key channels or ‘pathways’.** Due to the complexity of food systems, a structured approach is useful in understanding how production diversification and specialization impact resilience and nutrition of households and communities. This report adopts the use of ‘pathways’ through which diversification and specialization influence resilience and nutrition, organizing them in three key groups:

1. *Natural resources and ecosystem pathways:* whether and how agroecosystem and livelihood resilience—from the household to the community level—and nutrition are improved through the impacts of agricultural diversification and specialization on natural resources and ecosystems.

2. *Income pathways*: whether and how agricultural diversification and specialization affect household income and to which extent this improves resilience and nutrition.
3. *Food environment pathways*: whether and how productive diversification affects the food environment, that is, the physical, socio-economic, cultural or political factors influencing the availability, accessibility, acceptance, and affordability of food, and how this plays out in terms of resilience and nutrition.

## 2.1 NATURAL RESOURCES AND ECOSYSTEM PATHWAYS

**Improved biophysical conditions, preserved natural resources, and healthy ecosystems lead to beneficial impacts on agroecosystem resilience.** Both diversification and specialization can contribute to improved environmental conditions, more sustainable treatment of natural resources, and to the strengthening of agroecosystems. In the former case mainly through greater biological and functional diversity, and in the latter one through the introduction of sustainable land and livestock management practices. But above all, the scale of diversification and specialization matters: diversification will only result in benefits up to a certain point (after which benefits might diminish), while specialization on-farm needs to be balanced with landscape-level diversification to maximize benefits for ecosystem resilience.

### ACHIEVING THE OPTIMAL LEVEL OF DIVERSIFICATION

*Diversification*—and the related increase in biological diversity—contributes to improved agroecosystem function through enhanced ecosystem service flows such as soil fertility enhancement, biological pest control, or pollination, among others (Figure 6). These improvements, in turn, lead to increased agricultural productivity, reduced variability in production, and improved agroecosystem and livelihood resilience to environmental or economic disturbances. A diversity of crop and animal genetic resources on the farm and across the wider agroecosystem also ensures the provision of raw genetic material for nutritional security and dietary diversity. However, diversification has its limits, that is, a threshold beyond which benefits in terms of livelihood resilience start to flatten or diminish.

**Figure 6** Through improvements in the agroecosystem, diversification boosts livelihood and ecosystem resilience

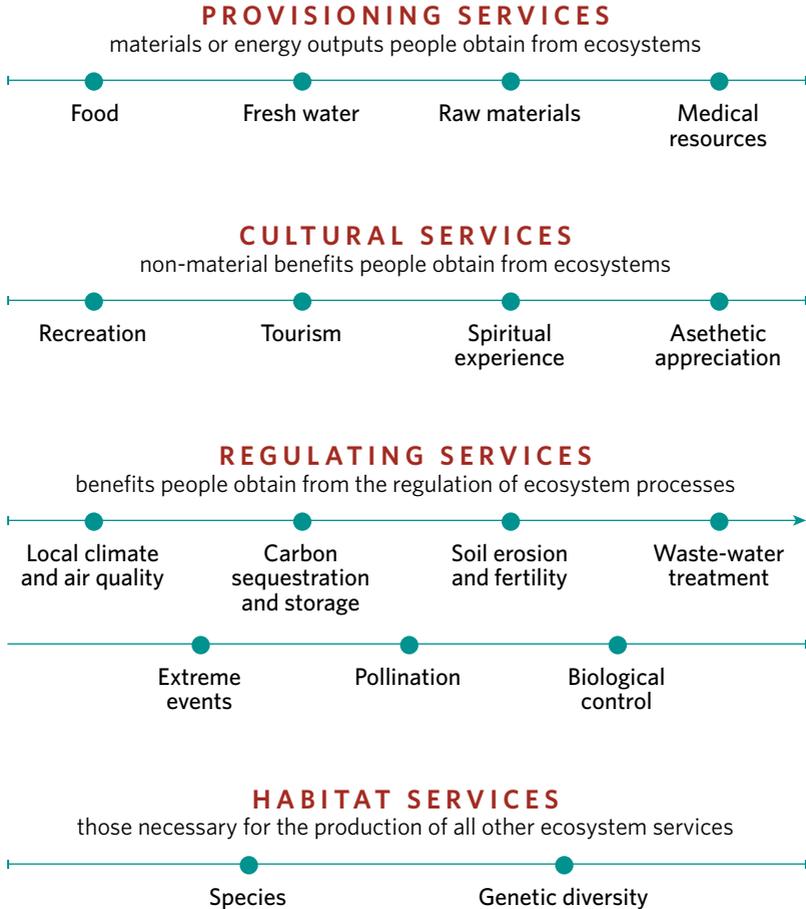


**The effects of diversification on agroecosystems are widely considered as positive.** Today, the effects of biological diversity, that is, the “heterogeneity of genomes, species, and ecosystems” (Carpenter et al. 2009: 1307) on ecosystem function and health are well understood. Biological diversification across different scales (ecological, spatial, and temporal) helps to maintain and regenerate key ecosystem services which are critical to agriculture and not always visible—such as nutrient cycling, freshwater purification, pollination, and biological pest control (e.g., Kremen and Miles 2012; see Figure 7 for an overview). A diversity of crop and animal genetic resources on the farm and across the wider agroecosystem provides for a redundancy in response mechanisms to environmental stressors, contributes invaluable traits to future varieties and breeds, and ensures the provision of raw genetic material for nutritional security and dietary diversity (Cook 2018; Li 2011).

**Agro-biodiversity also provides material for experimentation, innovation and adaptation in the face of climate change, and variability in the form of a diversity in traits such as drought or cold tolerance.**<sup>4</sup> Growing multiple crops and crop varieties, or breeding different landraces may also endow the farmer against market-related shocks such as a sudden drop in crop or livestock prices, and thus enhances livelihood resilience. Genetic diversity of crops and livestock as well as of genetic resources associated with on-farm productive diversification promote the long-term resilience in agroecosystems by allowing for continued ecosystem functioning in the face of change, and by lowering the susceptibility of agroecosystems to social, environmental and economic shocks that may arise from the concentration on one or few species or varieties (Altieri 2002; Baldermann et al. 2016). Moreover, crop varieties that are resistant to pests and diseases can reduce the need for applying harmful pesticides; more vigorous varieties can better compete with weeds, reducing the need for applying herbicides; and varieties that are more efficient in their use of nutrients

require less fertilizer, all of which reduce the dependency of farmers on external inputs and foster ecosystem health (Altieri et al. 2015).

**Figure 7** Services provided by ecosystems and biological diversity<sup>5</sup>



Source: TEEB (2015). Adapted from the Millennium Ecosystem Assessment's (2005) classification of ecosystem services.

**Examples from a variety of geographical locations underline the number of positive impacts that diversified farming systems bring on productivity and agroecosystem resilience.** In a study on the corn belt of North America, Liebman et al. (2013) showed that the conversion of small amounts of cropland to strips

of reconstructed prairie provided large improvements in soil conservation and nutrient retention, and increased the abundance of indigenous plants, pollinators and birds. The diversification of the dominant corn-soybean cropping system with small grain and forage crops led to substantial reductions in agrochemical and fossil energy use, lower herbicide-related aquatic toxicity, and improved soil quality. These benefits were achieved without compromising on profitability. In Malawi, Gilbert (2012) showed that maize yields on experimental plots increased by 116 percent when intercropped with legumes. Diversification can also foster biological pest control and enhance soil fertility at the same time, for instance through 'push-pull' where a natural repellent (push) and an attractant (pull) are managed in an integrated way. Testing the impact of Push-Pull (PPT) adoption on the welfare of smallholders in Uganda, Chepchirchir et al. (2017) found that average maize productivity was nearly three times higher for adopters compared to non-PPT plots. Kremen and Miles (2012) analyzed a variety of diversified farming system practices and their impact on ecosystem service provision, which are summarized in Table 1.

**Agroforestry, or the deliberate integration of trees or shrubs with crops or livestock on the same tract of land, respectively, can foster the provision of ecosystem services and increase both ecosystem and livelihood resilience.**

For example, agroforestry can support the regulation of air quality and simultaneously increase agriculture productivity through enhanced soil nutrient content. This is particularly the case when introducing nitrogen-fixing trees such as *Faidherbia albida* into crop systems. In Malawi, maize yields increased by about 50 percent when planting these trees in farms (Winterbottom et al. 2013). In Senegal, the presence of *Guiera senegalensis* and *Piliostigma reticulatum* shrubs in fields has increased nutrient-use efficiency over crop-only systems. Integrating these species has helped to create 'islands of fertility' which possess higher soil organic matter content as well as phosphorus and nitrogen concentrations below their canopies compared to open areas (ibid.). Agroforestry can further enhance nutritional security and livelihood resilience, for instance (1) through enhancing crop production or the direct provision of tree foods such as leafy vegetables and fruits; and (2) by raising farmers' incomes through the sale of tree products and surplus staples, among others (e.g., Jamnadass et al. 2013).

**In addition to improving agriculture productivity and nutrition, on-farm productive diversification that combines both crop and livestock production also lowers the risk of negative climate change impacts.** Thornton and Herrero

(2014), for instance, showed that farmers who combined crop and livestock production were better able to cope with climate-related hazards. At the same time, animal manure was used as fertilizer and nutritious crop residues as fodder, lowering the dependence of smallholders on external inputs, and improving livelihood resilience. On-farm productive diversification involving the introduction of crops and livestock can hence not only increase dietary diversity, but also improve farm efficiency, allowing for increases in profits that can be turned to positive use.

**The benefits of diversification, however, flatten or decrease once a certain level of diversification is reached.** If too many different species are grown on a small patch of land, they may compete for the same nutrients and water, lowering the

**Table 1** Relationship between diversified farming system practices and the provision of ecosystem services

Diversified farming system practices:	Compost/ manure	Inter- cropping	Agro- forestry	Insectary strips
<b>Ecosystem Service:</b>				
Biodiversity (above & below ground)	●	●	●	●
Soil quality	●	●	●	
Nutrient management	●			
Water-holding capacity	●		●	
Weed control		●	●	
Disease control	●	●	●	
Pest control		●	●	●
Pollination		●	●	●
Carbon sequestration	●		●	
Energy-use efficiency	●	●	●	●
Resilience to drought	●		●	
Resilience to hurricanes/heavy rains	●	●	●	
Productivity/yields	●	●	●	●
	<b>Within field</b>			

Source: Kremen and Miles (2012)

productivity of the farm. Findings also suggest that there may be an upper limit or saturation point of diversification beyond which the benefits to ecosystem resilience become smaller and may even start decreasing (Cardinale et al. 2012). The same threshold seems to hold in terms of nutrition outcomes. Several studies suggest that while greater farming diversity is generally positively associated with dietary diversity, this may hold true only to a certain level of diversity per ha of cropland. Especially when production diversity is already high, the association can even turn negative when diversified production results in lower cash incomes due to foregone farm sales from specialization (Sibhatu et al. 2015). More diverse farming systems can hence contribute to household food security; however, the relationship is influenced by other factors such as household market orientation, livestock ownership, or off-farm employment opportunities (Waha et al. 2018).

	No till/ Low till	Crop rotation	Cover crop/green manure	Fallow	Border planting	Riparian buffers	Woodlots/ meadows/ forests
	●	●	●	●	●	●	●
	●	●	●	●	●	●	●
		●	●		●	●	●
	●		●	●			
		●	●				
		●	●	●	●	●	●
		●	●	●	●	●	●
	●		●	●	●	●	●
		●	●		●		
	●		●	●		●	
	●	●	●	●	●	●	●
	●	●	●	●			
	Field				Perimeter	Landscape	

## SPECIALIZATION CAN INCREASE LIVELIHOOD RESILIENCE, BUT TENDS TO REDUCE ECOSYSTEM RESILIENCE

While usually considered damaging to agroecosystems, on-farm specialization can be combined with sustainable natural resources management to support agroecosystem function and resilience. The most important unit of analysis is not a single farm, but the wider landscape. If a combination of individual, specialized farms results in a diverse production landscape, benefits can be tangible. Yet, if specialization on only one crop variety or livestock breed occurs at the landscape level and over a longer period, negative impacts on agroecosystem and livelihood resilience will emerge (Figure 8).

**Figure 8** By adopting sustainable resource management, on-farm specialization can improve ecosystem resilience



**Specialized farming is largely associated with reduced agroecosystem function and related services.** Multiple studies from around the world have shown that agricultural specialization leads to landscape simplification, that is, increasingly homogenous land use, the loss of non-crop habitats, and hence the loss of plant and animal biodiversity. This reduces ecosystem services on which agriculture production critically depends (Bennett et al. 2015). Hydrological functions, decomposition services, and carbon sequestration may be impaired, too, as well as cultural services such as landscape aesthetics (Klasen et al. 2016). Research suggests that as the intensity of specialization increases, the use of inputs such as synthetic fertilizers, insecticides and herbicides increases as well (intensification)—with potentially negative effects on both human and environmental health (Pingali and Rosegrant 1995).

**Land use intensification can reduce soil health through the reduction of critical soil organisms or insect and bird species necessary for biological pest control.**<sup>6</sup> This can increase the fragility of agriculture systems to pest outbreaks and other climate-related shocks (Landis 2017). Likewise, the use of pesticides in

monoculture cropping systems has shown to reduce the number of pollinators such as bees around the world, thereby lowering one of the most critical services for ecosystem function and resilience (FAO 2016a). Negative environmental costs can be lowered by reducing the amount of inorganic inputs, and by introducing more sustainable practices. Independently of the use of inputs, though, agroecosystem resilience in specialized monoculture systems is low by default since single hazards—for example a pest or disease—can wipe out the entire production system as every individual plant offers the same degree of resistance or functional response, respectively, to a given pest or disease. Concentration on only one crop or genetic variety also poses a high risk to farmers against which they often cannot properly insure themselves (Klasen et al. 2016).

**Specialization can be conducted in a more sustainable manner when on-farm sustainable and climate-smart practices such as crop rotations and fallows are applied, but also when landscape-level diversification is ensured.** Using deficit irrigation in irrigated wheat systems in China, for instance, showed that water savings of 25 percent or more could be achieved (FAO 2011). This in turn reduced leaching and enhanced crop-fertilizer response, lowering fertilizer application rates. Yet soil salinization was still to be carefully monitored and managed. An assessment of productive alliances in South America underlined the importance of placing greater focus on environmental sustainability through ‘productive landscapes’, as opposed to promoting on-farm sustainable practices only (Altieri and Nicholls 2006).<sup>7</sup> In other words, while the use of sustainable on-farm practices such as crop rotation or agroforestry plays a key role in ensuring the sustainability and resilience of individual farms, the diversity of production across landscapes is critical in ensuring that even specialized farms contribute to broader agroecosystem and landscape-level resilience.

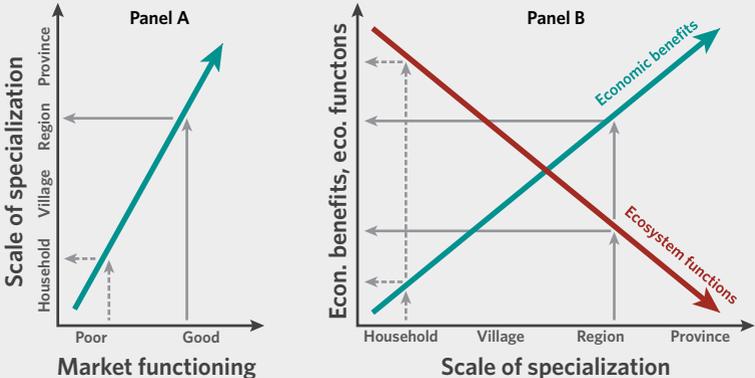
**The decisive factor that determines resilience and nutrition impacts of specialization are the spatial and temporal scales of specialization.** Kahane and others (2013) demonstrate that as specialization moves from the household level to the village or community level, the agroecosystem weakens and becomes more vulnerable to shocks associated with climate change, disease outbreaks, and pests. Similarly, Klasen et al. (2016) demonstrate the increase in ecological trade-offs with increased temporal scale of specialization on monoculture crops (BOX 2): In the shorter term, the progressive loss of agroecosystem functions and services may only have a minor effect on the profitability of crops. Yet, reduced crop diversity and potential soil depletion arising from longer-term

intensification can result in a drastic reduction of critical ecosystem services such as crop production. This may undermine the profitability of monoculture systems at large, and even threaten food security in case local product markets cannot provide for sufficient food diversity at affordable costs. Considering the economic and ecological trade-offs across scales underlines the importance of minimizing landscape level specialization, and to focus analysis beyond the level of individual farms.

**BOX 2 ECONOMIC AND ECOLOGICAL TRADE-OFFS WITH INCREASED SPECIALIZATION**

Klasen et al. (2016) demonstrate a possible dilemma in terms of ecosystem functions posed by improvements in the functioning of markets, which in turn depends on the scale of analysis. Improved markets can provide increasingly powerful economic incentives for specialization even without political interference. If market functioning is poor, specialization may only occur at the level of an individual farm (gray lines in panel a). In that case, economic benefits are generated for the respective farmer with few ecological costs overall since the diversity of crops remains high within the village. Yet, with increased spatial scale of specialization arising from better market functioning (black arrow in panel a), economic benefits may increase beyond the farm level, reducing ecosystem functions (panel b). The authors speak of a scale-dependent trade-off between specialization and ecosystem functions driven by market functioning.

The functioning of markets, the scale of specialization and the economics benefits and ecosystem functions



Source: Klasen et al. (2016)

## 2.2 INCOME PATHWAYS

**Productive diversification and specialization can both improve livelihood resilience and nutrition outcomes by generating higher and more stable incomes, as well as new off-farm employment opportunities.** When markets are well developed, increased incomes can represent an important pathway to boosting livelihood resilience and nutrition outcomes. Both diversification and specialization can, under specific conditions, enable farming households to generate higher incomes (or savings), but the specific context needs to be taken into account. Above all, markets need to generate sufficient demand for produce over longer periods of time, while in parallel offering a continuous supply of diversified and affordable food. Diversification and specialization can also lead to new off-farm employment opportunities that enable households to better manage risks through increased, more stable and more diversified incomes.

### MARKET ACCESS AS AN ENABLING FACTOR FOR GREATER INCOME GENERATION

Increased household income in most cases leads to improved resilience, especially against market and climate shocks, and better nutritional outcomes. Both on-farm diversification and specialization can contribute to higher—and more diverse and stable—earnings; yet, they are dependent on access to functioning markets where surplus crops can be sold for profit. Access to markets, in turn, enables households to choose from a larger variety of foods and thus to diversify their consumption further (Figure 9).

**Figure 9** Productive diversification in combination with market access can lead to increased incomes and resilience



**Overall, on-farm diversification increases and diversifies household incomes, provides a buffer against market price fluctuations, and improves nutritional**

**outcomes.** For the majority of households that depend largely on the use of natural resources for their livelihoods, as is the case in most Sub-Saharan African countries, increasing farm income is key for livelihood resilience to environmental or economic disturbances (e.g., Klasen et al. 2016). Evidence indicates that market-oriented on-farm productive diversification is the most viable option to ensure food security, smallholder welfare and resilience to market shocks, due to its potential to raise household income (Pingali and Rosegrant 1995). Income generated from diversified agricultural produce may enable farm households to purchase a variety of nutritiously rich foods, especially animal proteins, which households may not produce themselves (Timmer 1997).<sup>8</sup> This improved ability to access and purchase diverse foods can improve household nutrition, health, and resilience (Gebremedhin et al. 2017). Moreover, income from diversified products sold at markets can help in stabilizing household food consumption through time, including lean seasons (Timmer 1997).

**Increased incomes can be the result of on-farm diversification or specialization, as long as the farming household is connected to a functioning market.** Raising farm household incomes is key for building livelihood resilience and can be an important pathway for enabling the purchase and consumption of nutritious foods—regardless of the farm itself being specialized or diversified. The necessary precondition is rather that farms produce not only for subsistence, and that the farm is connected to well-functioning input and output markets. This has important implications for opportunities on the non-farm rural economy, which includes activities in industry and services. A large share of activities is linked to the agriculture sector, such as buying and selling agricultural products, processing raw agricultural materials, or providing services in support of farm production (McCullough 2018). Thus, growth in agricultural productivity through diversification or specialization increases production surplus for processing and supports growth of the rural economy (Christiaensen et al. 2011).

**The impacts of diversification or specialization on household incomes are not linear. There is a threshold beyond which the impacts on income may diminish.** In general, both production diversification and specialization can lead to higher incomes among farming households, but the links may not always be clear. A study conducted in Kenya among ultra-poor households found that on-farm diversification led to higher income, increased food consumption, and more stable incomes over the year (Romeo et al. 2016). In contrast, a study

from Niger revealed a negative relationship between crop diversification and income, emphasizing differences across welfare classes and the relevance of the socio-economic context (FAO 2016). Country studies on Zambia and Malawi conducted within the scope of this report confirmed diversification benefits in terms of increased household incomes, but only up to a certain level of diversification beyond which income benefits started to diminish. One reason may be a tradeoff towards the production of cash crops in specialized farming systems that could yield high incomes on markets (see e.g. Sibhatu et al. 2015). Ultimately, the effect of diversification on income follows a non-linear pattern, and underscores the need to consider several factors such as farm size and market access when comparing the benefits between production systems.

### OPPORTUNITIES AND CONSTRAINTS OF COMMERCIALIZATION

When market access is guaranteed, specialization can facilitate agriculture commercialization, and lead to improved profitability and on-farm incomes. However, specialization also increases dependence on external inputs, and can lead to worse food security and livelihood resilience outcomes in the absence of well-functioning input and output markets (Figure 10).

**Figure 10** Sustainable specialization can lead to higher incomes and improved livelihood and agroecosystem resilience



**Agricultural specialization and commercialization can lead to higher incomes, especially in contexts where farmers are able to access well-functioning markets.** When specialization and commercialization happens in a context of functioning input and output markets, these production decisions could become fundamental pillars for agriculture and economic development. Specialization can increase cross-border and international trade, which in turn is an important route for improving farmer income and welfare (Carletto et al. 2017).<sup>9</sup> Over a longer period of time, sustained access to markets can also

support the accumulation of productive asset such as land. Under favorable conditions and much like diversification, specialization and commercialization can improve livelihood resilience through the income pathway (BOX 3).<sup>10</sup>

### **BOX 3 HOW AGRICULTURAL COMMERCIALIZATION AND SPECIALIZATION IMPROVE RESILIENCE AND NUTRITION: SOME EXAMPLES**

Using nationally representative household panel survey data collected from three African countries—Malawi, Tanzania, and Uganda, under the Living Standard Measurement Study-Integrated Surveys in Agriculture (LSMS-ISA) initiative—Carletto and colleagues (2017) examine how agricultural commercialization affects (a) national and community food availability, (b) the ability of households to obtain food, and (c) intra-household food distributions. The study shows that there is a positive, albeit weak, relationship between commercialization and improved nutritional status.

Papaioannou and others (2014) use primary sources of data from seven countries in Africa —Uganda, Kenya, Tanzania, Gambia, Sierra Leone, Nigeria and Ghana—to construct a cross-sectional, district-level index which captures smallholders' involvement in the export crop economy ('cash crop economy'). They conclude that districts with relatively higher levels of specialized and commercialized agriculture—those with more cash crop farming—were significantly more resilient (measured in terms of social tension and distress, proxied by using annual imprisonment levels) compared to those with less cash crops. The authors also find that infrastructure associated with specialized and commercialized agriculture, such as roads and storage facilities, as well as the use of improved varieties of seeds and efficient markets were also indirect contributors to resilience. The study did not, however, take into account the number of crops produced but simply looked at cash crops versus subsistence crops, with the assumption that cash cropping meant a certain degree of specialization. Yet, the results are still telling: under certain conditions, there are benefits of diversification away from subsistence grains to more market-oriented cash crop production.

*Sources: Papaioannou et al. 2014; Carletto et al. 2017.*

**Increased income from specialization or commercialization may not translate into improved nutrition outcomes, however, as food security on-farm can deteriorate with the departure from subsistence farming.** A study by Aromolaran (2004) conducted in Nigeria finds that among low-income households, an increase in income does not necessarily translate into increased caloric intake. Studying Eastern Uganda, Whyte and Kyaddodo (2006) found that rice cultivators sell most of their produce and often face starvation at the

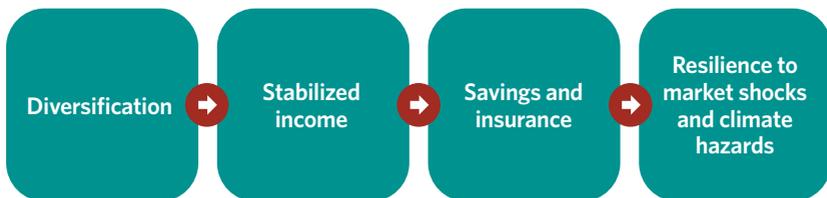
same time. This is an important caveat of specialization or commercialization: food security is inextricably linked to food availability, access, utilization and affordability. In fact, improving the productivity of few cash crops to gain higher income has limited potential for improving food security when farmers face constraints on market access or when food prices are prohibitive (and price movements unpredictable).

**Agricultural specialization can also lead to greater dependence on external inputs.** Specialization rests on the introduction of new production techniques, but also new inputs, such as seeds, inorganic fertilizer, pesticides or herbicides. As Pingali and Rosegrant (1995) note, specialization can lead to increased dependence on external inputs, as farms substitute non-tradable inputs (e.g., farmyard manure) with purchased inputs (e.g., inorganic fertilizers), and hence reduce livelihood resilience.

## THE BENEFITS OF DIVERSE INCOME STREAMS

Farmers are inevitably exposed to market and climate-related risks. In order to cope with these risks, they adopt different strategies—one of them is diversification, as income streams from a diverse range of agricultural produce leads to more stable income. This allows households to generate savings and boost resilience through better risk management strategies. However, on-farm diversification alone might not be enough when market prices of various goods are correlated and prone to simultaneous swings (Figure 11).

**Figure 11** Diversification can lead to more stable incomes, allowing households to save and boost livelihood resilience



**Farmers are often exposed to market price shocks and climate-related hazards.** This is the case also in many Sub-Saharan African countries where the majority of the farming households are poor and are largely dependent on low-input,

rained agriculture as their main source of livelihoods. In these countries, farmers face many different types of risks that affect their yields (e.g., weather-related risks like droughts and floods, crop and livestock pest and diseases) as well as incomes directly (e.g., market price fluctuations). With many Sub-Saharan African countries exhibiting limited agricultural diversity also at aggregate level, systemic production risks—that is, risks that affect large parts of the sector such as droughts, as opposed to risks that affect an individual such as robbery—easily translate into price fluctuations.

**Households adopt different strategies to cope with risks; many seek to increase and stabilize income, but the success of these strategies often depends on external factors.** Households cope and adapt to market fluctuations through (a) diversification of income (e.g., off-farm sources of income), (b) stabilization of income (e.g., production diversification, reliance on drought-resistant crops) and (c) precautionary measures (e.g., precautionary saving and informal risk sharing). The first two are dependent on external factors such as markets where diverse produce can be sold. When conditions are right, however, these strategies improve livelihood resilience not only to market shocks, but also to other shocks including those associated with climate change. Studies from Nigeria and Ethiopia, for instance, showed that crop diversification helped farmers deal with droughts and other climatic hazards that could endanger crop production otherwise (Martimore and Adams 2001; Cavatassi et al. 2012). On-farm productive diversification, when combined with greater market activity, also reduces community dependency on a narrow range of outputs and as a result enhances livelihood resilience to volatility of commodity prices (Barghouti et al. 2004).

**However, on-farm productive diversification alone—without diversification at the landscape level—might not be sufficient to cope with price shocks, as prices of agricultural crops are often correlated.** Dejene and others (2011) show that on-farm diversification involving mixed farming improves livelihood resilience to shocks by providing income streams that are non-correlated, under the precondition that farmers have access to functioning markets. For example, a farmer who engages both in crop and livestock farming can generate additional income from livestock for cash which can be used to buy food when crops fail (Twine 2013). However, Quiroz and Valdés (1995) note that on-farm productive diversification—when implemented at household level only—is unlikely to lower market risks since prices for agricultural commodities are

often correlated and may react in a similar pattern to national macroeconomic shocks. In addition, although on-farm productive diversification may lower risks by enlarging the basket of items produced, there are other risks involved in the undertaking of new and varied activities. Barghouti et al. (2004) argue that farmers' limited knowledge of these risks also plays a key role in their ability and willingness to diversify successfully.

**An increase in incomes—and their greater stability—can enable households to save and invest in better risk management strategies.** When on-farm diversification generates positive income effects, it enables households to adopt better risk management strategies against environmental and economic disturbances at the same time (Romeo et al. 2016), because increased earnings boost the households' ability to save and invest in shock/risk absorbing strategies such as crop insurance (Berzborn 2007). In addition, more stable incomes enable households to improve their resource allocation, to increase their adaptive capacity to climatic stressors, and to boost livelihood resilience (e.g., Folke et al. 2010).

**Diversification can also generate savings due to its positive effects on the agroecosystem and by eliminating the need to purchase production inputs such as seeds, fertilizer or pesticides regularly.** By limiting pests and diseases on farms due to biological pest control, on-farm diversification may lead to financial savings as a portion of income would otherwise be spent on inorganic inputs (Lin 2011; Pingali and Rosegrant 1995). Similarly, growing legumes or traditional plants alongside crops can further help households save money when these items otherwise be purchased on markets. In West and Central Africa, for example, on-farm crop diversification is often an integral part to ensuring the availability of traditional medicine from the leaves of indigenous plants. For example, *Telfairia occidentalis* leaves are used both as food and medicine and can generate savings when produced on-farm<sup>11</sup> (Aworh 2015; Otitoju et al. 2014). Another example is the tree *Moringa Olifera* which can be used for production of soap, oils, and as medicine, while contributing to a more sustainable and profitable farm at the same time. Wild oil palm is often considered a weed, but can also be intercropped with food crops and generate additional household income, thereby increasing livelihood resilience to market and climate-related risks (Ruf 2014).

## THE DEVELOPMENT OF VERTICAL VALUE CHAINS

The development of vertical value chains, also referred to as ‘vertical diversification’, leads to greater added value and potentially increased agricultural incomes. In parallel, the development of value chains opens new employment opportunities and reduces food loss, contributing to improved household food security and eventually livelihood resilience (Figure 12).

**Figure 12** ‘Vertical diversification’ generates new added value, reduces food loss, and creates off-farm jobs



**Vertical value chain diversification improves livelihood resilience and nutritional outcomes through higher incomes and income diversification off-farm.** Vertical diversification re-organizes production in a series of tasks (e.g., producing, cleaning, grading, packaging, advertising and marketing) that individually provide new opportunities for income generation for a variety of participants (e.g., farmers, market agents, private sector, transporters). The development of a value chain thus creates new employment opportunities and can potentially improve household resilience and nutrition through improved incomes, including from jobs off-farm (BOX 4). The co-operation of different actors along the vertical value chain can create synergies between production, innovation, and generation of new products, markets, and supporting institutions such as banks. Processors, transporters, and marketing agents benefit from farmers’ products, while farmers benefit from an extended shelf life—that is associated with processing—of agricultural products and increased income (Block et al. 2016).

#### **BOX 4 VERTICAL VALUE CHAIN DEVELOPMENT AND NEW JOB OPPORTUNITIES: AN EXAMPLE FROM KENYA**

Using data from an income survey of 263 households in Kenya, a study by the Institute of Development Studies (2002) examines the relationship between household income and vertical value chain integration. As poverty in Kenya is widespread—about 46 percent of the population lives below the poverty line—the research findings for the poorest households are very informative about the effects of vertical value chain development, such as horticulture. Results indicate that horticulture benefits the rural poor mainly through providing them with opportunities as laborers (in packaging and consolidation) and thus new sources of income. Relatively low-income households and unmarried women benefit most from the substantial employment opportunities created by horticultural farming business.

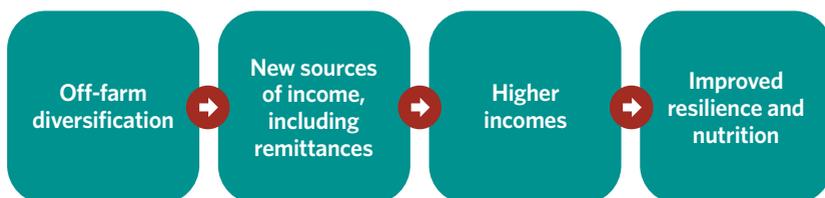
The study also reveals that increased incomes attract young people to enter horticultural farming and, most importantly, to try new crop varieties. Their ability to do so is assisted by the availability of family labor because horticultural farming is a high labor intensity venture. Support measures (e.g., on how to export, access to credit and extension services) provided to these farmers encourage others to participate in the horticultural business. The study concludes that welfare improvement policies should not have a preference toward any particular form of engagement with any specific sector. Instead, policy should focus on reducing barriers to the participation of the poor in different agricultural subsectors and value chains, as this can raise their income, improve their nutrition, and consequently improve their resilience.

*Source: Institute of Development Studies (2002)*

### **OFF-FARM DIVERSIFICATION AND THE IMPORTANCE OF REMITTANCES**

Off-farm employment and remittances are important sources of income, which improve livelihood resilience to climate hazards and market fluctuations, and contribute significantly to dietary diversity and nutrition (Figure 13).

**Figure 13** Off-farm diversification provides new sources of income and boosts resilience



**Off-farm employment generates additional income that can improve the resilience and nutritional outcomes of farming households.** In many countries in Sub-Saharan Africa, off-farm diversification is an income-generating pathway through increased short-term employment (von Braun 1995; Motbainor et al. 2016). Income of migrants working away from home for extended periods is often sent to the areas of origin in the form of remittances. Off-farm activities can include agri-business activities, but also activities outside farming, engaging both skilled and unskilled labor through part-time or full-time work.<sup>12</sup> Benefits are many: off-farm income (including remittances) helps to reduce farm-related income risks (Martin and Lorenzen 2016; FAO 2004), provides capital that can be reinvested in the agriculture sector (Headey et al. 2014), and provides extra income that is often used to buy nutritious foods (Ng'ang'a et al. 2016b). Off-farm income can also be used to acquire productive assets and technologies to lower farm vulnerability to economic and climatic stressors while increasing farm productivity at the same time. Examples entail more drought-resistant seeds, locally adapted livestock breeds, or irrigation technologies (Ng'ang'a et al. 2016a, 2016b; Barghouti et al. 2004). Due to their diverse benefits, off-farm activities can make a crucial contribution to household diets and health, and can enhance livelihood resilience more generally (Owusu et al. 2011; Tsiboe et al. 2016).

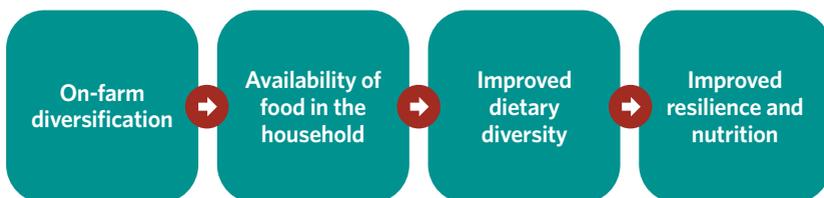
**The positive impacts of off-farm diversification extend beyond livelihood resilience and nutrition—often, these incomes are a pathway out of poverty.** Additional (and more predictable) income can be used for non-food related expenditure such as improved child and maternity health care as well as education. Better health and education, in turn, enhances the likelihood of higher household incomes due to improved employment opportunities in the future. In addition, households with good nutrition and better health are more productive and more resilient to shocks (FAO 2014b). Paternostro et al. (2004) showed that households who diversify their income sources by participating in non-farm activities are less likely to be poor, have higher income, and are therefore more likely to bridge their food gap in lean seasons through purchases. Remittances can also increase households' capacity to withstand shocks, such as death, injury, environmental disasters (FAO 2014b). Due to its important role in increasing and stabilizing income of the poorest households, off-farm diversification has been suggested as a pathway out of poverty (Cunguara et al. 2011).

## 2.3 FOOD ENVIRONMENT PATHWAYS

### THE EFFECT OF OWN PRODUCTION AND WOMEN'S EMPOWERMENT ON DIETARY DIVERSITY

On-farm diversification—to a certain level—leads to increased household dietary diversity and better nutritional outcomes through *direct availability of food*, especially when crop and livestock production are combined. This effect is particularly pronounced for children. Yet, access to well-functioning markets can have a similar impact, and so does women's empowerment and gender equality—that is, the socio-economic and cultural factors shaping the food environment. In fact, a greater influence of women on household decisions can help mitigate the detrimental effects of low diversity of production (Figure 14).

**Figure 14** On-farm diversification increases the diversity of food directly available to the household



**On-farm productive diversification has been associated with improved dietary diversity, but other factors such as proximity to markets may be equally important.** Numerous studies showed that productive diversification increases dietary diversity since food for own consumption is directly available to households (Jodlowski et al. 2016; Sibhatu et al. 2015). Particularly in rural remote areas where household access to food depends largely on own production, crop diversification provides farmers with a diversity of crops they cannot access otherwise – either because of high costs or infrastructure constraints (Adjimoti and Kwadzo 2018). For instance, an analysis conducted in Zimbabwe by Makate and others (2016) showed that an increase of on-farm crop diversification by 1 unit led to a 0.6 increase in dietary diversity—a significant impact on the household's diet. Similarly, a study of 13 sites highly exposed to weather risks in South Asia and East and West Africa revealed that the most food secure farmers were also the most diversified in terms of the number of crop and livestock species produced on the farm (OECD/ UN ECLAC 2012). However, the study showed that households

also needed to possess nutritional awareness for consumption to result in better dietary outcomes, underlining the importance of other factors within the food environment beyond on-farm availability. To this end, many studies also note that access to well-functioning markets is important, often driving production decisions in the first place (BOX 5). For instance, in a study covering 600 households in Kenya, Uganda, and Tanzania, Silvestri and colleagues (2015) show that food secure farming households have a wider variety of crops on their farms and are more market-oriented than food-insecure households.

**On-farm diversification can have a particularly strong positive impact on children.** Studying households in Zambia, Kumar and colleagues (2015)

### **BOX 5** THE IMPORTANCE OF MARKET ACCESS FOR DIETARY DIVERSITY

Sibhatu et al. (2015) use data from Indonesia, Kenya, Ethiopia, and Malawi to analyze the relationship between production and consumption diversity in smallholder farm households.<sup>a</sup> Their findings show that on-farm productive diversification was positively associated with household dietary diversity. The magnitude of the effect, however, differed depending on the level of farm diversification in each country. For the countries whose production diversification is low (e.g., Malawi and Indonesia), adding few additional crops or animal species was associated with a positive and relatively high level of dietary diversity. However, after a certain threshold of diversification, further diversification resulted in no change or even lower levels of dietary diversity.

The authors attribute this to potential trade-offs between the amount of produce to be sold on markets vs. thus for own consumption. In addition, they found that the link between farm productive diversity and dietary diversity does not universally exist and may depend on the type of farm (e.g., subsistence or commercial focus), size of the farm, and the distance to markets. Most importantly, even in the face of improved incomes, there was a significant inverse relationship between household dietary diversity and distance to food markets; implying that the closer a farm was to the markets, the higher the dietary diversity.

The research also shows that in order to diversify diets, farm diversification does not require a subsistence production system. In fact, since the distance to market reduces the effect of on-farm diversity on household dietary diversity, the distance to markets may be more important for household nutrition than actual diversification.

*Source: Sibhatu et al. (2015)*

Note: (a) The data from Kenya and Indonesia referred to specific regions within the countries, focusing on locations where smallholder cash crop production dominated. The data used in the study for Ethiopia and Malawi were nationally representative.

report a strong positive relationship between production diversity and dietary diversity among younger children aged 6–23 months, and significant positive associations between production diversity and height among older children aged 24–59 months. In a study on Ethiopia, Hoddinott and colleagues (2015) found that keeping cattle—alongside farming—raised children’s milk consumption, increased growth, and reduced stunting. This impact was particularly pronounced among those households better connected to markets. To improve maternal and children’s nutritional status, the authors underlined the importance of nutritional awareness among caregivers, which increased with rising market access.

**Nutritional awareness and women empowerment can have equally positive impacts on improved household nutrition as on-farm diversification.** Women empowerment—that is, facilitating women’s access to productive resources to the same level as men—influences nutrition through several ways. This includes caring capacity and time use, on- or off-farm workload, and women’s control of resource allocation and income (Carletto et al. 2015; Malapit et al. 2015). Empowered women can efficiently allocate their time for child care and feeding, for agricultural work, and for household chores so as to enhance household, maternal and child nutrition as well as child education. Quisumbing et al. (2014) estimate that empowering women globally would increase yields by 20–30 percent and reduce the malnourished population by up to 150 million people.

**Even on farms with low productive diversity, nutrition outcomes can be improved through the empowerment of women.** Studying households in Nepal, Malapit and colleagues (2015) find that while on-farm productive diversification is positively related to maternal and child dietary diversity, women’s empowerment can mitigate the negative effect of low productive diversity on maternal and child dietary diversity including child stunting. The authors indicate that factors such as women’s group membership, control over household income, increased gender equality, and reduced workload are all positively associated with better maternal and child nutrition, and, arguably, livelihood resilience.

**Similarly, gender equality plays a critical role for nutritional outcomes within the household more generally, and among children and women in particular.** According to FAO et al. (2018), the distribution of food and resources within a household is influenced by various cultural and social factors. Especially when resources are scarce, children and women can be discriminated against in the

distribution of food, with mothers often adjusting their food intake to buffer against food insecurity among their children. Increased decision-making power and gender equality in a society are pivotal for every household member to access food equally, and hence to guarantee for food security and nutrition for both women and children (ibid.).

## THE IMPORTANCE OF WELL-SUPPLIED FOOD MARKETS AND CONSUMER EDUCATION

Diversification of crop and livestock production at the local, regional and national level results in increased diversity of food supply through markets. Increased supply results in more affordable prices, enabling consumers to purchase a greater variety (and quantity) of foods. However, consumer education also plays a role: even when food is readily available and affordable, lack of knowledge about nutritious foods can limit nutrition outcomes (Figure 15).

**Figure 15** Diversification and specialization increase food supply in local markets, but consumer knowledge and acceptability of food importantly defines nutritional outcomes



**Farm households use markets to sell agricultural produce as well as to buy foods that they do not or cannot produce themselves.** Producing diversified commodities for sale can positively influence the diversity of food available in local markets. Increased food diversity and supply in these markets may also lead to price reduction, making food more affordable—another critical pillar of the food environment. This relationship is particularly important for urban and peri-urban consumers who mostly rely on markets as their main source of food, but also for poor rural households who in most Sub-Saharan African countries are largely net consumers (Taylor et al. 2009). The availability, accessibility and affordability of food in local markets may influence the households’ food consumption patterns and thus affect dietary diversity and nutrition outcomes (BOX 6).

## **BOX 6 MARKET ACCESS AND DIETARY DIVERSITY IN BANGLADESH**

Using primary household survey data from two districts in Bangladesh, Davidson and Kropp (2017) set out to investigate the effect of agricultural production and market participation on the consumption of various food groups. The authors modelled the consumption of various food groups as a function of farm production diversity, access to markets, household income and household characteristics. They reached two important conclusions. First, in several cases, on-farm diversity (that is, the number of crops and livestock that a household produces) increases the likelihood that a food group is consumed. Second, despite the on-farm diversity effect, market participation (in terms of buying foods) may be more important than farm diversity in the effort to improve nutrition.

*Source: Davidson and Kropp (2017)*

**Both diversified and specialized farms can contribute to the availability of food in markets and, at the same time, compensate for gaps in own production.**

Sibhatu and colleagues (2015) find that specialization and lower production diversity are not necessarily associated with lower dietary diversity. Through functioning markets, diverse types of foods are readily available for both types of households to purchase and thus complement own production—on the condition that households have sufficient means to do so. The level of dietary diversity and nutrition intake hence depends on multiple factors. Knowledge on nutritious foods is crucial—even where nutritious foods are available in markets—and helps determine households' food preferences (Keding and Ng'endo 2015).

## **2.4 SUMMARY: BALANCING DIVERSIFICATION AND SPECIALIZATION**

**Numerous pathways exist through which on-farm diversification and specialization can positively influence livelihood and agroecosystem resilience, as well as nutrition outcomes.** Some pathways are more direct and apparent than others. However, some broad conclusions can be drawn about diversified food systems: (i) they strengthen livelihood and agroecosystem resilience to environmental and economic disturbances, and nutrition by improving agricultural productivity and lowered production variability; (ii) they improve incomes through market and employment opportunities; and (iii) they ensure that nutritious food is more consistently available on-farm for

direct consumption and in markets for purchase. Specialization can equally benefit livelihood resilience and nutrition, in particular through the market and employment pathways. For specialized farmers to purchase and consume nutritious food, however, nutritional awareness and socio-cultural factors play an important role. While negative effects on the environment arising from industrialized farming can be reduced by applying sustainable intensification methods, agroecosystem resilience to natural hazards is lower compared to diversified production systems, and other challenges such as farmers' dependence on external inorganic inputs need to be considered.

**There is no one-size-fits-all solution—the right production decisions should be made after careful consideration of the socio-economic and socio-cultural context.** There are conditions under which the benefits of pursuing certain pathways are most apparent. Thresholds exist beyond which the benefits of either diversification or specialization start to diminish. Finally, there are always exceptions—a greater understanding of the local socio-economic and socio-cultural context is thus a must in order to understand which pathways may be more important and impactful than others. For example, on-farm diversification leads to stronger resilience and better nutritional outcomes only up to a certain level of diversification, mainly in cases where farmers are comparably poor or farm sizes are small. In their case, diversification leads to increased household dietary diversity through direct consumption as well as to increased resilience through income stabilization and potential savings. Wealthier farmers and/or those connected to well-functioning markets can compensate gaps in own production with food purchases in the market—and may thus rather pursue specialization. Most importantly, for greatest impacts to be felt, and regardless of the pathway, the particular needs and constraints of individual farming households must be taken into account when designing production strategies that aim at improving nutrition, food security, and livelihood resilience.<sup>13</sup>

**Diversification and specialization of agriculture are not mutually exclusive, and should be seen as complementary.** Diversification and specialization should not be thought of simply as existing only at the level of a farm. Instead, a more useful frame of reference is often the landscape level where on-farm specialization can result in overall diversification across the landscape. In practice, individual farms and value chains can focus on increasing productivity, while at the landscape level the co-existence of individual farm production and value chain activities provides for diversified food supply, income streams,

and employment opportunities. Both diversification and specialization can therefore support livelihood and agroecosystem resilience, as well as dietary diversity and nutrition, although through different pathways and including potential trade-offs.



# 3. Drivers of Agricultural Diversification and Specialization

*This section turns to the drivers of agricultural diversification and specialization, and provides a literature review that is Africa-specific while also providing insights from other regions. Acknowledging that many drivers interact dynamically, the following analysis divides drivers into three groups: (i) Environmental drivers; (ii) Policy and market drivers; and (iii) Socio-economic and institutional drivers. There is another broader distinction to be taken into account—that between internal (endogenous) and external (exogenous) drivers. Internal drivers are those that are part of the farming unit or agroecosystem<sup>14</sup>, and can be influenced by the farmer him/herself; biophysical factors such as vegetation cover, knowledge or economic decisions made are examples of internal drivers. External drivers are those which do not form part of the agroecosystem and are outside the control of farming households or communities. Examples include market forces, natural hazards, or shifting consumption patterns at the national level.*

## 3.1 ENVIRONMENTAL DRIVERS

**Farmers' production decisions are often strongly dependent on the natural environment in which they operate.** Environmental factors such as natural resource endowment, biophysical and climatic conditions strongly influence decision-making related to production strategies. Often, these factors determine the choice of crops and land use system, the decision to diversify into livestock production, and further into off-farm activities. On-farm diversification is often chosen as risk management strategy in Sub-Saharan Africa to help farmers address the numerous risks stemming from the natural environment, in particular when risk-buffering mechanisms such as crop insurance or irrigation systems are not in place.

### THE IMPACT OF THE NATURAL ENVIRONMENT ON DECISIONS TO DIVERSIFY OR SPECIALIZE

Countries and regions with longer growing seasons often have greater diversity of crop and livestock production; farmers tend to specialize towards high-yielding varieties when temperatures and rainfalls are either consistently high or consistently low.

**Unsurprisingly, farmers take the climatic and natural conditions into account when choosing their production strategy for crops.** Analyzing different agroecological zones in East Africa, Davenport and Nicholson (1993) found a strong correlation of temporal and spatial patterns between diversity in vegetation and rainfall, especially when the annual rainfall was below 1,000 mm and monthly rainfall did not exceed 200 mm. Seasonal variation is also important for land use decisions since different crops require water at different times, while requiring dry conditions during key periods (BOX 7). Coffee, for example, must have a dry period before and during harvest, while maize would benefit from heavy rain in the same period (Adhikari et al. 2015). Cotton production is highly reliant on the availability of a long rainfall season, needing about 200 days to mature and cannot, therefore, do well in areas with a short growing season (ibid).

#### **BOX 7 FARMER CROP PORTFOLIO CHOICE IN RESPONSE TO RAINFALL VARIABILITY IN ETHIOPIA**

In a study that used farm-level panel data from Ethiopia, Di Falco and co-authors (2010) investigated the relationships between agro-biodiversity, risk preferences and environmental risk. Findings suggested that both rainfall variability and risk aversion tend to increase the level of crop diversification on a given farm. In particular, in Ethiopia, the variability of rainfall in spring (the minor rainy season) is crucial and more relevant to crop choice than the variability or availability of summer rainfall (the major rainy season) which is generally more reliable.

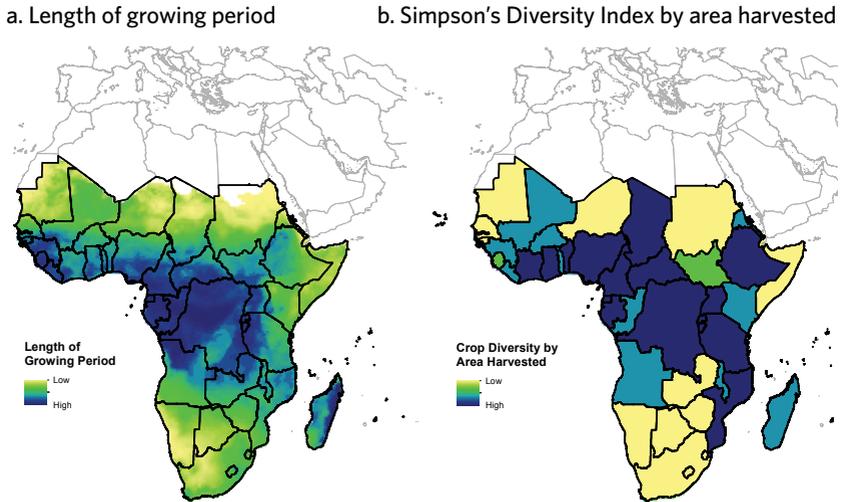
Farmers generally looked at the variability of past rainfall seasons as an indicator of overall rainfall variability and used this information to inform their crop portfolios. If past rainfall variability was high, farmers tended to grow a larger portfolio of crops, using diversification as a strategy to guard against risks. The authors also observed that rainfall, land size, tenure security and household economic status also impacted household decisions related to diversification.

*Source: Di Falco et al. (2010)*

**Similarly, the choice of livestock is also largely determined by agroecosystem conditions.** Extensive livestock rearing is common in the dry—arid and semi-arid—areas of Sub-Saharan Africa, which make up about 60 percent of the continent. Livestock include cattle, which are kept largely for milk and meat, but also camels and goats. In dryland ecosystems, nomadic pastoralism and transhumance remain the most viable agricultural practice both economically and ecologically, while (rainfed) crop production is hardly feasible due to harsh

climatic conditions (IUCN 2006). In mid- and high-altitude areas such as the highlands of Kenya, where the climate is cooler, farmers often specialize in dairy farming. Swine and poultry are often kept over a range of environmental conditions, but specialized poultry production for meat and eggs is normally conducted in areas with sufficient water (Pell 1999).

**Figure 16** The length of the growing period importantly determines crop diversity in Sub-Saharan Africa



*Note: The length of growing period during the year is highly correlated with crop diversification, with shorter growing periods having lower diversification. Southern Africa, much of the Sahel, and parts of west Africa are the least diversified areas in Sub-Saharan Africa.*

**However, while natural conditions certainly play an important role in determining production decisions, other factors are at play, too.** Natural conditions importantly shape farmers' production decision: the more favorable conditions are for a diversified portfolio of crops and livestock, the more diversified the production should be. By extension, countries with a diverse range of agroecological zones and climatic conditions are also expected to feature a large diversity of crop varieties and livestock. In part, this is the case: a quantitative analysis of diversity showed that the *length of growing period* during the year was a major factor driving diversification of agricultural harvested area in Sub-Saharan Africa (Figure 16). The *diversity of agroecological zones*, however, showed no significant contribution to the level of diversification. For instance,

while Ethiopia exhibits a broad diversity of crops and legumes across its 33 agroecological zones, the agroecologically diverse Malawi scores low on the Simpson's Diversity Index for crops. It can hence be assumed that drivers other than biophysical ones are important for diversification.

## POOR ENVIRONMENTAL CONDITIONS AS DRIVER OF DIVERSIFICATION

Poor environmental conditions, especially poor or degraded soils, encourage farmers to diversify agricultural production as means of improving land productivity.

**Poor soils are cited as an important reason for why yields in Africa are often low.** According to the FAO (2016), 40 percent of Africa's soils are degraded, that is, they suffer from soil nutrient depletion, soil organic matter decline and soil biodiversity loss.<sup>15</sup> Poor soils and land degradation have been attributed to population pressure, deforestation, unfavorable climatic conditions, and poor farming practices including intensive mono-cropping with little or no fallow. Recurrent droughts, wind and heavy rainfall can further erode already degraded soils.<sup>16</sup>

**African farmers try to address the challenges associated with poor soil conditions by adopting better land management practices and by diversifying production.** The production of specific crops does not only depend on soil type, but also on soil 'health' or nutrient content (Dou et al. 2016).<sup>17</sup> While still insufficient in numbers, many farmers in Africa have introduced soil and water conservation practices such as crop rotation, contour bunds and intercropping, largely with the aim of improving agricultural productivity, but also to promote soil nutrient replenishment and to prevent degradation. In some cases, poor soils and degraded land provide households with the incentive to practice on-farm productive diversification through, for example, the integration of livestock into crop systems or growing fodder plants or trees. These measures enable households to capture and recycle nutrients, thereby improving soil quality and water holding capacity (Hendrickson et al. 2008).<sup>18</sup>

## DIVERSIFICATION AS A RISK MANAGEMENT STRATEGY

Farmers adopt productive diversification as a risk management strategy in the face of climate-related shocks and other risks.

**On-farm diversification is a way for farmers to manage and adapt to changing social, economic, and environmental conditions and related risks.** Productive diversification is often used as a strategy to reduce risks and uncertainty while achieving efficiency in farming (McElwee and Bosworth 2010; Iizumi and Ramankutty 2015). Farmers may diversify to minimize exposure to risks, shocks, and insecurities inherent in farming due to its high exposure to external drivers, low marginal productivity, offsetting fluctuation in market prices, or to counter liquidity constraints (Bertoni et al. 2016; Dercon 2002). When households are exposed to risks and shocks, they make investment decisions that have lower risks, such as allocating land to different crop species or livestock production (BOX 8), even when these may have lower returns (Cole et al. 2017). In Niger, for instance, farmers work multiple small plots scattered across the landscape—instead of one bigger plot—to cope with highly erratic rainfalls (Mikulcak 2011).

**Farming households in Sub-Saharan Africa are often exposed to significant risk of climate-related shocks—also in this case, diversification represents a coping strategy.** Due to the large reliance on rainfed agriculture among rural farming households in Sub-Saharan Africa, their livelihoods are highly vulnerable to weather-related risks and climate change (Adhikari et al. 2015). Climate change is a particularly pertinent threat that is exposing African agriculture to various forms of risks, ranging from weather variability, increased frequency and severity of droughts and floods, changes in the occurrence and range of crop and livestock pests and diseases, or greater price volatility in output, input and factor markets. The direct impact of climate risks includes a drop in agricultural production (crops and livestock), while indirect effects may entail a decreasing demand for labor and increased local prices for inputs and the product itself (Thornton and Lipper 2013). Since most smallholder households lack the means to effectively buffer against or manage weather-related risks, these impacts are compelling push factors for on-farm diversification as a risk management strategy (Reardon et al. 2000).

### **BOX 8 DIVERSIFICATION INTO LIVESTOCK PRODUCTION AS A RISK MANAGEMENT STRATEGY**

In a study using household-level data from agro-pastoral households in 12 sites in Kenya, Uganda, and Tanzania, Rufino et al. (2013) estimated the contribution of livestock and livestock activities to income, food security, and poverty. Specifically, they tested the hypothesis that in zones that are likely to become warmer and drier in the future, sedentary farmers may be required to increase their reliance on livestock as opposed to crops. They found that crops such as maize and beans as well as a few others like cassava, sorghum and millet dominate in these areas and that households are increasing the diversity of crops in response to harsher climatic conditions. In addition, households in these areas diversify their livestock holdings by replacing cattle with goats, sheep, and also camels, since these species cope better with drought than cattle. This in turn is helping to maintain household food security, while increasing dietary diversity, especially in areas with an annual rainfall of 800mm or less. Their findings highlight that households in dry zones with high susceptibility to climate hazards increasingly engage in on-farm diversification, including through livestock production, in order to better cope with risks and build a safety net.

*Source: Rufino et al. (2013)*

**Market and regulatory risks also create an uncertain investment and climate and can have an impact on farmers' production choices.** Such risks include price volatility, exchange rate and interest rate risks, but also export and other market regulations, and affect farmers' incomes and production decisions over time. Contrary to constraints such as permanent export bans or seasonal price fluctuations which are longer-term obstacles resulting in sub-optimal sector performance, market and regulatory risks are sudden changes that are difficult to predict and adapt to. Managing these risks is more or less in control of the farmer or the Government, depending on whether these risks are endogenous or exogenous. It is also important to determine the root causes of these risks. Endogenous price risks are often a result of production fluctuations or suddenly imposed export bans, and thus necessitate investment in on-farm risk management, post-harvest infrastructure, or regulatory transparency. Nevertheless, in the short run, farmers often respond by shifting production (Giertz et al. 2015). Exogenous price risks can be more difficult for small-scale farmers to manage, and can either drive them out of production, or to alternative, niche markets. Larger farmers may have the option to manage these risks via price hedging, longer-term storage, or access to warehouse receipt systems.

**In addition to adopting on-farm productive diversification, farmers also hedge against uncertainties stemming from the natural environment by engaging in off-farm and value addition activities.** Studies have shown that increases in long-term variation in the length of the growing period are pushing households to diversify their production in order to diversify household income. For example, in Zambia, an increase in the long-term variation in rainfall has been found to cause households to diversify in livestock production (FAO 2016).<sup>19</sup> Weather variability and climate change also provide incentives for diversification into activities that are less susceptible to disruption from climate-related shocks, such as off-farm diversification and value addition activities (Béné et al. 2012). Since it can effectively reduce fluctuation in household incomes and insure against production and market risks (Katera 2016; Kijima et al. 2006), off-farm diversification has long been an important livelihood strategy among Sub-Saharan Africa’s households, and especially in climatic zones with highly erratic rainfall and recurrent dry spells such as the Sahel (Babatunde and Qaim 2009). When agricultural production becomes less profitable and riskier, for instance due to crop and market failure or climate variation, households are pushed into off-farm income generating activities (De Janvry and Sadoulet 2001; Ruben and Van Den Berg 2001).<sup>20</sup>

## **3.2 POLICY AND MARKET DRIVERS**

**A number of public policy measures can drive investment and production decisions in agriculture; some, such as subsidies, are known to induce farmers to specialize and to forgo diversification.** Investment and subsidy policies can greatly influence farmers’ decisions about diversification and specialization, directly or indirectly through their impact on market functioning. While such policies can—when designed and implemented well—nudge farmers towards sustainable long-term production strategies, they often distort markets and prove unsustainable. Similarly, regulatory restrictions or public market interventions influence production strategies and create distortions, too, but can be justified on the grounds of public safety or food security. Particularly pressing determinants of economic development in general, but also agriculture production decisions in Africa specifically include, among others, the condition of market infrastructure, access to knowledge and technology, and services such as energy and water.

## THE IMPACT OF PUBLIC POLICY ON PRODUCTION DECISIONS

Staple crop-related subsidies, incentives, and investment policies discourage agricultural diversification in many African countries.

**Changing regulations and policies that control how farmers link to markets are among the main drivers of agricultural diversification.** Interventions aimed at promoting commercial transformation and improving market orientation of smallholders, and the facilitation of market entry and participation of households in output markets, are key drivers of agricultural specialization (Gebremedhin and Jaleta 2012). For instance, the removal of trade barriers through macroeconomic policy reform may lead to an increase in real returns to the production, processing, and marketing of particular crops (Barrett et al. 2001), and this may encourage households to engage in specialized farming for crops such as coffee, cocoa, tea and maize. While these actions explicitly aim to promote agricultural commercialization and transformation, there is a category of policies and actions at the other end of the spectrum which promote specialization unintentionally without adequately addressing the commercialization and transformation components. In particular, a common practice in sub-Saharan Africa has been the—intentional or unintentional—promotion of specialization by providing incentives such as subsidies for particular crops (Pritchard 2013; Lin 2011).

**Agricultural specialization is often driven by public policy measures, mostly subsidies, rather than market incentives.** Agricultural input support programs in Malawi and Zambia, presented in this report, highlight two examples where subsidies are geared towards production of maize, and where public market intervention—through food reserve agencies—increases demand for the selected crop. Such incentives favor greater production of fewer species planted in space and time (Altieri and Nicholls 2006). Consequently, subsidy programs often benefit predominantly the wealthier farmers with large acreage of crop produced and who are well connected to markets (Lin 2011).

**Removal of subsidies has been undertaken as a strategy to reduce the level of specialization in some African countries, and attempts have also been made to use subsidies to stimulate diversification.** For example, the beneficiaries of the Farm Input Subsidy Program in Malawi were given a flexible coupon in

the 2008/9 season that allowed for purchase of both maize and legume seed. The effectiveness of these measures is however questionable, for two reasons. First, in some cases, subsidies do not succeed to stimulate diversification due to other agro-ecological or socio-economic constraints.<sup>21</sup> Second, the removal of subsidies—or other financial incentives—has been shown to drive farmers back to production strategies that preceded the public intervention.

**Policy measures beyond subsidies and financial incentives can also promote or stifle agricultural diversification.** For example, in Uganda, a regulatory change that allowed the Uganda brewery to outsource its supplies made it possible for smallholders farmers to start supplying their sorghum (Nile Breweries 2017). This new regulatory arrangement provided an entry point for farmers and represented a nudge to engage in sorghum production (Ibid.). However, while linking farmers to this (new) steady market was undoubtedly positive for their income, it may—over a longer period—lead to increased focus on the production of a single crop, and hence reduce agroecosystem resilience to market and climate-related shocks.

## EXPOSURE TO PRICE VOLATILITY AND (EXPORT) MARKET-RELATED REGULATORY CHANGES

Market price fluctuations are a key driver of on-farm and vertical value chain diversification. Similarly, the risk of sudden regulatory changes affecting farmers' trading position also tilts production decisions towards greater diversification.

**Market price fluctuations are a key risk to agricultural production and hence can drive farmers' decision regarding diversification or specialization.** A diversified portfolio of farm products allows farmers to better manage price risks, on the assumption that not all products will suffer low prices (or low demand) at the same time. Kumssa and Jones (2010) note that oft-changing input and output prices, or in other words, recurring market shocks, have driven Ethiopia's farmers to introduce a greater variety of crops on their farms so as to better manage risks. Farmers who depend on international markets are also motivated to diversify production as a way of avoiding export risks associated with changes in policy and regulations. A sudden change in export market conditions can expose farmers to large losses. The example of the Caribbean banana industry, which collapsed as a result of the removal of quota

protections on the European Union markets, is a telling example (European Commission 2017).

**Developing countries are also subject to large aggregate shocks due to the undifferentiated nature of their economies and to specialization in the export of a few primary products.** Any swing in international prices of a dominating export commodity—or few commodities—can have large impacts on national economies. By extension, such shocks will affect farming households and especially those that produce for export, since changing terms of trade result in a massive fluctuation in foreign exchange earnings (Myers 2006). On-farm diversification and value chain diversification are strategies that enable farmers to reduce the risk of macroeconomic fluctuations.

**The need to cater to export market demand is an important driver for value chain diversification in sub-Saharan African countries.** Value chain diversification offers farmers a way of complying with and meeting standards certifications. In the absence of compliance with these standards, the potential to reach export markets can be jeopardized (GLOBALGAP 2011). There are also demand-related reasons for value chain diversification. In fact, the demand for time-saving products such as processed foods is on the rise, and so is their price. The opposite is true for products that take a long time to prepare, which holds both for developed and developing countries. Consequently, the increased need for ready or almost-ready meals and time-saving packaging (e.g., precut salads) is an important opportunity for farmers and processors to gain access to quality differentiated food markets and to raise income (Reardon and Gulati 2008).

## **MARKET INFRASTRUCTURE AS A DRIVER OF DIVERSIFICATION AND SPECIALIZATION**

The presence of market infrastructure (e.g., agro-dealer networks, feeder roads, storage facilities, sales facilities, credit facilities) and well-functioning markets increase the tendency of farmers to specialize and to produce high value commodities. However, these same factors—in a different context—also provide opportunities to diversify production away from staple grains and cereals, as well as to invest in value addition.

**Proximity and access to infrastructure and markets importantly influences farmers' marketing and consumption of agricultural products, but the exact**

**impact will depend on the context.** The provision of infrastructure allows farmers to access new markets or strengthen already existing trade ties. However, although proximity to markets is an important driver for agricultural diversification, provision of good infrastructure can also promote specialization. Proximity to the market—in the case of, for example, peri-urban farms—can also push farmers to diversify into vertical value chain diversification, engage in specialized agriculture and form cooperatives to strengthen their marketing power. In short, the opening of markets, both local and regional, creates opportunities for both diversification and specialization—it is the specific circumstances and characteristics of the farm that will tip the balance in one or the other direction. BOX 9 provides further insights.

#### **BOX 9 THE LINKS BETWEEN MARKET INFRASTRUCTURE AND PRODUCTION DECISIONS**

While access to infrastructure and markets will provide a 'push', the final choice of the actual production strategy will also depend on other factors. The *AGRA Africa Agriculture Status Report (2017)*, for instance, indicates that the production of high value perishable commodities is more likely to take place on commercial farms in areas with good access to roads connecting to urban areas. Similarly, opportunities for off-farm income diversification are also more likely in such areas. Subsistence farmers on the other hand are likely to be concentrated in less favorable areas with poor agricultural potential and poor market access, contributing to the range and type of products that they grow.

Diversification into high value crops may, therefore, be appealing if households are in areas with suitable agroecological environments and good market access. Access to markets is therefore key as households are able to sell their farm produce. Through road networks, for example, market access will also open up access to inputs (e.g., seeds, fertilizers and farm equipment) needed for a wide variety of crop and livestock products. However, while this may be deemed as diversification away from staple crops into high value crops, the use of inputs and the commercial oriented nature of the production system is largely a specialized one.

**When markets are barely accessible or imperfect, households tend to diversify in order to ensure access to a variety of products.** In the arid and semi-arid areas of SSA, for example, most households diversify by keeping different species of animals such as goats, cattle, camels, and sheep. When pasture is plenty, animals such as cattle can provide adequate milk for the household; during times of pasture scarcity, camels produce more milk than cattle. A mixed

stock of cattle and camels, therefore, provides a twofold benefit in terms of resilience to adverse weather conditions as well as the year-round availability of milk protein.<sup>22</sup> Analyzing crop production in Zambia, Mofya-Mukuka and Hichaambwa (2016) find that on-farm diversification at both the household and community levels increases with rising distance from the nearest urban center with at least 100,000 inhabitants.

**On-farm diversification can also be influenced by input markets, in particular when these are combined with improved access to knowledge, information, and resources.** In countries where farmers have access to agriculture inputs (e.g., seeds, fertilizer, herbicides), information (e.g., on the benefits associated with on-farm diversification), have better educational attainment and resource endowment levels (e.g., own productive resources such as land), and have access to finance or credit-providing institutions, they may undertake on-farm agricultural diversification in order to improve their food and nutritional diversity or to improve yields and income. This underscores the fact that if fostering on-farm productive diversification is a stated public objective, targeted policies, alongside appropriate investment in agricultural extension, can make a big difference.

**Production decisions of farmers in SSA are influenced by the increasing market power of large retailers.** The decision to diversify or to specialize also depends on the type of actors engaged in the middle (trade) and last segment of the value chain (retail). Over the last 15 years or so, the modern retailing sector, often in the form of large supermarket chains, has increasingly become dominant in Africa, especially in urban centers in Southern and Eastern Africa. This change has led to the displacement of more traditional retailers, such as small shops and public markets, with implications for local small producers who are often unable to meet supermarkets' scale of procurement and quality and safety standards. To sustain their livelihoods, small farmers must adjust. In order to compete with imports or larger farmers, they can form cooperatives to aggregate supply or invest in novel farming or post-harvest practices (Weatherspoon and Reardon 2003). In many countries however, the formation of cooperatives remains a challenge since it can be considered a threat to ruling elites (e.g., World Bank 2018a).

## HOW ACCESS TO SERVICES AND TECHNOLOGIES DRIVES PRODUCTION AND INCOME DIVERSIFICATION

Farming households can improve their livelihoods—either through on-farm or off-farm diversification, value chain diversification or specialization—if they can rely on access to essential services, such as energy and water supply or credit, as well as education, information and technology. There are some promising signs of progress in information and communication technologies, but it is the overall access to these ‘enabling’ services that will define future progress.

**Off-farm employment not only allows rural households to diversify their incomes, but can also boost rural development through better hard and soft infrastructure.** In many Sub-Saharan African countries, rural labor is fast flowing into off-farm employment in rural and urban areas—at least in part driven by the acquisition of new skills and opportunities offered by modern technology (e.g., World Bank 2018a). As noted earlier, diversification into off-farm earnings represents an element of stability for household incomes. However, in parallel, it also provides both the local and national government with an additional source of income (e.g., taxes), which in turn is used in promoting the improvement of the quality of the existing hard infrastructure (e.g., roads, energy, and water), soft infrastructure (e.g., information and communications technologies) and institutions (social and political). These interventions help mitigate constraints to value addition activities.

**Well-developed rural ICT infrastructure is a key driver of vertical value chain diversification.** Transactions along the value chain are enabled and supported by the timely exchange of information about input needs (e.g., equipment, seeds, and financial resources), demand and prices for produce, available production technologies, and other information that can encourage or facilitate farmers to add value to their products. When ICT infrastructure is well-developed, information asymmetries between actors—which make transactions difficult and sometimes distort the market (David and Han 2004)—are also minimized. For example, the use of cell phones can be an important driver of vertical value chain diversification, as it enables farmers to transfer and access information, among others, about market prices, weather-related risks, market demand and opportunities quickly, timely and efficiently. The development of ICT infrastructure has also been shown to have job-creation potential in rural areas—BOX 10 illustrates an example.

## **BOX 10 THE DEVELOPMENT OF ICT AND JOB CREATION IN KENYA**

Over the past decade, information and communications technologies (ICT) have expanded remarkably in Kenya. Specifically, the use of mobile telephone applications such as MPesa and the use of ICT in various sectors and sub-sectors including agribusiness is rising. Applications such as M-Shamba not only provide farmers with information on crop management, weather and markets; but also provide income-generating opportunities for ICT entrepreneurs.

The ICT sector continues to grow in both urban and rural areas, providing important opportunities for off-farm employment. Kenya's Vision 2030 development plan considers ICT and related business process outsourcing as an important driver for economic growth and a key to job creation, especially among the youth. Consequently, a number of interventions—such as ICT skills training and development, technology hubs and incubators, ICT enabled job search applications, and creation of digital job opportunities—have sought to leverage the ICT potential and might lead to important spillovers across the various economic sectors, including agriculture and agri-business.

*Source: INCLUDE: Knowledge Platform on Inclusive Development Policies*

**Energy supply and infrastructure are important factors for the development and diversification of supply chains.** Farmers rely on various energy sources, especially electricity, for their farming operations (e.g., milling, mechanization, irrigation, lighting). Yet access to electricity is a major challenge for most rural farming communities, and the African Development Bank (2016b) cites it as one of the major challenges facing agricultural value addition in Africa. Limited access and supply of electricity hinders various cooling and processing activities (especially for perishable products such as vegetables, meat and milk), thereby limiting the options for value addition, which in turn constrain production and income generation. Consequently, energy-related constraints curb the development potential of diverse agricultural value chains, which could foster employment in rural areas. Ensuring reliable access to affordable electricity is thus crucial for value chain diversification and specialization.

**Lack of credit is often cited as a constraint to agricultural development, and especially value chain diversification.** Lack of financing has been identified as an important constraint to all development strategies, but its impact is more pronounced in vertical value chain diversification (World Bank 2008). Markets may also play a crucial role in either driving or constraining value chain diversification through their role in determining existing and potential

benefits (e.g., profit margins, embedded services, competitive advantages, and economies of scale) and risks (e.g., competition, sizeable investment, and business relationships) for each actor in the value chain—thereby influencing their access to credit. Farming households are somehow caught in a trap, as greater rural development would likely lead to (a) setting up of financial institutions or mobile banking services in rural areas, (b) improving access to credit and, as a result, (c) improving productivity (e.g., through improved access to inputs) and profitability (e.g., due to potentials for economies of scale). For value chain diversification to occur, farming needs to become more attractive as an investment, while inherent sector risks need to be lowered.

**However, even with improved rural services and infrastructure, it is ultimately the skills and knowledge of the rural workforce that largely determine their ability to engage in productive diversification, value chain diversification and off-farm employment.** Evidence indicates that the role of education and extension services in agriculture development is not limited to “traditional” agricultural activities, but it extends to a number of other interventions such the expansion of financial literacy or introduction of new ICT needed for broader rural development and rural innovation (De Rosa et al. 2014). In Ethiopia for example, for many years, farming was largely traditional, and as such, there was little economic justification to invest in education (Sharada 1999). However, the importance of agricultural extension, as well as financial, technical and vocational training has become apparent due to the rising demand by farmers to adapt their practices to a changing and increasingly uncertain environment, to manage land degradation, and to improve food security and nutrition. The provision of extension services—through public, non-governmental or private actors—, training and education will largely define the success of production decisions and off-farm diversification with a view to resilience and nutrition outcomes.

### 3.3 SOCIO-ECONOMIC AND INSTITUTIONAL DRIVERS

***Socio-economic drivers* are defined as aspects or features that typify a group of people in a community or society that constrain or facilitate the productive diversification at the household level; institutional drivers are constructions or arrangement that exist in a society that may either constrain or facilitate productive diversification.** Examples of socio-economic drivers include, among others, the level of education, gender, market access, status and income, and

knowledge about the nutritional value of foods. Examples of institutional drivers include, among others, the rules, norms, and routines that guide the behavior of people in a society or in a community, as well as the distribution of power in decision-making.

## AVAILABILITY OF LABOR ENABLES SPECIALIZATION AS WELL AS DIVERSIFICATION

Environments where seasonal or migrant labor supply is abundant and flexible are more conducive for specialization.

**A high degree of specialization in agriculture implies demand of hired or more specialized labor, which sometimes needs to be outsourced.** The engagement of farmers in specialized agriculture is a product of economic advantages brought about by the concentration of gains in productivity, economies of scale, and market efficiency for both the producers and the processor. There are some key factors driving specialization: (i) availability and cost of labor; (ii) availability and cost of other inputs (such as agrochemicals or financing); (iii) specialized knowledge and skills; and (iv) a supportive environment (Klasen et al. 2016). Together, these factors act as pull factors into specialization, not only at the household level, but also at the community and national level. However, as case studies for Zambia and Malawi in Chapter 4 show, labor availability can also be a driver of diversification, in particular family and hence ‘free’ labor. Malawian farmers reported that expanding crop diversification demands more labor, which they had to hire. In both cases, the topic of labor supply is particularly important as it requires the right legal framework and a pool of seasonal or migrant workers, who in turn would often be part of off-farm income diversification strategy of individual households. The need for highly seasonal or specialized labour, then, is often a disincentive to complete specialization since it often cannot be procured locally (Klasen et al. 2016).

## LAND OWNERSHIP AND SECURITY OF TENURE

Small land holdings, land fragmentation, and insecurity of tenure can discourage diversification, but particularly discourage investment in productivity- and efficiency-increasing technologies for specialization and value-addition.

**At the household level, resource endowment—and in particular land tenure, size, and availability of labor—are important drivers of agricultural diversification.**

In countries where agricultural households do not have large tracts of land for crop production, as in most of rural Africa, being endowed with land and the security of tenure may affect whether households practice on-farm diversification or not. In theory, a larger farm size and hence scale of production can reduce outlays per unit of output, for example in purchasing agrochemicals, and foster the adoption of indivisible machines such as tractors—hence driving specialization due to internal economies of scale (Klasen et al. 2016). The relationship between farm size and production decision is not always straightforward. The case studies in Chapter 4, for instance, show that land size and productive assets correlate negatively with diversification. Yet, this is corroborated by an earlier study by Mofya-Mukuka and Hichaambwa (2016) who show that that increases in landholding, up to 3 hectares, led to an increase in on-farm productive diversification. Any further increase in land size did not lead to further diversification. Reasons for why larger farms do not necessarily lead to specialization may be distance to input and output markets, but also potential ‘diseconomies of scale’ as larger farms tend to require more (hired) labor and arguably higher labor productivity, and can result in higher costs of monitoring (Klasen et al. 2016).

**Land ownership and tenure security also affects land investments and collective action.**

Deininger et al. (2009) find that shifting a plot from occupancy to full ownership in Ethiopia more than doubles incentives for soil conservation and increases tree investment almost five-fold. According to Selhausen (2016), women’s landownership increased the probability of joining a women’s coffee cooperative in Western Uganda, with land size positively affecting participation.

**Smallholders in Africa have limited resources and struggle to improve their wellbeing, but remain critical for ecosystem function and local food security.**

Households with small landholdings and limited access to productive resources are constrained in their potential to diversify or embark on commercial agriculture as a way of raising household income and breaking out of poverty (Jayne et al. 2003). However, both small and large farms play important roles in ensuring diversity of agricultural produce and availability of healthy foods. Even though large commercial farms dominate global food systems, smallholder farms play a critical role in maintaining the genetic diversity of local food and input supply, which reduces the risk of nutritional deficiencies and ecosystem degradation, and improves resilience to climate hazards (Fanzo 2017). As smallholder farms

in Africa continue to shrink in size while larger, commercialized farms—and increasingly medium-sized farms between 50 and 100 hectares—continue to dominate export agricultural production, Fanzo (2017) notes that it is farm landscapes, rather than individual farms, that can sustain diversity of production for the local market. In fact, landscape level diversification is just as—if not more—important than farm-level diversification, in terms of both ecosystem functioning and food availability benefits.

## EDUCATION AND GENDER EQUALITY IMPACT ON- AND OFF-FARM DIVERSIFICATION

Low levels of knowledge and skills, as well as high levels of gender inequality, are major barriers to on-farm diversification, vertical value chain diversification, and off-farm employment.

**Production decisions in agriculture are largely determined by the skills and knowledge of farmers and farm households.** There are several ways through which education and training may enhance or trigger on-farm diversification: Enhanced knowledge and skills can improve the quality of labor that is required for on-farm productive diversification; education can enhance the response mechanisms and strategies needed for climate adaptation and livelihood resilience, and has shown to foster the adoption of new technologies including ICT, as well as to increase agriculture productivity. Education not only enhances human capital, but also enables farmers to be more open toward innovation and experimenting, such as through endeavoring into value addition and diversified value chains.<sup>23</sup> In a rapidly changing technological and economic environment, education can be considered the most important factor enabling on-farm productive diversification (Ellis 2007).

**Better educated households—most often also wealthier ones—are also more likely to engage in off-farm diversification.** The probability of engaging in off-farm diversification is largely defined by how well individuals or households cope with entry barriers, such as (a) skills, where age, gender, literacy, and education level play an important role, (b) contacts, or social capital, (c) access to finance and (d) the fluctuation in agricultural production (Barret et al. 2001; Loening et al. 2008). Out of these, according to McCarthy and Sun (2009), literacy and education are key determinants of households' ability to take advantage of

off-farm income generating opportunities.<sup>24</sup> Unsurprisingly, evidence shows that wealth is positively associated with high levels of education among households (ibid.), and this provides them with an advantage to participate in off-farm labor markets (Bhatta and Arethun 2013). Consequently, these households have more opportunities to engage in off-farm income generating activities—such as trade and (seasonal) migration—since they can bear the initial costs and may have greater opportunities to pull resources together (Ng’ang’a et al. 2016b).

**The factor of education affects women more strongly: they benefit more than men when better educated, but also face worse job prospects than men when less educated.** McCarthy and Sun (2009) highlight that a high level of education increases the likelihood for both men and women to participate in off-farm income generating activities, but that the impact is greater for women. In contrast, without education, household members are more likely to engage in low paid, low skilled, and low return labor-related activities (Kent and Poulton 2008), which is particularly so in the case of women and youth.

**Women are often found in less productive employment.** Women, as a result of comparably lower wages and prevailing patriarchal systems in many SSA countries that render them less educated, are often clustered in low entry, low return activities (Whitehead 2009). In fact, evidence shows that smallholder female-headed households diversify significantly less compared to men-headed households, including off-farm, suggesting that women would benefit from targeted policies that can help them expand their rural livelihood portfolios (FAO 2016). In Ghana, for example, one reason cited for women having low ability to engage in off-farm income generating activities, alongside their traditional caring duties for the young and elderly, is that male labor is relatively more productive on-farm versus off-farm (McCarthy and Sun 2009). Katera (2016) highlights that one way to facilitate the participation of women in off-farm income generating activities is by increasing their participation in community groups.

## KNOWLEDGE AND AWARENESS ABOUT THE NUTRITIONAL VALUE OF FOOD

Knowledge and awareness about the nutritional value of various foods influence consumer food choices, and ultimately affect the range of crop and livestock products available and produced for local markets.

**Consumers' food choices may influence food production decisions at the farm level, and consequently the type of foods available in markets.** Consumers' food choices may be influenced by diverse factors, among them, socio-cultural preferences for certain foodstuffs, the level of knowledge and awareness on nutritional value of various foods, or beliefs about a specific product's healthfulness. These factors will importantly shape their consumption patterns and preferences (e.g. Fanzo et al. 2013). Through their consumption, consumers provide signals to producers, and producers respond by producing (more of) what consumers want. BOX 11 provides an example of a change in consumers' demand for African indigenous vegetables that resulted in an impact on production of these.

### **BOX 11 RETURN TO THE CONSUMPTION OF AFRICAN INDIGENOUS VEGETABLES**

The shift in demand of vegetables consumed in Africa is a good example of how consumer preferences drive production decisions. Over the past decades, consumption of African indigenous vegetables (AIVs) has been overlooked in most African countries, and consumers shifted towards increased demand of exotic vegetables. Many AIVs however provide high-quality nutrients and contain minerals and vitamins in levels exceeding those found in exotic vegetables (Singh et al. 2013), and are often more affordable and available than their exotic counterparts.

Various development organizations, research organizations, and governments have been disseminating nutrition information on the benefits of consuming AIVs, and the results are encouraging. There has been an upsurge in demand of the AIVs in most African countries, especially in Kenya. The expansion in production, marketing, and consumption of AIVs has been attributed to rising consumer awareness about their benefits in terms of health and nutrition (Schippers 2000). This has resulted in increased market demand, which has been followed by small-scale commercialization of AIVs by farmers who produce and supply them either individually or collectively (Muhanji et al. 2011). Food retail outlets are increasingly selling AIVs, and their availability and diversity as high-value niche products in supermarkets have further stimulated their consumption in urban areas (Ngugi et al. 2007).

The case of AIVs illustrates two important lessons. First, a concerted effort to shift consumer demand can be successful, even in the case of traditional products that might be perceived as a remnant of the past. Second, the shift in demand leads to a change in production decisions at the local level that can benefit domestic economies.

**Without nutrition information and knowledge, or access to healthy foods, consumers may settle for unhealthy diets mainly driven by other considerations such as affordability, accessibility, and desirability.** Studies show that people in developing countries are increasingly making unhealthy food choices, among others due to lack of nutrition knowledge and wrong perception towards healthy foods (Mirmiran et al. 2007). This is in part the result of faster-paced urban lifestyles, but also the result of marketing and advertisement whereby processed, ready-made foods are portrayed as modern and desirable. However, physical access to healthy foods also plays an important role. In fact, it is the physical setup of the food environment itself which will importantly determine to what extent people are able to eat healthy. Kyallo and others (2013), for example, found that children in urban centers such as Nairobi have easy access to fast food outlets, restaurants and supermarkets, while access to healthier options is more limited.<sup>25</sup> It is these ‘food environments’ which nudge consumers’ food choices in particular directions, and which contribute to dietary habits and preferences which can have long-term impacts, especially in children (Hawkes et al. 2015). They also have an impact on local production decisions, as demand for healthier, unprocessed foods drops.

## **THE IMPORTANCE OF STABLE MARKET ACCESS THROUGH VERTICAL COORDINATION**

Specialization, and to a lesser extent diversification, occurs more likely in environments where contractual relations are clearly laid out and established for a longer time horizon. The stability of income provided by vertical coordination, for instance through contract farming or productive alliances, enables farmers to plan long term and make optimal production choices. Often, vertical coordination also extends beyond a mere purchase agreement to include the provision of inputs and services as well as the transfer of new resource management practices.

**Farmers are more likely to specialize in situations where their market access can be improved through vertical coordination.** The decision to specialize often rests on the guarantee of stable incomes over a longer period of time. Vertical coordination through smallholder aggregation, for instance in cooperatives, contract farming arrangements or out-grower schemes that provide inputs credit to farmers, is important in this respect. Contract farming, for instance, involves agricultural production being carried out based on an agreement between the

## **BOX 12 CONTRACT FARMING IN MADAGASCAR**

In Madagascar, one of the poorest countries in the world, small-scale farmers that produce vegetables, specifically the hand-picked fine French beans, for supermarkets in Europe receive assistance and supervision through a contract mechanism, which helps them to meet the complex quality standards of the European market. All exports of French beans from Madagascar go through one company, *Lecofruit*, and are sold to seven supermarket chains in the Netherlands, France, and Belgium. As documented by Minten and others (2009), despite being an island with poor local infrastructure, low rural education levels, high compliance and transaction costs, the number of farmers producing vegetables for exports is increasing. For instance, in early 1990s, *Lecofruit* was buying French beans from about 100 farmers, while by 2005 the number increased to about 10,000 farmers. The company provides extension workers who visit the farmers at least once a week on average; there is a written contract between the farmers and the company, as well as an elaborate database to follow up on farmers' adherence to pesticide use regulations and avoidance of side selling. The company received incentives from the government to produce under an export processing zone regime. Given proper support, incentives, and transparent contractual arrangements, smallholder farmers in Sub-Saharan Africa can seize the potential of accessing greater and more sophisticated markets.

*Source: Minten et al. (2009)*

## **BOX 13 PROVISION OF INPUTS AND MARKETS FOR SPECIALIZATION**

The Eagle project launched by the Nile breweries in Uganda encourages local cultivation of Epuripur Sorghum, a local species of sorghum. The sorghum is then used to produce low cost, high quality beer, while ensuring a cycle of sustainability for all the stakeholders involved (that is, the Nile breweries, the farmers and their families, seed commodity brokers).

The project is built around contract farming. At the core of the agreement are the supply of seeds and the supply of sorghum. The Nile breweries distributes Epuripur Sorghum seeds to 8,000 farmers in Apac, Lira, Masindi, Oyam and Soroti districts through Afro-Kai, its sorghum agent. After harvest, farmers supply sorghum to the brewery. Thus, Nile breweries play a key role in the grain marketing and effectively link smallholder farmers to the market. But this is not all. The farmers also benefit from the support of Afro-Kai and the provision of additional services such as training or technical advice on all aspects of crop management. Through this arrangement, farmers are guaranteed a regular and predictable income, with beneficial spillovers effects on the rural communities and economy of Uganda.

*Sources: Balya (2007); Nile Breweries (2017)*

buyer and farm producers, whereby the farmer produces and supplies a specific agricultural product and the buyer acquires it on an agreed price. Vertical coordination integrates farmers in output supply chains and provides them a ready market for their produce, as well as, commonly, access to inputs, training, and production support.<sup>26</sup> This results in reduced risks for farmers and increased farm efficiency through specialization, and hence higher incomes.<sup>27</sup> Evidence from the reviewed literature shows that households are likely to engage in specialized vertical coordination arrangements if the market linkage (e.g., as provided by major companies from within and outside the country) is available. Minten and co-authors (2009) describe the success of contract farming in Madagascar (BOX 12), while BOX 13 presents the case of Uganda’s Nile Breweries. To guarantee the best and fairest outcomes of vertical coordination for both smallholders and aggregating firms, it is important that contracts be transparent and based on good practices for responsible agricultural investment (World Bank 2018a).

## COMMUNITY SUPPORT AND POWER STRUCTURES

Local social support can encourage efforts of diversification, while established power structures might hamper them when specialization is considered as beneficial to those in power.

**Local social support, both formal or informal, can assist and encourage farmers with on-farm diversification.** The availability of social support at the community level—including informal social networks, formal programs, and the presence of extensions services—helps farmers in their efforts to diversify (Kefyalew 2012). To farmers, the risks of investing in on-farm diversification activities are more acceptable if they are attached to their community and if they have confidence in local connections and support networks. These social connections and support systems reduce the challenges associated with on-farm diversification activities that may otherwise make their acceptability and their spread—such as territorial characteristics—more difficult (De Rosa et al. 2014). At the community level, on-farm diversification may therefore be influenced by elements of social capital including knowledge, trust, and bridging ties between communities.

**Power structures in politics can also determine production choices.** Another important driver of diversification and specialization is the environment within which production decisions takes place. This environment can be dominated

by particularly powerful groups, also farmer associations, that can themselves benefit from a particular choice. For instance, large and politically well-connected landowners may advocate for specialization in agriculture, which may lead to the eviction of smallholder farmers (Binswanger and Braun 1991; Binswanger et al. 1995). The preferences of influential groups can be mirrored in government policies, most often in the form of subsidies for particular cash crops, but also in migration, land, or infrastructure policies (Klasen et al. 2016).

### **3.4 SUMMARY: DRIVERS OF DIVERSIFICATION AND SPECIALIZATION**

**A mix of environmental, public policy, market and socio-economic factors can drive or constrain production decisions on-farm, value chain and off-farm diversification.** Incentives for cash crop production, small land holdings, lack of capital, and lack of knowledge all discourage farmers from diversifying production, whereas a diverse range of available technologies, supporting services and well-functioning markets can promote diversification. Poor environmental conditions and climate-related shocks often lead farmers to diversify in order to better manage associated risks. Different drivers usually interact, resulting in a complex interplay of various factors that prohibit generalizations. In other words, whether farmers diversify or specialize ultimately depends on the context. Some factors might drive value chain diversification, but also off-farm employment diversification; while others might constrain diversification and encourage specialization. Table 2 provides an overview of the main drivers of productive diversification in African agriculture and indicates the extent to which these are likely to support or inhibit on-farm diversification, value chain diversification, and off-farm diversification.

**There is an important caveat to the discussion of drivers of diversification and specialization: environmental, socio-economic and institutional factors can be mitigated with public policy interventions.** While these factors were already discussed in this chapter, there are cases when environmental or socio-economic drivers can be—and were—overtaken in importance by the implementation of policies and programs that either intentionally or inadvertently affect the diversity of agricultural production on a farm, in a community, or at the national level. Considering their particular role, public policies and their impact on production decisions are discussed in greater detail in Chapter 5, along with their impacts on resilience and nutrition.

**Table 2** Relative importance of different drivers of diversification

Driver	Impact			
	On-farm diversification	On-farm specialization	Value chain diversification	Off-farm diversification
<b>Environmental Drivers</b>				
<b>Long growing season</b>	●	●	●	●
<i>Summary: Countries with longer growing seasons and diverse agroecological zones often have greater diversity of crop and livestock production; when temperature and rainfall are either consistently high or low farmers tend to specialize in high yielding varieties.</i>				
<b>Poor environmental conditions and soils</b>	●	●	●	●
<i>Summary: Poor environmental conditions, especially poor or degraded soils, encourage farmers to diversify agricultural production as means of improving land productivity.</i>				
<b>Climate shocks and other agricultural risks</b>	●	●	●	●
<i>Summary: Farmers adopt productive diversification—but also engaging in off-farm and value addition activities—as a risk management strategy in the face of climate-related shocks and other risks.</i>				
<b>Policy and Market Drivers</b>				
<b>Subsidies, incentives</b>	●	●	●	●
<i>Summary: Staple crop related subsidies, incentives and investment policies discourage agricultural diversification in many African countries.</i>				
<b>Price volatility and regulatory changes</b>	●	●	●	●
<i>Summary: Market price fluctuations are a key driver of on-farm and vertical value chain diversification. Similarly, the risk of sudden regulatory changes affecting farmer's trading position, also tilts production decisions towards greater diversification.</i>				
<b>Market infrastructure</b>	●	●	●	●
<i>Summary: The presence of market infrastructure and well-functioning markets increase the tendency of farmers to specialize into high value commodities. However, the same factors can also provide opportunities to diversify production away from staple grains and cereals, as well as invest in value addition.</i>				
<b>Access to services and technologies</b>	●	●	●	●
<i>Farming households can improve their livelihoods—either through on-farm or off-farm diversification, value chain diversification or specialization—if they can rely on access to essential services, such as energy and water supply or credit, as well as education, information and technology.</i>				

*continued*

**Table 2** continued

Socio-economic and Institutional Drivers				
<b>Availability of labor</b>	●	●	●	●
<i>Summary: Environments where seasonal labor supply is abundant and flexible are more conducive for specialization. However, availability of labor within a household also drives diversification.</i>				
<b>Small land size or tenure insecurity</b>	●	●	●	●
<i>Summary: Small land holdings, land fragmentation and insecurity of tenure discourage diversification, but also discourage investment in productivity- and efficiency-increasing technologies for specialization and value-addition.</i>				
<b>Lack of education and gender equity</b>	●	●	●	●
<i>Summary: Low levels of knowledge and skills, as well as high levels of gender inequality, are major barriers to on-farm diversification, vertical value chain diversification and off-farm employment.</i>				
<b>Knowledge and nutritional awareness</b>	●	●	●	●
<i>Summary: Knowledge and awareness about the nutritional value of various foods influence consumer food choices, and ultimately affect the range of crop and livestock products available and produced for local markets.</i>				
<b>Reliable market access through vertical coordination</b>	●	●	●	●
<i>Summary: Specialization, and to a lesser extent diversification, occurs more likely in environments where contractual relations (e.g., vertical coordination) are clearly laid out and established for a longer time horizon.</i>				
<b>Community support and power structures</b>	●	●	●	●
<i>Summary: Local informal social support can support efforts of diversification, while established power structures might hamper them when specialization is considered as beneficial to those in power.</i>				
<i>Note: a green dot (●) denotes a positive driver, a red dot (●) denotes a negative driver, whereas a gray dot (●) indicates that the linkage is unclear.</i>				

# 4. Country Case Studies: Zambia and Malawi

*The previous chapters explored how agricultural diversification impacts nutrition and resilience, and the drivers of diversification. There are numerous pathways through which diversification positively impacts resilience and nutrition—either indirectly, for example by improving the environmental conditions in the agroecosystem, or directly, for example by providing more diverse food for own consumption and for purchase in local markets. However, the impacts, drivers and constraints of diversification or specialization will largely depend on the specific local, regional or national context. To look at the interplay of these factors in a specific policy setting, this chapter turns to two country case studies, namely on Zambia and Malawi. The studies are based on a quantitative approach for both countries, supplemented by a qualitative study in the case of Malawi, based on focus group discussions and key informant interviews in two subnational sites. Appendix B provides details about the methodology and data used. Appendix C presents regression results of drivers of diversification and Appendix D elaborates on the impacts of diversification on resilience and nutrition.<sup>28</sup>*

## 4.1 QUANTITATIVE ANALYSES: ZAMBIA AND MALAWI

### METHODOLOGY AND DATA

**For the quantitative analyses longitudinal data are used.** For Zambia, the case study is based on the Rural Agricultural Livelihood Survey (RALS; 2012 and 2015) covering the 2010/11 and 2013/14 agricultural season, and including 8,090 and 7,254 households, respectively. For Malawi, the analysis uses the Integrated Household Panel Survey (IHPS), a nationwide representative longitudinal survey with data collected in 2010 and 2013, covering 2,387 and 2,947 rural households, respectively.

**To measure the level of diversification, the Simpson's Diversity Index (SDI) is calculated.** SDI provides values between zero and one. More diversified households have a higher SDI value. If a household has only one source of income, then the SDI will be 0, thus complete specialization. For example, a household with two income sources and each contributing an equal amount to household income will have a SDI of 0.5. However, if the contribution of

these income sources is 80 percent and 20 percent respectively, the SDI will be 0.32. Therefore, more diversified households will have a higher SID whilst the less diversified will get a lower value. If a household has only one source of income, then the SDI will be 0, thus complete specialization. Specialization of agricultural production refers to a reduction in diversity or an increase in the production of a particular product. The SDI has been used in previous studies (e.g., Mofya-Mukuka and Hichaambwa 2016; Aslan et al. 2016). Following indices were calculated: (i) *Crop Production Diversification*, calculated using the proportion of area planted of each field crop including cereals, roots and tubers, industrial cash crops, pulses and fruits and vegetables; (ii) *Crop Income Diversification*, based on the gross value of all field crops including cereals, roots and tubers, industrial cash crops, pulses and fruits and vegetables; (iii) *Agricultural Income Diversification*, calculated by adding gross value of livestock income, which includes cattle, small livestock and products income, to the gross value of crop income; and (iv) *Livelihood Diversification*, calculated by summing gross farm/agricultural income and income from remittances, formal and informal employment and businesses.

**To examine the causal effects of diversification on nutrition security, two nutrition indicators are calculated:** (i) *Months of Adequate Household Food Provisions (MAHFP)* and (ii) *Household Dietary Diversity Score (HDDS)*, approximating improved food access and improved household food consumption, respectively (Bilinsky and Swindale 2010).<sup>29</sup> Both MAHFP and HDDS are internationally recognized to approximate household food security, which is considered a necessary, but not sufficient, condition for achieving nutrition security (FAO 2009). BOX 14 elaborates on the effectiveness and challenges of these indicators to measure nutrition.

**To approximate household resilience, a several variables are used.** For the analyses in Zambia and Malawi livelihood resilience is measured by (i) *household food production*, measured by value of food crops harvested by the household; and (ii) *household income from all farm and non-farm activities*. For Zambia, also the (iii) *value of household productive assets*, as value of livestock and farm implements, is used; and for Malawi (iv) *the amount of food stocks*. The indicators are measured as a ratio of the possible maximum outcome value, resulting in values between 0 and 1. For Malawi, agroecosystem resilience is approximated with the (v) *Soil Quality Index* and, to measure the general ecosystem and natural resources conditions, with the *Canopy Greenness Index*.

## **BOX 14** CHALLENGES TO SECONDARY DATA ANALYSIS OF LINKAGES BETWEEN AGRICULTURE AND NUTRITION

The data requirements for analyzing the full trajectory of agriculture to nutrition pathways are substantial. There are a full range of indicator categories that would ideally be used to investigate the impact of agricultural activity on nutrition outcomes, such as food groups consumed over a short-term period, nutrition and health related knowledge, attitudes and practices, or individual dietary diversity score. However, it is hard to construct these metrics from a single source. If diet quality at individual level is to be assessed—and ideally, it should be—researchers must have access to diet diversity or food recall data that are not routinely collected in any of the large national surveys which countries typically conduct. The same goes for efforts to investigate the food environment and women’s empowerment, both of which are critical mitigating factors in agriculture’s impact on nutrition.

For researchers who are relying on secondary data from routinely administered national surveys, these are major challenges and quantitative analyses that assess individual level diet outcomes, women’s empowerment, all aspects of the food environment (availability, affordability and acceptability) are often not possible. A common “next best option” are analyses which rely on Household Surveys and use HDDS as a diet-relevant outcome of interest (e.g., Carletto et al. 2015; Jones et al. 2014; Aberman et al. 2016). Household Surveys have a high potential for narrowing the data disconnect (Carletto et al. 2013) as their agricultural production data are easily merged with their detailed household consumption data, moreover they often collect information on many of the other indicator classes.

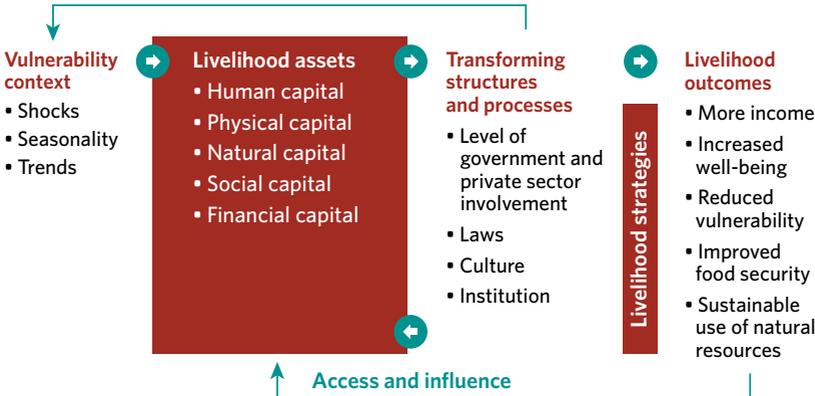
For instance, IHPS used for the Malawi case study collects information on crops grown using rainfed and dimba wetland cultivation, crop sales, livestock ownership and sales, food prices, household food consumption, access to markets and to drinking water, and even child stunting. The RALS in Zambia collected information on crop and livestock production, household income, women’s decision-making power, market access, household food consumption and seasonal household food security, as well as access to markets and drinking water. Both household surveys routinely capture a wide scope of data along the agriculture-nutrition nexus.

However, there are several nutrition-related shortcomings associated with Household Surveys: (i) they do not collect individual diet data. Even the most rigorous analyses of these surveys will be limited to household food security indicators (that is, HDDS or MAHFP), meaning that impact at individual level—where it matters most—remains unknown. (ii) The quality of anthropometrics surveys—when included—may be low. Enumerators receive no or little training in anthropometry, resulting in high risk of measurement errors. For instance, in Malawi and Zambia, the stunting rates in the IHS and Living Conditions Monitoring Survey respectively differ significantly from the stunting rates in the traditional and trusted Demographics and Health Survey (Verduzco-Gallo et al. 2014); (iii) household surveys do not always capture data on women’s empowerment (though the RALS is an exception).

*Source: Meerman (2017)*

To assess the drivers of diversification, the analysis is guided by the Sustainable Livelihoods Assessment Framework. The framework conceptualizes how farming households cope with vulnerability in the face of various economic and environmental shocks, and how households use their assets—expressed in capitals—to achieve positive livelihood outcomes by building on a variety of livelihood strategies (Ashley and Carney 1999). Based on the framework, a range of drivers of diversification are selected, which focus on the impact of changes in natural, financial, human, physical and social capital on diversification. In addition, the effect of environmental conditions as represented by climatic factors such as rainfall, location of households, access to markets, and other services on different types of diversification and subsequently resilience and nutrition is assessed (Figure 17).

Figure 17 Sustainable livelihood framework



Source: adapted from Ashley and Carney (1999)

### 4.1.1 ZAMBIA: QUANTITATIVE ASSESSMENT OF DRIVERS AND IMPACTS OF DIVERSIFICATION

#### Background

Zambia is a landlocked country in Southern Africa, divided into four distinct agroecological regions (AER) illustrated in Figure 18. The northern regions receive relatively high rainfall compared to the southern regions. Region I covers most parts of the Southern and Western Provinces. It is a drought-prone area characterized by low rainfall (< 800 mm/year) and a short, hot growing season.

Region IIa and IIb cover most of the Eastern, Central and Western regions of the country and have the highest agricultural potential. Region IIa has a slightly higher rainfall (800-1,000 mm/year) than Region IIb (600-800mm/year). Region III covers the Northern regions of the country with rainfall of 1,000-1,500 mm/year.

**Figure 18** Zambia: Agroecological zones



Source: IAPRI (2015)

**Zambia is a resource-rich lower middle-income economy and has successfully raised its average annual Gross Domestic Product (GDP) growth rate since the early 2000s.** Zambia's economic growth is strongly dependent on the minerals sector and changes in the international copper price. During the 1985-1990s period, low levels of investment and production led to sluggish GDP growth, which recovered

between 2000 and 2014 when Zambia recorded an economic growth of 7.4 percent per year—while the average of Sub-Saharan Africa was 5.8 percent—and returned to middle-income status in 2011. This success was driven by improvements of the economic management in the 1990s and macroeconomic indicators, a rebound in copper production, expansion of construction and services industries, and investment in the social sectors by the government and cooperating partners. Despite the increase in per capita economic growth, Zambia's poverty and inequality has remained high and is accompanied by striking levels of inequality between rural and urban areas (World Bank 2018).

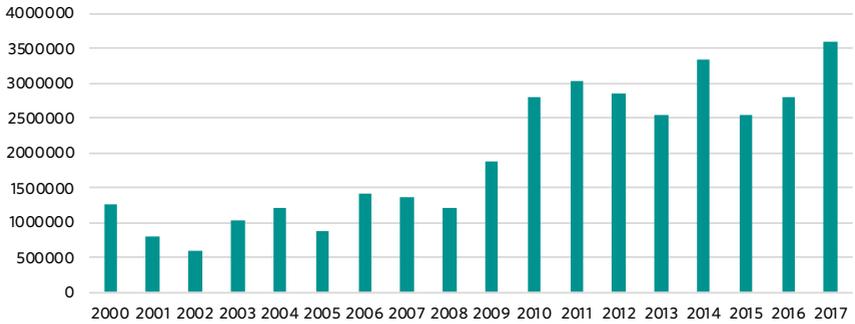
**Zambia's agricultural sector represents the backbone of its rural economy, and 60 percent of the population depend on the sector; however, many of them are poor and locked into low-productivity, subsistence agriculture.** About 60 percent of the population depend on agriculture for their livelihoods, of whom 80 percent are poor. While employment in the sector remains high, agriculture's contribution to the GDP has declined from about 17.3 percent in 2004 to around 5.3 percent in 2015. This coincides with a decline in agriculture's productivity—measured as annual value added per worker—from US\$702 in 2004 to US\$584 in 2015 (in constant 2010 US\$).<sup>30</sup> About 98 percent of farmers are smallholder farmers of which 75 percent cultivate less than 2 ha; 20 percent cultivate 2-5 ha, and 5 percent cultivate between 5-20 ha.

## State of agricultural diversification

**Zambia exhibits one of the lowest levels of crop diversification in Africa as measured by the Simpson's Diversity Index.** Maize continues to dominate crop production among smallholder households: 89 percent of households cultivate it. Groundnuts rank second: they are cultivated by 50 percent of households. These two main crops are followed by cassava, mixed beans and sweet potatoes. Maize occupies about 57 percent of all arable land in Zambia. Tubers and cash crops account for around 18 percent each, while legumes cover 12 percent (IAPRI 2016). Currently, about 70 percent of smallholder farms cultivate on average three crops, of which 20 percent cultivate only one crop. As shown in Figure 20, provinces in the north and north-east are the most diversified in terms of crop production, while provinces covering the south and central regions in Zambia are the least diversified. Livestock diversification is higher in provinces in the east and south than any other areas in the country (Arslan et al. 2016). Descriptive analysis of the Rural Agricultural Livelihoods Survey 2012 and 2015 shows that between 15 percent and 41 percent of households have low levels of livelihood diversification and agricultural livelihood diversification, respectively.

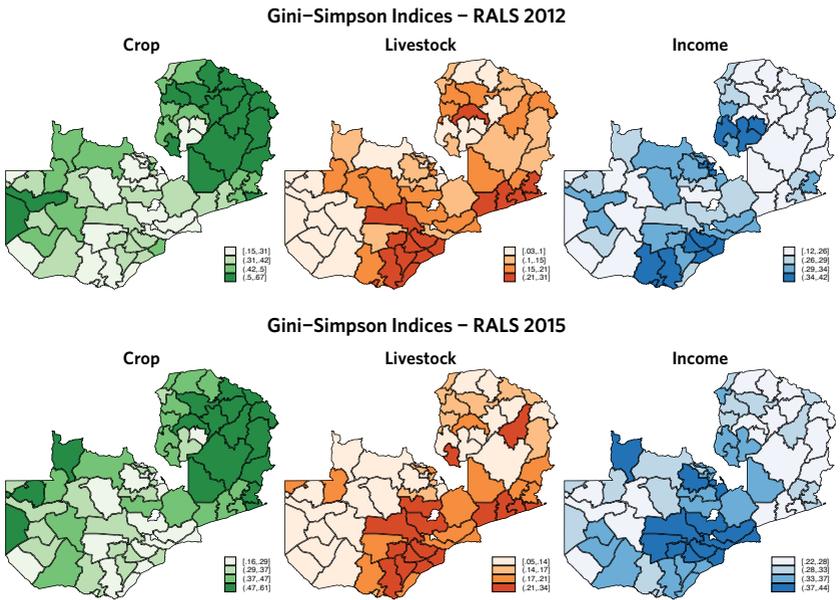
**While Zambia has achieved self-sufficiency in maize, the focus on one crop can have several adverse consequences.** Between 2007 and 2017, national maize production increased by more than two million metric tons (Figure 19). Zambia produced surplus maize, which it exports to most of its neighbors. However, production increase largely stemmed from an expansion of area, while maize productivity has improved only modestly and remained particularly low for poorer households (at 1.9 t/ha compared to about 2.8 t/ha among non-poor households) (World Bank 2017). In addition to low productivity, returns to maize production are low compared to horticultural and high-value crops (Hichaambwa et al. 2015). Non-diversified production systems are highly vulnerable to climate and market variability, and cause of environmental degradation. While there may be enough caloric intake, an undiversified diet can lack proteins, vitamins, and minerals and may reinforce malnutrition outcomes. While Zambia has ample surface and groundwater resources and fertile land, most households engage in rainfed, staple crop production, leaving the sector's potential untapped (Chapoto and Chisanga 2016).

**Figure 19** Zambia: Trends in Maize Production (2000–2017)



Source: CSO Crop Forecast Surveys, 2000 -2017

**Figure 20** Zambia: Trends in crop, livestock, and income diversification (2012, 2015)



Source: Arslan et al. 2016; using data from the Rural Agricultural Livelihoods Survey 2015 and 2012; The Gini-Simpson index for crops refers to the area allocated to different crop species; for livestock the contributions of different livestock species to the total livestock holdings; for income the monetary shares of income sources disaggregated into six categories for income diversification.

## Malnutrition and vulnerability to climate change

**Food insecurity persists in some areas of the country, and while health indicators have improved, they are still alarmingly high.** Despite self-sufficiency in some crops, around 46 percent of the rural households experienced inadequate food provision in at least one month in 2015. In lean times of the year, for instance in January or February 2015, the highest share of households reporting adequate food provision was only 9.6 percent of households in the Western Province, while none of the households in Central, Copperbelt, and Muchinga Provinces reported adequate food provision. Hunger is at its lowest in April through August, which is the main harvest period when stocks are relatively large and food prices are relatively low (IAPRI 2016; World Bank 2018). During a similar time frame, 2007-2014, child malnutrition has declined and the prevalence of stunting among children under five (a measure of long-term childhood nutritional deprivation) fell from 45 percent to 40 percent and underweight prevalence (which measures short-term changes in child nutrition) remained stagnant at 15 percent. Despite the relative decline, the rates are still unacceptably high, given the long-term social and economic cost the country has to bear as a consequence (World Bank 2018; citing the Zambia Demographic and Health Survey).

**Zambian farmers are vulnerable to shocks, climate change, and climate-induced risks.** Although Zambia is politically stable, many smallholder households face numerous shocks, such as periodic droughts, food insecurity, household income instability, illness, death, and macroeconomic instability (del Ninno and Marini 2005; Arslan et al. 2016; Kusonose et al. 2016). Climate change is expected to aggravate vulnerability in the future. Zambia's climate is highly variable and over the last few decades has experienced series of climatic extremes, e.g., droughts, seasonal floods and flash floods, extreme temperatures and dry spells, many of these with increased frequency, intensity and magnitude. Annual temperatures are expected to increase by 1.2 to 3.4 degrees Celsius by 2060 relative to current conditions and crop yields are projected to decrease between 2.9 percent (groundnut) and 8.7 percent (maize) by 2050, compared to a situation without climate change (CIAT and World Bank 2017). Thus, for households relying on a non-diversified production system, this can have severe consequences.

## The agricultural policy context

**The dominance in maize production is driven by two large spending programs, which dominate the budgetary allocation for agriculture in Zambia: The Food Reserve Agency (FRA) and the Farmers Input Support Program (FISP).** FISP was introduced in 2002/03 to improve the supply and delivery of fertilizer and seeds for maize production to increase productivity and food security. Different evaluations of FISP showed that it was poorly targeted, benefitted the richer segments of the population, or didn't deliver inputs on time (Mason et al. 2013). However, farmers still produce maize because they have a reliable market: FRA, a parastatal, strategic maize marketing board, buys maize at a pan-territorial price that typically exceeds the wholesale market price in major maize producing areas, thus crowding out the private sector (Mason and Myers 2013). Between 2008 and 2016, FRA and FISP accounted for, on average, 79 percent of government spending on the agriculture sector. FISP and FRA have helped turn Zambia into a structural surplus producer of maize, but have not managed to enhance productivity, to ensure food and nutrition security, or to sustainably reduce poverty (World Bank 2017).

**Since several years, national policies such as the National Agricultural Policy (NAP, 2004) or the Sixth National Development Plan (SNDP, 2011-2015) emphasize the need for enhancing agricultural diversification.** Agricultural diversification and the development of private-led marketing systems were already major objectives in the SNDP, the NAP and its implementing strategies. At the same time, the biggest share of the Ministry of Agriculture's budget was used to finance the provision of subsidized inputs and fertilizers through the FISP and buying of maize from farmers through the FRA. Regionally, Zambia is a member and signatory to various agreements and initiatives on agriculture<sup>31</sup>, which also have put in place strategies to promote agricultural diversification. Under the African Union's 'Comprehensive Africa Agriculture Development Program' (CAADP), the National Agriculture Investment Plan (NAIP) was developed for the period 2014-2018. A key component of NAIP was improved crop diversification and the introduction of different varieties adapted to the country's agroecological zones and weather patterns to enhance resilience and food security. Additionally, it also includes the financing of improved extension services and increased facilitation of access to inputs for smallholder farmers through improved targeting of FISP.

In recent years, Zambia has made some progress towards increasing agricultural diversification. The Government piloted the use of e-vouchers for distributing FISP to smallholder farmers in the 2014/15 season. The e-voucher system allows farmers to choose what type of inputs they want to obtain, both in terms of seeds and fertilizer.<sup>32</sup> This restructuring of the FISP also aims to improve targeting, the nationwide expansion of the e-voucher and a reduction in support as some farmers successfully complete and leave the program (Kuteya et. al 2016). The implementation of the e-voucher system has yet to be improved. In addition, the FRA is encouraged to take their role as strategic reserve and limit their buying activities to 300,000 tons, thereby targeting poor farmers in remote areas (Harman and Chapoto 2017).

## RESULTS OF THE QUANTITATIVE ANALYSIS FOR ZAMBIA

### Determinants of diversification in Zambia

For the quantitative analysis, factors that affect diversification have been categorized into sustainable livelihood capital assets—similar as presented in the Sustainable Livelihood Framework by Ashley and Carney (1999)—namely: (i) human capital; (ii) physical and natural capital; and (iii) financial capital; as well as (iv) policy institutions and (v) environmental factors. The results of the impact of these drivers on diversification in Zambia and Malawi are presented in Table 3 as well as in Appendix C.

#### i. Human capital

**Of several human capital variables (e.g., age, gender, education levels) only labour availability had a statistically significant effect on diversification.** Results of the regression analysis show no significant effect of age, gender and education levels of the household head on the extent of diversification. Instead, the number of full time adults in the households measured by full time adult equivalent (*fte*), which approximates labor availability, was found to have a statistically significant effect on all types of diversification. This is also supported by previous studies (Weiss and Briglauer 2000; Benin et al. 2004). The analysis finds that a household with fewer than 5 adults is likely to increase crop diversification up to 0.4 SDI, while for households with 5 adults or more the effect is negative. This result should be seen in the context of land size. Rural households in Zambia cultivate on average 2.8 hectares of land (Chapoto and Sitko 2015), which implies that there may be a limit to labor efficient utilization for achieving crop diversification.

## ii. Physical and natural capital

**The analysis confirms the importance of physical and natural capital as drivers of diversification.** Specifically, land size, livestock (important for crop production and crop income diversification), receiving diversification extension messages, practicing minimum tillage, ability to irrigate and proximity to wetlands have a statically significant effect on diversification. Previous studies have also found these factors to be important for diversification among rural agricultural households in Zambia (Mofya-Mukuka and Hichaambwa 2016; Sichoongo et al. 2014). These results indicate the importance of more investment in agriculture extension, land management, livestock programs (which includes disease control and restocking) and irrigation if diversification is to improve in Zambia. For instance:

- The effect of receiving extension-related messages increases all types of diversification, but is more significant for crop income diversification and livelihood diversification compared to crop diversification and agriculture diversification.
- There is a significant difference in terms of levels of diversification between those households that practice minimum tillage and those that do not—whereby the former are more diversified. These results were expected as many programs promote conservation agriculture as a mix of measures that include minimum tillage and crop diversification through crop rotation and intercropping.
- Household wealth status, as measured with lagged household productive assets (value of livestock and farm implements), has a positive effect on crop diversification for household with lower levels of wealth. As the wealth status increases, the effect of diversification is negative, implying that wealthy households are not necessarily diversified but tend to specialize.
- Size of land owned by the households positively influences diversification of all forms.
- Access to water for irrigation can have a statistically significant effect on diversification. Households situated in wetland are more likely to diversify their crop and agriculture income than those situated in dry land. The results are as expected given that households in wetlands in Zambia grow more vegetables mainly for the market compared to households in dry areas. The effect of a household's ability to irrigate on all types of diversification is even more significant and larger compared to the household's location.

### **iii. Financial capital and market access**

**The factors examined under financial capital are access to credit, distance to markets, and membership to economic groups, which have a statistically significant effect on diversification.** The analysis finds that having better access to credit increases income-related diversification (crop income, agriculture income, and livelihood diversification). The results indicate that households that borrow are market oriented. Access to markets, as measured by hours to the nearest urban center with at least 500,000 inhabitants, appears to have a non-linear influence on crop production and crop income diversification. Below a certain distance, households tend to specialize depending on market demands while more remote households depend on their own production for food consumption and other needs, hence diversifying their production. This result mirrors the work of Sichoongo and others (2014) who also concluded that households farther from the nearest market will diversify to boost food security. These households are also unlikely to diversify for commercial purpose. Therefore, the effect on crop income is marginal compared to the effect on crop production. Membership of economic groups, such as cooperatives, has a positive effect on income related diversification but not on crop diversification. These results are expected given that most economic groups are market oriented which can have an effect on income diversification.

### **iv. Policy environment**

**The study focused on two key aspects of agriculture policy in Zambia—the FRA and the FISP—and confirms the impact of FRA purchases on diversification.** The results found no significant effect of the amount of FISP fertilizer received on any type of diversification: crop production, crop income, agricultural production and livelihood. On the other hand, FRA purchases at district level negatively affect all types of diversification. When FRA purchase one bag of maize from a household, it reduces the probability of that household to diversify crop production and crop income by one percentage point. Even if the bivariate relations show non-linear positive effects at relatively higher level of purchases, the overall effect is negative. These results are as expected given that FRA mainly purchases maize, which can be an incentive for households to produce maize at the expense of other crops. Mofya-Mukuka and Hichaambwa (2016) also found that FRA activities had a negative impact on crop diversification in Zambia.

### **v. Environmental factors**

**The amount of rainfall received, measured by number of days of moisture stress over a 20-day period, is a key determinant of crop diversification.** The

results show an overall negative effect of moisture stress on crop, income and livelihood diversification. Thus, when moisture stress is reduced, the household is likely to diversify its crop production, agriculture income as well as livelihood income. Agriculture diversification as well as livelihood diversification both include diversification towards livestock, which is likely to increase with increased rainfall, which positively affects the availability of grazing pastures. However, moisture stress has a positive effect on crop income diversification. This could be explained by the fact that prices tend to be higher during dry periods providing higher incentive to sell.

**Furthermore, the results have shown that moving from the low rainfall agroecological region I to higher rainfall region IIb or IIa increases the probability to diversify.**<sup>33</sup> The insignificant results on diversification for region IIa could indicate that while it receives more rainfall than region I, crop and agriculture income increases because the climatic conditions necessary for crop processing (mainly sun drying) do not significantly change compared to region IIb and region III. In fact, moving from region I to region IIb reduces the probability to diversify crop income and agriculture income as processing of various products may be limited due to too much rainfall.

### **Impact of diversification on *food and nutrition security* in Zambia**

**Diversification can be used as a tool to improve household incomes, enhance food security and mitigate risks to production, reduce malnutrition and alleviate poverty, especially among resource poor small-scale farmers** (Joshi et al. 2004; Lin 2011). The analysis confirms this hypothesis and shows that diversification of all kinds reduces hunger in a household, measured by the number of months of household inadequate food provisions. The results show a higher impact for livelihood diversification implying off-farm income is important for improving household food security.

**The results also show a non-linear relationship between all types of diversification and the Household Dietary Diversity Score.** The impact of diversification on the HDDS is optimal at about 0.4 SDI for crop production, crop income and agriculture income. The optimal effect is about 0.6 SDI for livelihood diversification. Higher levels of diversification have a negative effect on HDDS. The results are similar to previous findings that showed that 0.4 SDI of crop diversification has the largest impact on reducing stunting in Zambia

**Table 3** Drivers of all types of diversification, that is: crop production, crop income, agricultural income, and livelihood diversification, in Zambia and Malawi

Drivers	Zambia	Malawi
<b>HUMAN CAPITAL</b>		
Female-headed household	Not stat. significant	(+)
Age of household head	Not stat. significant	(+): livelihood
Level of education of the household head in years	Not stat. significant	N/A
Household labor availability (measured in household full time adult equivalents)	Non-linear: initially (+): crop production (-) negative after a threshold of 5 fte	Not stat. significant
Household received extension advice Zambia: diversification- related advice Malawi: advice on sustainable agriculture practices	(+)	(+)
<b>PHYSICAL AND NATURAL CAPITAL</b>		
Value of productive assets (that is, value of livestock and farm implements)	(+): crop production	(+)
Farm size (hectare)	(+)	Non-linear: initially (+): crop income and agricultural income; after threshold: (-): crop income, agricultural and livelihood
Household keeps livestock	(+): crop production	
N/A: for others	(+): agricultural and livelihood	
Household applies minimum tillage practices	(+): crop production	N/A
Household has cropland in wetland areas	(+): crop income and agricultural	N/A
Household irrigates fields	(+): crop income, agricultural and livelihood	(+)
Household cultivates in dry season	N/A	(+): livelihood
<b>FINANCIAL CAPITAL AND MARKET ACCESS</b>		
Number of loans obtained by household	(+)	N/A
Hours to nearest urban center with at least 500,000 inhabitants	Non-linear: initially (-); then (+): crop production and crop income	N/A
Distance to Boma of residence (log)	N/A	Not stat. significant
Head/spouse related to the village authorities	Not stat. significant	N/A

Drivers	Zambia	Malawi
<b>FINANCIAL CAPITAL AND MARKET ACCESS</b>		
Household member belongs to economic group	(+): crop income, agricultural, livelihood	N/A
Household participates in cereal markets	N/A	(-): livelihood
Household participates in legume markets or in industrial cash crop markets	N/A	(+)
Household participates in horticultural markets	N/A	Not stat. significant
<b>POLICY ENVIRONMENT</b>		
FISP fertilizer vouchers received	Not stat. significant	Non-linear: initially (+), then (-)
Maize purchases through FRA (Zambia) and ADMARC (maize price: Malawi)	(-): crop production and crop income	(-)
Distance to nearest ADMARC center or auction floor	N/A	(+)
Distance to maize auction floor	N/A	Non-linear: initially (+), then (-)
<b>ENVIRONMENTAL CONDITION</b>		
Expected moisture stress (# of 20-day periods with <40mm rain)	(-): crop production, agricultural, livelihood	
(+): crop income diversification	N/A	
Agroecological Region IIA (base=Region I)	(+): crop income, agricultural, livelihood	N/A
Region IIB (base=Region I)	(+): crop production	
(-): agricultural, livelihood diversification	N/A	
Region III (base=Region I)	(+): crop production and crop income	N/A
Observations	14,501	between 4,704 and 4,931

Source: Own elaboration

Note: This table provides a simplified summary of drivers of crop production diversification (only Zambia), crop income diversification, agricultural income diversification and livelihood diversification (both countries). The direction of impact on diversification is denoted in a simplified manner: positive (+) and negative (-) for all levels of statistical significance. It is indicated when the effect is only valid for one type of diversification, or the effect is not statistically significant ("not stat. significant"). Due to the use of different data sets, some variables are not available for each country, which is indicated with "N/A". Regression coefficients are presented in Appendix C.

(Mofya-Mukuka and Kuhlitz 2015). The results imply that at higher levels of SDI, the household may not produce or purchase enough food of every type and high levels of diversification beyond 0.4 may not be necessary for improving household food access.

### **Impact of diversification on *resilience* in Zambia**

**The impact of diversification on resilience is non-linear, and positive for poor households with relatively low levels of income, and food production.** Resilience in this study is measured by three variables: (i) value of productive assets; (ii) food production; and (iii) household income. As highlighted earlier, as households increase their wealth status, they tend to specialize. The effect of diversification on income follows a similar, non-linear pattern—while at lower levels of income, diversification contributes to income increase, at higher levels of income further diversification reduces the probability of increasing household income. These results are similar to diversification’s impact on HDDS, showing an optimal impact level of around 0.4 SDI for crop production, crop income and agricultural income diversification. Similarly, the results show a non-linear relationship between diversification and food production. At lower levels of food production, diversification appears to have a positive effect, but as food production increases, the effect declines. A more efficient specialized production increases food production overall; hence, households producing more food are less likely to be highly diversified. However, diversification remains critical for households with lower levels of food production, which is the situation for the majority of rural households in Zambia.

### **POLICY IMPLICATIONS FOR ZAMBIA**

**First, the analysis of impacts of diversification on nutrition and resilience in Zambia shows that increasing diversification of all kinds (crop production, crop income, agriculture income and livelihood) to a certain level reduces a household’s hunger incidence and increases resilience indicators.** The analyses found the impact of diversification on the HDDS to be non-linear—lower levels of diversification have a positive effect, while higher levels of diversification have a negative effect. Highly diversified households may not produce enough food for own consumption, and neither produce enough to sell in the market. The impact on household income follows a similar pattern, whereby low levels of diversification have a positive impact on household income, while excessive

levels result in negative impacts. The analyses indicate a level of diversification, at 0.4 SDI, which seems optimal to achieve resilience and nutrition impacts. However, at the same time, the analysis shows that the starting point matters: at lower levels of income, increasing diversification contributes to income increase, while at higher levels of income this is not the case.

**Second, the results of the quantitative study show that diversification is determined by various factors, related to knowledge, labor availability and access to assets.** As a result, there are also several policy implications that emerge from the analysis. The results identify the following key drivers of diversification in Zambia: size of land, labor availability, exposure to diversification-related extension messages and minimum tillage, access to loans, and membership of economic groups. There is, therefore, an urgent need to rearrange the allocation of agricultural budget away from input subsidies towards extension services. There is also a need to invest more in human resources for extension services and especially diversification-related messaging. Extension messages, however, should go beyond encouraging households to simply diversify, but develop customized messages for different types of farmers. Given that there may be a desirable level of diversification for different types of farmers, the messaging should be developed for a heterogeneous landscape of farmers, where some should be encouraged to diversify, while others should specialize to improve national food security and resilience.

**Third, the results also highlight that the distance to markets is an important determinant of outcomes.** Farming households farther away from markets tend to diversify in order to ensure greater food security and self-sufficiency. However, diversification in remote conditions will only bring a certain amount of benefits and these households are unlikely to move out of poverty. Households closer to urban markets tend to specialize depending on market demands and tend to be more commercialized. This highlights the need to invest in infrastructure to connect remote areas to agriculture input and output markets, but at the same time underlines potential economic and environmental trade-offs of specialization.

**Fourth, the results show that households in wetlands and those with the ability to irrigate are more diversified.** Similarly, households in higher rainfall areas of the Northern and Eastern regions are more diversified. This indicates that more investments in irrigation would likely result in improved food and nutrition

security. For instance, households that have access to irrigation can benefit from horticulture production and recent studies have shown that growing tomatoes and cabbage had more than 150 times higher returns compared to producing maize in Zambia (Hichaambwa et al. 2015).

**Fifth, the FRA interventions in the maize market represent a key constraint, and public expenditures should be directed to more productive investments.**

These findings highlight a mismatch between the needs of the agricultural sector in Zambia and public expenditure—the large share spent on FRA comes at the expense of key drivers of agricultural growth and diversification such as agriculture extension and irrigation. The findings also amplify previous research-based policy recommendations, which emphasize the benefits of a reduced role of government in maize purchases, resorting to limited interventions only for the purpose of maintaining strategic reserves and to conduct purchases from remote areas that cannot be reached by the private sector (Chapoto et al. 2016; Goyal and Nash 2017; IAPRI 2017; World Bank 2017).

## 4.1.2 MALAWI: QUANTITATIVE ASSESSMENTS OF DRIVERS AND IMPACTS

### Background

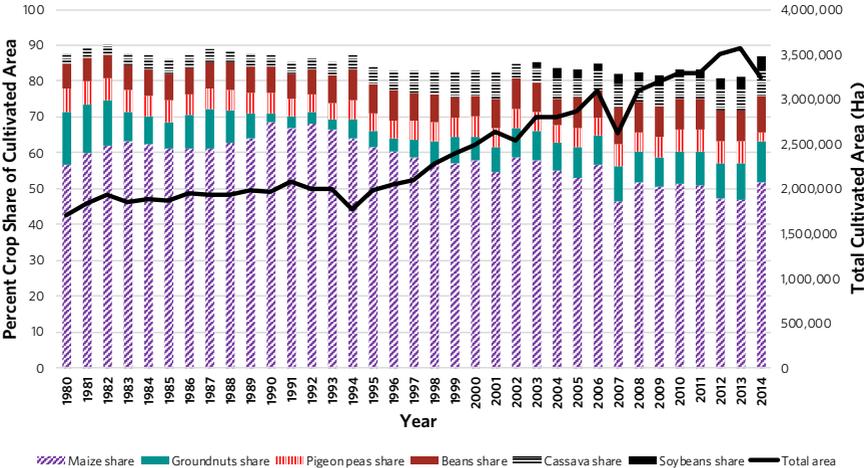
**Malawi is endowed with diverse agro-climatic zones and plentiful fresh water, but land is becoming severely degraded due to increasing population pressure and agricultural intensification.** The reliance on rainfed, undiversified cultivation coupled with the potential effects of climate change presents vital challenges to the sustainability and resilience of Malawi's agricultural sector. The population, very young and predominantly rural, is growing rapidly. The majority of Malawi's poor reside in rural areas and depend on agriculture for their livelihoods. The importance of agriculture for the improvement of overall wellbeing indicators is therefore significant. The analysis that follows assesses whether promoting agricultural diversification would be an appropriate investment to build resilience and enhance nutrition outcomes.

**The Malawian economy is largely based on agriculture and most of the population is engaged in the agricultural sector.** Economic growth of the country is highly dependent on the agricultural sector. Agriculture accounts for about a third of Malawi's GDP and indirectly affects a large part of the country's

services sectors (World Bank 2017b). The sector is considered the engine of Malawi’s economic growth since, between 2005 and 2011, more than 80 percent of the country’s total exports were agricultural commodities, primarily tobacco, sugar and tea. Tobacco alone represents an average 60 percent of Malawi’s total exports. The manufacturing and agricultural sectors work together in their contribution to the overall growth of the economy, which in 2013/14 registered an average GDP growth rate of 5.2 percent. The 2013 growth in manufacturing was attributed to usage of higher volumes of raw agricultural inputs and a more constant supply of fuel and other raw materials (World Bank 2017).

### State of agricultural diversification

**Figure 21** Malawi: trends in crop area planted (1980-2014)

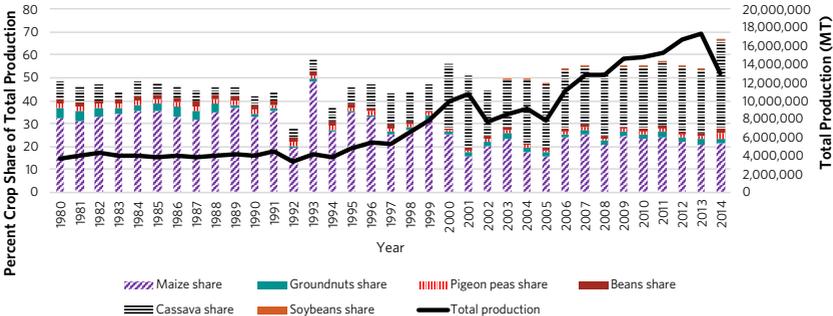


Source: Author’s computations based on FAOSTAT (24 July 2017)

**The Malawi smallholder agricultural sector is dominated by maize production with an underdeveloped livestock sub-sector.** Total crop area has been increasing from the mid-1990s average value of 2 million hectares to 3.5 million hectares in 2014 (FAOSTAT 2017; see Figure 21). Between 1980 and 2014, six crops have consistently accounted for 80-90 percent of the total cultivated crop area in Malawi. During the 1980s, the share of total crop area under maize cultivation was close to 60 percent, and since then only dropped by 10 percent to close to 50 percent, with exceptions in 2007, 2012 and 2013, when the share fell below 50 percent. Groundnuts are the second most cultivated crop, with a share

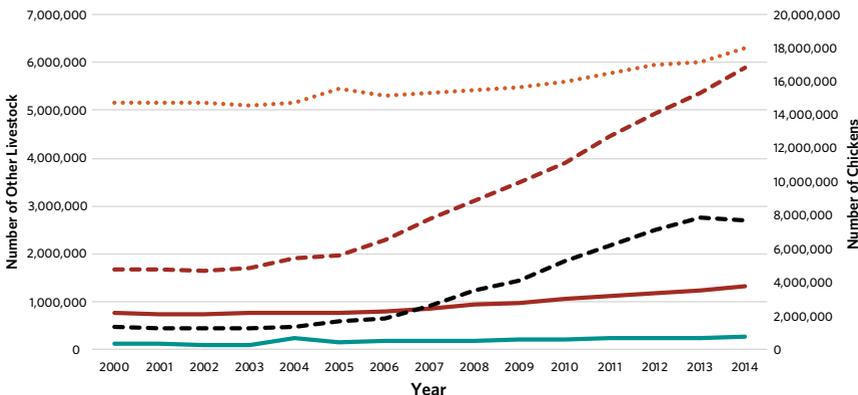
of 14 percent in 2014, followed by beans, which ranges in the 6-10 percent range, and pigeon peas, which has remained within the 5-7 percent range during the period until 2014 when it decreased to 3 percent. The share of soybeans grew from 2 percent in 2003 to 4 percent in 2014, while cassava has maintained its share within the 3-7 percent range.

**Figure 22** Malawi: trends in crop production (1980-2014)



Source: Author’s computations based on FAOSTAT (24 July 2017)

**Figure 23** Malawi: trends in livestock numbers (2000-2014)



Source: FAOSTAT (24 July 2017)

Six crops accounted for between 45 to 60 percent of total production in the last three decades (Figure 22). The production of maize has largely been stable and ranged between 20-25 percent of total crop production. The share of cassava increased significantly: from 8 percent in 1980 to 39 in 2014—although its share

of cropped land only grew from 3 to 7 percent over the period. This could be attributed to significant improvement in productivity arising from cultivation of improved varieties. Beyond maize and cassava, the shares in total production are small. In 2014, groundnuts accounted for 2 percent of production, pigeon peas 3 percent, beans and soybeans for 1 percent each.

**The livestock sub-sector is largely underdeveloped.** Figure 23 shows that the total amount of cattle owned in the country has increased between 2000 and 2014, growing from around 763,000 to around 1,316,000, respectively. Similarly, the amount of chickens and sheep owned has increased only modestly. However, goat and pig numbers have increased more significantly, especially since 2005.

### **Food security, nutritional diversity, and vulnerability to climate change**

**The average Malawi diet remains poorly diversified and mainly composed of cereals, primarily maize, starchy roots (cassava and potatoes) and starchy fruit (plantain).** The government of Malawi (GoM) has for many years placed great emphasis on maize production for food self-sufficiency at both household and national levels, which resulted in a dramatic increase in maize production, especially since implementation of the FISP (Mazunda et al. 2015).

**While the increase in maize production may have enhanced maize self-sufficiency, diets remain poorly diversified.** Ecker and Qaim (2011) report that more than 60 percent of the total food quantity in Malawi consists of staple foods, primarily maize, which accounts for 46 percent of total food quantity, more than 60 percent of energy, and almost half of protein consumption, 67 percent of total iron, 65 percent of total zinc, and almost 70 percent of total riboflavin consumed, with very little intake of animal-source, vegetables and fruits which largely leads to micronutrient deficiencies.

**Food security and nutritional outcomes among the majority of the rural population remain poor.** The Malawi Demographic and Health Survey (MDHS) shows that the prevalence of stunting in children under five, that is being too short for their age, which is a sign of chronic undernutrition, and underweight, that is too thin for their age, has decreased markedly since 1992 but remains high in absolute terms. Stunting in children under the age of five decreased from

46 percent in 1992 to 37 percent in 2015-2016. Twelve percent of children remain underweight in 2015-2016 and 3 percent of children under the age of five are wasted, that is, too thin for their height, which is a sign of acute undernutrition.

**In addition, the sector remains vulnerable to climate change and risk.** Malawi is particularly vulnerable to weather shocks. The impact of these shocks have intensified over the past years and are likely to continue to worsen with climate change. In 2016, Malawi was facing drought and subsequently poor harvests for the second consecutive year. The production of maize fell by 14.7 percent following a reduction of 30.2 percent the previous year and the maize production deficit increased from 233,000 MT to 768,687 MT (World Bank 2016). The humanitarian impact of the drought of 2016 was estimated to be significant with around 40 percent of Malawi's population (at least 6.5 million people in the 24 drought-affected districts) expected to experience food insecurity. On average, these shocks have caused annual losses to a value equivalent to one percent of GDP (World Bank 2016). While this food security crisis was undoubtedly a result of changing weather patterns, the impact of the drought has been exacerbated by policies that have made Malawi particularly vulnerable to shocks. The effects have been compounded by a number of other factors, including the high rate of population growth and environmental degradation mainly due to unsustainable land use practices such as undiversified agriculture and cutting of trees for fuel wood and charcoal.

## **The agricultural policy context**

**The Malawi 2020 Vision was adopted in 1998, providing a framework for the implementation of medium-term plans for the development of various sectors, with agriculture playing a key role.** The Vision document identified agriculture and food security as key priority areas to foster economic growth and development. This long-term vision has been translated into a medium-term policy framework, the Malawi Growth and Development Strategy (MGDS). The primary objective of MGDS I (2006-2011) and MGDS II (2012-2016) is to reduce poverty through sustainable economic growth and infrastructure development, focusing on agriculture and food security as a key priority area. MGDS II promotes agricultural diversification away from a historic reliance on maize and tobacco. Also, the Malawi Economic Recovery Plan (ERP 2012) intended to scale up support to other agriculture products such as multiplication of cassava cuttings and sweet potato vines.

**Although crop diversification is one of the main goals of the MGDS II and is also a component of the Agriculture Sector Wide Approach (ASWAp), the majority of resources are allocated to maize producers through the Farm Input Subsidy Program (FISP).** The core component of FISP is support to maize through the provision of vouchers or coupons for hybrid seed and fertilizer to small-scale farmers. It was developed in the 1998/99 season. Since 2005/06, the Government provides 50 percent of farm households with vouchers for 100kg of fertilizer and maize and lately legume seed, with mainly privately imported fertilizers delivered principally by two parastatal input suppliers (Chibwana et al. 2012). Over the years, the Government allocated around 50 to 70 percent of the agriculture budget to FISP. Although there have been efforts to distribute vouchers for legume seeds (pigeon peas, cow peas, soybean seed and groundnut seed), in the 2015/2016 season around 87 percent of all distributed seeds were maize.

**In addition to the FISP, the Agricultural Development and Marketing Corporation (ADMARC), a parastatal marketing board, is heavily involved in the maize market.** Through ADMARC, the Ministry of Agriculture and Food Security has operated a price band system for maize since 2006, to protect consumers and support producers. In August 2008, private maize trade was banned and ADMARC established as the exclusive legal buyer and seller of maize. A month later, the government issued a new price band within which private trade was allowed. However, this policy has not been sufficient for price stabilization, particularly during 2008/09 and 2012/13 partially due to the limited financial capital of ADMARC. Between 2006 and 2014, ADMARC purchased between 90 percent and 62 percent of total maize (NSO 2015).

**Even though the FISP is recognized as a successful model of an agricultural input support program due to it leading to a dramatic increase in maize yields, it has not had a positive impact on agricultural diversification** as advocated by Malawi's national agriculture-related and economic development policies. An analysis of households participating in the FISP program showed that these households allocated on average 45 percent more land to maize production than households not included in the scheme. While the allocation of more land to improved maize resulted in an overall increase in household food security, it also resulted in reduced allocation of land to other crops such as groundnuts, soybeans cassava and sweet potato—these were allocated 17 percent less land by farmers who received FISP vouchers as opposed to those who did not. Reduced land allocated to drought tolerant crops such as cassava and sweet

potato could have an impact on drought resilience, while reduced allocation of land for legumes may have negative outcomes for soil fertility meaning greater amounts of fertilizer will be needed to maintain maize yields from year to year (Chibwana et al. 2012).

## RESULTS OF THE QUANTITATIVE ANALYSIS FOR MALAWI

### Determinants of diversification in Malawi

**The quantitative analysis considers a series of factors that could drive diversification, building on the sustainable livelihoods framework.** In the case of Malawi, these are grouped into: (i) human capital; (ii) physical and natural capital; (iii) market access; and (iv) policy environment. The SDI was calculated for crop income diversification, agricultural diversification and livelihood diversification. The estimation results of the impact of these drivers on diversification are presented in Table 3 as well as in Appendix C.

#### i. Human capital

**The results indicate that the key driver of agricultural diversification in Malawi is the household being headed by a woman and training on sustainable farming methods: there is a positive relationship with all three types of diversification.** The age of the household head and number of household adult equivalents also seem to have a positive relationship with diversification, but the relationships were not found to be statistically significant. Training in sustainable agricultural methods significantly increases all types of diversification. Analysis has shown that household participation in this training significantly increases the probability to diversify crop, agricultural production and livelihood income. There is a positive relationship between the distance to a major urban center and diversification of the farm.

#### ii. Physical and natural capital

**The study finds a clear linear relationship between the value of farm assets and diversification, whereby diversification increases with an increase in the value of farm assets.** In the case of farm size (cultivated land), diversification increases with increasing land area up to about one hectare for crop and agricultural production and 0.5 ha for livelihood diversification. After these thresholds, diversification decreases with increasing land size. Using upland or wetland irrigation has a positive relationship with diversification.

### iii. Market access

**In the case of household market orientation, there is a clear negative relationship between selling to ADMARC and diversification.** There is a negative relationship between the ADMARC maize farm-gate price and diversification and the distance to the nearest ADMARC and tobacco auction floors. The relationship between the distance to the nearest tobacco auction floors show strong quadratic relationship while that of the distance to the nearest ADMARC center is linear, with increasing diversification as one moves away from these centers. Participants who participate in in legume and horticultural markets tend to be more diversified.

### iv. Policy environment

**Participation in FISP is positively related to diversification.** Each additional voucher received by households increases the probability to diversify crop and agricultural production and livelihood income. However, receiving too many vouchers is negatively associated with diversification. The analysis finds a linear positive relationship between farm size and number of FISP vouchers received with each additional voucher received being associated with an additional 0.11 hectares of farm land owned. Further analysis showed that the average number of input vouchers received by households with larger farm sizes was significantly higher than that of their counterparts owning smaller land sizes (1.28 compared to 0.82). This highlights the positive impact of large land sizes on diversification.

**The number of vouchers received significantly increased the probability to diversify agricultural production and livelihood income among the households with large land sizes, by 3.4 and 3.5 percentage points, respectively.** Too many FISP vouchers significantly reduced the probability to diversify agricultural production and livelihood income by 0.4 and 0.3 percentage points respectively. There are several possible explanations why an increase in FISP can lead to an increase in diversification. FISP was observed to increase maize productivity, which may have allowed farmers to allocate land to other crops without impacting the production volumes of maize. Another explanation is that since 2008/9 FISP vouchers allowed for purchases of maize and legumes which may have had this measurable impact, showing that agricultural input support programs, if carefully designed, can achieve both productivity and agricultural diversity outcomes.

## IMPACT OF DIVERSIFICATION ON FOOD AND NUTRITION SECURITY AND RESILIENCE IN MALAWI

The analysis confirms the positive linkages between diversification and household dietary diversity and livelihood resilience as measured by household income, food production and food stocks. The analysis shows that higher levels of all types of diversification under assessment, that is crop production, agricultural income and livelihood income, are positively and significantly associated with higher levels of HDDS, for all types of households. However, a positive impact of diversification on MAHF cannot be confirmed. Instead, MAFHP seems to decline with increasing diversification for all types of households. Only households with large land endowments appear to have an increasing MAHF with increased levels of diversification. All types of diversification were found to increase livelihood resilience as measured by household income, food production and food stocks, regardless of the household's farm size. However, for wealthy households, income and food production seem to decline with increasing diversification. This seems to indicate that wealthier households benefit more from specialization.

The analysis clearly shows that diversification, specifically diversification in crop production, promotes on agroecosystem resilience. Households with higher levels of diversification have improved values of soil quality, as measured by the Soil Quality Index. The effect is most pronounced for diversification in crop production. Similarly, the growing season Canopy Greenness Index increases linearly with increased diversification. Again, the effect is most pronounced for diversification in crop production and is hardly visible for livelihood diversification.

### 4.2 QUALITATIVE STUDY: MALAWI

#### METHODOLOGY AND STUDY AREA

A qualitative study was conducted in several districts in Malawi to analyze and gain an in-depth understanding of drivers and impacts of diversification. The qualitative study complements quantitative research through a mixed-method analysis, broadening the understanding of impacts on different actors, and capturing the types and complexity of decision-making processes on whether to diversify or specialize and their impacts. The qualitative research approach

provides greater breadth and depth of analysis - examining underlying factors and pathways of how and why climate resilience and nutrition diversity have transpired for households engaged in agricultural diversification. It analyzed the contextual background and enabling environment in which activities and programs operate, with consideration of mediating factors including sociocultural norms and belief, existing institutions, socioeconomic factors etc., which influence decisions, results and outcomes. The study consisted of analysis of two sites where agricultural diversification is practiced (Lilongwe and Dedza districts) and incorporated a “light” comparative analysis of less diversified communities.

**The sampling strategy for the study was purposive—focus areas of the qualitative study included two study sites in two agriculturally diverse districts.** In Lilongwe district the study focused on the Mpingu and Malingunde extension planning area (EPA), where the project School of Agriculture for Family Independence (SAFI) operates. This initiative promotes a diversified livelihood approach, including diversified production systems through farmer field schools.<sup>34</sup> The second site was identified in nearby Dedza district, characterized by a highly diversified production. Dedza lies in relatively similar agroecosystem conditions as Lilongwe district with a cooler climate and without SAFI intervention, and is characterized by a variation of agricultural diversification context—including crop diversification and livestock farming systems. Both study sites included “comparison areas”, which comprised of communities nearby with ‘relatively’ more specialized and less diversified agricultural systems.

**The qualitative approach was based on a triangulation of methods,** including focus group discussions (FGDs), key informant interviews (KIIs), in-depth household case studies, and participatory tools (such as the “motivational and driving forces matrix” and the “gender-based seasonal calendar, decision-making and division of labor tool”). Intensive daily team debriefings were conducted after each day’s fieldwork, facilitating in-depth systematic review of findings to capture key conclusions.

## **Research hypotheses**

**The research design is based on a core set of hypotheses.** The study examines diversification from three main perspectives and aims to test the following three core hypotheses:

- i. Agricultural diversification<sup>35</sup> increases household income streams, enabling higher value products, value-chain activities, leading to increased and more stable income. This results in improved levels of food and nutrition security at household and community-wide levels.
- ii. Agricultural diversification improves household consumption and nutrition (food content quality and preparation). This occurs through changes in labor requirements, workloads, time availability among household members, particularly care-givers.
- iii. Households are willing to sacrifice potential benefits of agricultural specialization to better manage risks and reduce vulnerability through agricultural diversification.

## RESULTS

**Concerning the first hypothesis, the study found agricultural diversification has led to higher production yields and results in increased sales.** In many cases, however, this is due to expanding land area—which could be a potential impediment given increasing land scarcity. Widened income streams through livestock and income-generating activities (IGAs) in particular, are complementing farm production activities, contributing to increased revenues. Increases in crop production and income sources are leading to greater sufficiency and stability in food availability of varied diets throughout the year, including from own production and purchases. This is improving consumption levels, resilience and wellbeing.

**Prioritization of nutrient-dense diets however was found to be mediated by nutrition awareness exposure,** particularly prominent among School of Agriculture for Family Independence (SAFI) farmers in Lilongwe district. There was a growing interest among less diversified farmers to learn more and pilot trial in diversification, particularly given potential benefits in increased income, food security and savings. Less diversified farmers are aware that their nutrition levels are precarious and varying in response to shocks and the seasons. The analysis of agricultural diversification, nutrition and effects on time and workloads shows that farmers engaging in agricultural diversification have experienced increased demands in time and workloads but have managed these challenges through adaptive measures including hiring in ganyu (paid labor), gradual shifts towards an increased sharing of gender-ascribed roles, and adopting more efficient food preparation technologies, which are also more nutritious.

**The analytical focus of the third hypothesis indicated that multiple income streams, including in agriculture and income generating activities, offer alternative sources of food and income security,** in particular, in situations of stress, thus strengthening household resilience. Ecosystem and agricultural management practices<sup>36</sup> were considered central to sustainable diversified production systems, particularly in the context of increasing land scarcity. Climate-smart practices were typically mainstreamed as part of diversification strategies, notably among SAFI farmers such as tree planting, organic manure making and application, soil coverage. This is not as common in less diversified farms, or if applied, typically in less intensity.

**Despite benefits, farmers expressed some concern regarding potential trade-offs, for instance yields, soil fertility competition, greater need for land, compromise in revenues, or need for ongoing technical support.** On the other hand, government policy/strategic efforts actively encourage transformation to 'farming as a business' with promotion of agribusiness/commodity-based production. Among technicians and farmers alike however, the study found an awareness of potential underlying risks in more specialized approaches, e.g., market prices, natural resource degradation, year-round food availability and sources for nutritional diets, technical support. Table 4 provides the summary of the results of the qualitative study.

## **RESULTS AND POLICY IMPLICATIONS**

**Both quantitative and qualitative analyses indicate potential benefits of diversification on nutrition and resilience (approximated by income, food production and food stocks).** The qualitative analysis also highlights that nutrition impacts would need to be mediated through nutrition awareness. Many farmers benefitted from intense training at the SAFI school which supports the finding of the quantitative analysis that targeted training supports diversification. Specifically, the qualitative study highlighted that diversified agriculture is a multi-purpose livelihood strategy that generates both stability in household income and increased revenues. It widens opportunities for households (e.g., capturing market advantages) and has multiplier effects on the local economy (e.g., employment generation). Based on the analysis of drivers of diversification the policy implications can be summarized as follows.

**Table 4** Summary of results of qualitative study on impacts of diversification in Malawi

HYPOTHESIS	CONCLUSION
<p><b>Agricultural diversification increases household income streams</b>, enabling higher value products, value-chain activities, leading to increased and more stable income. This results in improved levels of food security, and nutrition at household and community-wide levels.</p>	<p><b>True.</b> Agricultural diversification has led to higher yields and sales. In many cases, due to expanding land area—which is a potential impediment given increasing land scarcity. Increased production, complemented with widened income streams, e.g., livestock and income-generating activities, is generating increased revenues, greater sufficiency and stability of household food availability of varied diets throughout the year, and improving resilience and wellbeing. Prioritization on nutrition is advanced by nutrition awareness, particularly prominent among SAFI farmers.</p>
<p><b>Agricultural diversification improves household consumption and nutrition</b> (food content quality and preparation), but this is mediated by changes in labor requirements, workloads, time availability among household members</p>	<p><b>Partly true.</b> Farmers’ accounts of increased labor demands—time in particular—due to agricultural diversification have been managed through adaptive measures such as hiring in ganyu (unskilled labor) increased sharing of gender-ascribed roles, and adopting efficient food preparation technologies, which are also more nutritious.</p>
<p><b>Households are willing to sacrifice potential benefits of agricultural specialization to better manage risks</b> and reduce vulnerability through agricultural diversification</p>	<p><b>True, but with some trade-offs.</b> Multiple income streams, including in agriculture and income-generating activities offer alternative sources of food and income security under stress. Ecosystem practices are considered central to sustainable diversified production, particularly in the context of increasing land scarcity. But potential trade-offs exist e.g., yields, soil fertility competition, greater need for land, compromise in revenues, need for ongoing technical support. On the other hand, government policy/strategic efforts actively encourage transformation to ‘farming as a business’ with promotion of agribusiness/commodity-based production. Among technicians and farmers alike however, there is awareness of possible underlying risks in more specialized approaches, e.g. market prices, natural resource degradation, year-round food availability and sources for nutritional diets, technical support.</p>

**First, the FISP in Malawi is an example of an input support scheme that has contributed to diversification—this could be taken a step further through guaranteeing access to multiple crops.** Further changes within FISP can be contemplated to increase the positive impact on diversification, for instance by ensuring that input vouchers can be redeemed for a broad range of productive inputs from participating agro-dealers. This voucher could be leveraged to promote uptake of climate smart agriculture inputs and technologies and inputs/technologies most suited to their agroecological zones. At the same time, it should be ensured that sufficient agricultural advisory services to farmers are provided, e.g., by participating agro-dealers who are trained, to ensure uptake.

**Second, targeted extension advice has been shown as effective in supporting diversification and should be further supported, possibly with differentiated message for different types of farmers and to promote ‘diversification as a business’.** This is confirmed by the qualitative study which describes the overwhelmingly positive outcomes of SAFI on agricultural productivity and better nutrition and resilience. This should include information and awareness to sensitize farmers on the potential breadth of benefits in the short and long-term, capacity development and ongoing technical support and skills training - through multiple approaches in diverse areas of production and livelihood income-generating activities. Considering that proximity to markets was found effective in increasing diversification, the extension messaging could also entail promoting and intensifying “agricultural diversification as a business”. Considering that incentives for diversification seem to increase with increasing land size, management practices should be considered and taught which allow for diversification also on small land areas.

**Third, participation in legume and crop market can serve as incentive for farmers to diversify production.** This highlights the importance of public investment in the enabling environment for diversification. Conversely, the analysis shows that proximity to ADMARC and increasing maize price is providing a disincentive to diversify.<sup>37</sup> To ensure that rural population can engage in productive diversification, supply chain development for a wider set of crops should be promoted by supporting the development of input and output markets and smallholder farm market access, supporting private systems of input delivery, finance, and commodity marketing for a range of crops that offer higher returns to farming. Ameliorating market failure is likely to require increased commitment to investing in public goods (e.g., road, rail and

port infrastructure, R&D, agricultural extension systems, market information systems) and institutional change to promote the functioning of market-oriented trading systems as well as a functioning land tenure system.

**Fourth, raising awareness about nutrition appears to have positive effects.**

Any agricultural diversification support should thus be combined with nutrition awareness and education to increase good household nutrition practices, which is an imperative to improve levels of household nutritional practices, and should be integral to a multi-sectoral policy approach. Household prioritization on improved nutrition varies, depending on several factors, e.g., awareness, education knowledge base, capacity to produce or purchase nutritional foods (e.g., access, availability, affordability), periods of high risk. Consistent promotion of good nutritional practices has been found to be effective in influencing smallholders' consumption practices in this study. Intensifying nutritional awareness advocacy and educational programs, particularly linked with agricultural extension support, is recommended to maximize consumption from both own-production and market purchases.

# 5. Policies for Agricultural Diversification and Positive Impacts on Nutrition and Resilience

*Although environmental, market, socio-economic and institutional drivers importantly influence production decisions, it is often policies—national and international—that have a decisive impact on whether farms decide to diversify or specialize. The aim of this section is to analyze in more detail the policy drivers that promote or constrain productive diversification in African agriculture and their impact on resilience and nutrition outcomes. Building on the preceding work on drivers of diversification in Chapter 3, the analysis groups policies into six broad categories: (1) Subsidies and agricultural public expenditure; (2) Rural infrastructure and markets; (3) Agricultural research and seed systems; (4) Agricultural advisory services, skills development, and agripreneurship; (5) Natural capital, land and water tenure; (6) Nutrition, health, and social protection.*

**This chapter draws on a literature analysis of Sub-Saharan Africa countries, by which the policies, strategies and institutions potentially supporting productive diversification were explored.** Focus was placed on 10 countries, namely, Senegal, Ghana, Nigeria, Democratic Republic of Congo (DRC), Ethiopia, Kenya, Rwanda, Madagascar, South Africa, and Mozambique.<sup>38</sup> Almost all focus countries have action plans related to resilience and nutrition, as well as overall national ‘vision’ documents (e.g., Kenya Vision 2030, Rwanda Vision 2020, Senegal Vision 2035), national development plans, green growth strategies, all often based on international declarations or strategies.<sup>39</sup> Many have also put in place sectorial food security, agriculture and climate change policies and strategies that indicate their treatment of agricultural diversification and specialization. Most countries recognize the value of diversification for nutrition and resilience outcomes, yet some have declared the pursuit of agricultural specialization and intensification as critical for national economies, while some advertently or inadvertently promote specialization under the pretext of improving national food security.

## 5.1 SUBSIDIES AND AGRICULTURAL PUBLIC EXPENDITURE

Public spending, including the use of agricultural input subsidies, is one of the most effective instruments in promoting agricultural growth and reducing poverty in developing countries. It provides an opportunity for diversification if done smartly, but can be a constraint if the type of intervention and the range of commodities supported are too narrow.

### DESIGNING 'SMART' AND MARKET-FRIENDLY AGRICULTURE INPUT SUPPORT PROGRAMS

**Agricultural input support programs (AISPs) have been a common and a major feature of agricultural development policies in Sub-Saharan Africa for many decades.** FAO (2012) indicates that these programs have evolved over time from small-scale demonstration packages to large-scale, multi-year programs that heavily subsidize agriculture inputs, focusing largely on fertilizer and seeds. These programs focus on the promotion of increased agricultural productivity through the adoption of 'improved technologies', and are *targeted* to small-scale farmers, as is found in several countries in Eastern and Southern Africa (Kenya, Malawi, Rwanda, Zambia; overview in Table 5), or have untargeted, *universal* application, as in West Africa (Ghana, Mali, Nigeria, Senegal; overview in Table 6). The subsidized affordability of inputs aims to (a) increase farm profitability and (b) to reduce agriculture-related risks perceived by farmers due to the adoption of new technologies and management practices. It is assumed that the limited knowledge of the benefits of inorganic inputs and their correct usage, alongside perceived risks, constrain farmers' expenditures on inputs (FAO 2012). Universal input subsidies were phased out in almost all Sub-Saharan African countries in the early 1990s because of structural adjustment policies at that time. However, after the 2008 food crisis, agricultural input support programs were reintroduced or expanded, and have remained in force to date (Demeke et al. 2014).

**More recently, AISPs have become major components of agricultural development strategies of African countries and have turned into major drivers of farmers' crop choices.** In most cases, the resurgence of AISPs has been related to boosting food security in the short-term, while supporting longer-term agricultural productivity goals. In the countries observed in this report, agricultural input support has mostly been focused on inorganic fertilizer, improved seeds

**Table 5** The main characteristics of targeted subsidies in selected Sub-Saharan African countries

Targeted Subsidies				
Country	Kenya	Malawi	Rwanda	Zambia
Program name and date	NAAIP <i>since 2007</i>	FISP <i>since 2005</i>	CIP 2007-10	FISP (ex-FSP) <i>since 2002</i>
Number of beneficiaries	2.5 million	1.5 million or 65% of farm households	0.7 million	0.5 million
Targeted crops	Staples	Maize + tobacco	Maize, wheat, potato	Maize
Targeted farmers	Poor	Poor	Poor Land > 0.5 ha	Less poor Land 1-5 ha
Allocation criteria	N/A	Farm size and need	N/A	N/A
% subsidy and ration	100% on 1 acre or for 2 bags	64-91% on 1 acre or for 2 bags	75%, 50%, 25% Up to 3 bags	50-60% on 2 Acres (1 ha bef. 2009) or for 4 bags
Distribution system	Vouchers	Vouchers	Vouchers (since 2010)	Physical distribution (cooperatives and farmers organizations)
Other inputs	Seed subsidy	Seed subsidy Extension	Seed subsidy Extension Land consolidation	Seed subsidy
Participation of agro-dealers	Encouraged	Very limited (dealers affiliated importers)	Encouraged	Limited

Source: adjusted from Jayne and Rashid (2013)

Note: NAAIP refers to the National Accelerated Agricultural Input Programme; FISP refers to the Farm Input Subsidy Program in Malawi; in Zambia FISP refers to the Farmer Input Support Programme and FSP to Food Security Pack. N/A indicates that no information was available.

and agrochemicals, and in some cases on irrigation equipment and mechanization services. The main reasons of governments to launch these support programs include the need to address seasonal cash-flow challenges encountered by rural smallholder farmers, and to support rural communities whose livelihoods are threatened by market and climatic shocks and declining soil fertility.

**Table 6** The main characteristics of universal subsidies in selected Sub-Saharan African countries

Universal Subsidies				
Country	Ghana	Mali	Nigeria	Senegal
Program name and date	FSP <i>since 2008</i>	Rice Initiative <i>since 2008</i>	FMSP <i>since 1999</i>	GOANA <i>since 2008</i>
Number of beneficiaries	0.9 million	N/A	N/A	1.5 million
Targeted crops	Staples + cash crops	Rice, maize, wheat + cotton (credit)	Staples	Staples
Targeted farmers	50% (30-50% actual)	25%	25% (federal) +0-60% (state)	50%
Allocation criteria	N/A	N/A	N/A	N/A
% subsidy and ration	50% (30-50% actual)	25%	25% (federal) +0-60% (state)	50%
Distribution system	Physical (Vouchers piloted and dropped)	Physical (Vouchers may be piloted)	Physical (Vouchers piloted in several states)	Physical Local committees
Other inputs	N/A	Seed subsidy	(None)	Seed subsidy
Participation of agro-dealers	Very Limited (dealers affiliated importers)	Very Limited (dealers affiliated importers)	None (Public outlets)	N/A

Source: adjusted from Jayne and Rashid (2013)

Note: FSP refers to Fertilizer Subsidy Programme in Ghana; FMSP refers to Federal Market Stabilization Program in Nigeria; GOANA refers to Grande offensive pour la nourriture et l'abondance in Senegal. N/A indicates that no information was available.

**In addition, input support can help to improve farmers' access to agricultural inputs which otherwise may be unaffordable.** In some cases, input subsidies could be economically justified if they supported poor farmers, thereby addressing market failures (FAO 2012; Druilhe and Barreiro-Huirlle 2012). AISP often provide farmers with access to and information on a wider range of crops and varieties that better addresses livelihood and agroecosystem resilience as well as their nutrition needs. However, the experience of most African countries shows that AISP have resulted in increased specialization.

**Across Africa, a large focus of AISP's has been on inorganic fertilizer, under the premise that low fertilizer usage rates among smallholder farmers is a key constraint to improving productivity.** Yet, this focus might not give the best return on investment. Fertilizer has been cited as the key constraint to agricultural growth in Africa, and fertilizer subsidy schemes have been justified as market-correction mechanism, arguing that fertilizer markets were weak, and farmers required support to access fertilizer (and indeed, other agricultural inputs such as improved seed and other agrochemicals; an example from Senegal is presented in BOX 15) (e.g., World Bank 2007). In most cases however, evidence suggests that investments in low-cost irrigation infrastructure, for example, would provide greater benefits and return on investments than the funds currently spent on fertilizer subsidy schemes.

**Despite various efforts by African governments, average fertilizer use in Africa remains low.** Data from Africa Fertilizer<sup>40</sup> indicates that average fertilizer use in Africa was 11 kg/ha in 2014, which is well below the Abuja Declaration target of 50 kg/ha by 2015, and ten times less than the global average. This figure was expected to reach 12 kg/ha by the end of 2015, but—while there is a rising trend—this is still very far from the 50 kg/ha target. According to FAO (2016b), the main goal should no longer be simply to increase inorganic fertilizer use, but to improve soil health through sustainable soil management. Fostering access to irrigation where needed, to markets, ICT and financial infrastructure would further allow for investment in a more diversified agriculture base. These measures combined might provide more efficient and effective use of public resources than single-focused fertilizer subsidies.

**Agricultural input subsidies are complex measures that can be effective, but need to take into account specific socio-economic circumstances if they are to enhance efficiency, equity, and sustainability of agricultural input use.** In the face of external shocks such as rising global commodity prices, political motivations to demonstrate leadership and decisiveness in providing such incentive schemes for agricultural input subsidies often override economic considerations—Malawi is a case in point (see Chapter 4). Although significant increases in agricultural productivity and food production are possible with agricultural input subsidies, the programs are generally expensive and, as Danida (2011) notes, it is unclear if they provide value for money in the long run. There is also little evidence that productivity outcomes would be sustained if public support was terminated.

## BOX 15 INPUT AND PRICE SUBSIDY PROGRAMS IN SENEGAL

Senegal is a food deficit country for cereal staples. It produced 650,000 tons of rice in 2015, while importing 959,000 tons, ranking as the third largest African importer of rice after Nigeria and Cote d'Ivoire. Senegal does not produce wheat, and its imports of wheat and wheat flour in 2015 amounted to 545,000 tons.

Since independence, Senegal has used input subsidy programs to improve agricultural productivity with the aim of achieving self-sufficiency in domestic staple food production, and thus enhancing national food security. One of the instituted programs was a fertilizer subsidy that aimed to ensure availability and affordability of fertilizer through cooperatives. The program was in place between 1960 and 1989 – when it was entirely phased-out. However, following the Africa Fertilizer Summit held in Abuja, Nigeria in 2006 and the world food crisis of 2007–2008, the input subsidy was reintroduced as part of the national food sovereignty policy aimed at reducing the country's vulnerability to external shocks. One of the aims of the new program, known as *Le Programme d'Accélération de la Cadence de l'Agriculture Sénégalaise* (PRACAS), is to accelerate agricultural diversification away from peanut production that has long dominated the rural economy, using up around 40 percent of cultivated land. A main reason driving this diversification effort was the decline in world demand for peanuts and hence massive income loss for producers, but also rising natural resource degradation such as soil depletion.

The priority commodities for diversification under PRACAS include rice, onions, and off-season fruits and vegetables with the aim (a) of reaching rice self-sufficiency by 2017 with a production of 1.6 million tons of paddy, (b) onion self-sufficiency with production of 350,000 tons, and (c) to develop the fruits and vegetables sector to an export volume of 157,500 tons per year. The subsidies thus cover a large spectrum of agricultural crops—mainly staples, but importantly also fruits and vegetables. While public support thus spans much beyond fertilizer, and also covers seeds, phytosanitary products, fuel, machinery and equipment, water, and producer prices, fertilizers remain highly subsidized—by as much as 50 percent of their price.

Despite PRACAS, however, rice self-sufficiency in Senegal has not yet been achieved. Rice still accounts for one of the largest share of food imports and peanuts remain the dominant crop.

*Source: Loayza et al. (2018)*

**However, there are some lessons learned that can lead to improved design of AISPs.** First, policy interventions should address market failures that drive the demand for these programs, rather than exacerbate inherent market distortions. Second, the scope, target beneficiaries and exit strategies of these programs need to be carefully designed if they are to be successful in enhancing agricultural

productivity growth, reaching more farmers and achieve value for money (World Bank 2014). Third, channeling the various agricultural inputs through private sector or non-government entities, rather than public sector and parastatal organizations would probably lead to greater efficiencies. Finally, the programs need to better serve the apparently targeted poor or vulnerable farmers by minimizing opportunities for rent seeking and political manipulation.

**The design of AISPs needs to move beyond productivity enhancing objectives if positive impacts are to be felt in terms of agricultural diversity, agroecosystem and livelihood resilience, and nutrition.** Building on extensive experience with AISPs, there is general agreement that targeting criteria, distribution mechanisms, level of involvement of agro-dealers and farmer contributions are among the key features that impact the programs' efficiency and, ultimately, success in improving production, as well as agricultural diversity, food security and nutrition. Economic efficiency and equity considerations aside, the available evidence suggests that agricultural input support programs have been effective in raising fertilizer use, average yields and agricultural production; however, their impacts on rural poverty, nutrition and long-term resilience are less clear, with some arguing that such schemes do little in addressing these issues, or are even detrimental to both smallholders and the environment.<sup>41</sup>

**Input subsidies are increasingly delivered as 'market-smart' subsidies and bring innovations in design and targeting (e.g., use of vouchers and smart cards) to support the most constrained farmers, and to encourage the development of input markets.** So-called 'smart' subsidies seek to enhance farmers' welfare while being market-friendly by involving the private sector in the design of the schemes and the distribution of inputs. They usually have the following features: (i) they target specific farmers who would otherwise not use purchased inputs due to financial or other constraints, or who reside in locations where increased fertilizer application can contribute most to yield improvement; (ii) they are guided by defined and measurable results, not just agricultural yields but also with respect to agricultural diversity, food security and nutrition; and (iii) they have a fixed and usually short-term duration with an clear exit strategy once benefits for farmers are tangible (e.g., increased incomes). They can also entail a farmer graduation mechanism based on improving overall market function and the availability and affordability of a wide variety of agricultural inputs.<sup>42</sup> In practice, however, medium- to long-term financial, technical and capacity building investments, for instance in research and education, are

needed if ASIPs are to enhance (a) farmer knowledge on agricultural diversity and the impacts on resilience and nutrition, and (b) farmer capital so they can invest in value addition.<sup>43</sup>

**To create better performing programs, policy makers can consider the following measures.** First, AISPs need to be clearly and unequivocally aligned with national food security, resilience and nutrition objectives, while reconciling the apparently competing objectives of increasing productivity and increasing agricultural diversity. Second, procurement and distribution of subsidized inputs should facilitate the development of competitive private sector-led input markets. Third, parallel public investments in creating an enabling environment for improved overall market-functioning (e.g., roads, market centers, storage facilities, transport and processing equipment for a wide variety of agricultural products)—particularly in rural areas—will likely enhance the outcomes of AISPs. Finally, subsidies should be part of a holistic approach to enhancing the use of a wide variety of improved inputs—and not only inorganic fertilizer—through the provision of complementary services (e.g., research and extension, irrigation, credit), social policy measures (e.g., productive safety nets, cash transfers) and private sector-led market development (e.g., policy reforms, infrastructure development) (FAO 2012; Druilhe and Barreiro-Huirle 2012).

## ASSESSING THE QUALITY OF AGRICULTURAL PUBLIC EXPENDITURE

**Despite the challenges associated with AISPs, public spending remains one of the most effective instruments in promoting agricultural growth and reducing poverty in developing countries** (Fan et al. 2009). In light of the relative effectiveness of public spending, African Heads of State agreed to increase agricultural public expenditure to at least 10 percent of national budgets as part of the Maputo Declaration. However, simply increasing the budget allocation for agriculture might not bring the desired results. Instead, the funds need to be allocated where they can make the greatest impact in terms of productivity, profitability, resilience, nutrition and poverty reduction. This is where tracking and assessing the quality and effectiveness of agricultural expenditure becomes crucial, particularly since public investments may have different impacts. Expenditure that benefits agriculture can, or even should also include investments in infrastructure (e.g., roads, storage facilities), and education.

**A coherent mechanism for assessing the quality and impact of public expenditure in agriculture could support better targeting and implementation.**

The African Union (AU) has already developed the Guidance Note on Tracking and Measuring the Levels and Quality of Government Expenditures for Agriculture (AU 2015)—its basic features are outlined in BOX 16. In combination with other available tools for tracking agricultural expenditure, such as the Practitioner’s Toolkit for Agricultural Public Expenditure (World Bank 2011), developed by the World Bank and UK Aid, the AU Guidance Note could be used to better manage, monitor and evaluate agricultural expenditure.

**BOX 16 AFRICAN UNION GUIDANCE NOTE INDICATORS FOR TRACKING THE QUALITY OF AGRICULTURAL EXPENDITURE**

1. *Allocative Efficiency*: refers to the degree to which resources are allocated in conformity with government priorities and highest comparative socio-economic returns (e.g., existence and application of sound prioritization criteria; degree of alignment with and direct contribution to national and sector level priorities and targets; comparative economic returns vis-à-vis other alternative sectoral investments in terms of the composition of sectoral allocation of expenditures);
2. *Technical Efficiency*: refers to the ex-ante and ex-post use of allocated public resources at a cost that achieves efficiency gains and is competitive with market prices; this would include relevant indicators on “value for money” and economic returns e.g., expenditure performance (% of approved/actual budget which is executed); timeliness of expenditure releases (relative to target releases); unit costs for different types of expenditures, compared to efficiency-based unit costs;
3. *Agricultural GDP Growth rates*: (% p.a. of agricultural value-added growth);
4. *Rural poverty reduction*: % of rural population below national poverty line.

Source: AU (2015)

## 5.2 RURAL INFRASTRUCTURE AND MARKETS

Market and trade policies are major factors driving productive diversification and value addition, predominantly through providing access to markets for sales of a diverse range of products. However, government involvement in food reserve programs can distort market prices, thereby affecting farmer crop choices; while trade regulations can also influence the production and marketing of agricultural produce.

## INVESTING IN PHYSICAL AND REGULATORY MARKET INFRASTRUCTURE

**In many African countries, population growth, urbanization, and increasing incomes are driving demand for increased quantity, quality, and diversity of foods, yet constraints to supply remain.** Urban food markets are set to increase fourfold to exceed US\$400 billion by 2030, requiring major agribusiness investments in processing, logistics, market infrastructure, and retail networks (World Bank 2013). Market access opportunities have become a key pull factor for growth in the variety and quality of agricultural products. However, there are several constraints that hinder the development of the agribusiness sector in Africa, including: (i) poor physical infrastructure (roads, marketing centers, storage and processing facilities); (ii) fragmented and underdeveloped markets; (iii) poorly functioning input supply and distributions systems; (iv) difficulties in accessing water, land, and finance; and (v) inadequate skills and technology. Legal and regulatory barriers as well as poor trade facilitation pose additional challenges for both farm and national level agricultural diversification. Governments can address these constraints by putting agriculture and agribusiness on top of the development agenda, by taking note of lessons learned, including from failures in Africa, by adapting success stories from other parts of the world, by focusing on a few carefully selected priorities, and by engaging strategic ‘good practice’ investors (Okello et al. 2007; World Bank 2013).

**Getting the right institutions and rules in place is a necessary precondition for more lasting and high value-added growth.** Establishing and strengthening effective institutional arrangements for marketing of agricultural produce can assist in overcoming the challenges facing agriculture growth by increasing bargaining power and lowering transaction costs (Barrett et al. 2001; World Bank 2015). This requires getting the right institutions and rules in place, including: (i) mechanisms to grade and standardize products for the market; (ii) market information that is accessible to all market actors; (iii) competition among all market actors, (iv) financial markets that respond to market needs for trade finance; (v) effective dispute settlement and regulatory systems; (vi) risk transfer mechanisms such as warehouse receipts; (vii) building capacity for all actors including cooperatives, private traders, and public actors (Bigsten and Tengstam 2011).

**Transport infrastructure plays a crucial role in timely delivery of agricultural inputs to farmers and farm produce to markets.** Yet, the state of transport

infrastructure in many Sub-Saharan countries is often inadequate, with rural areas being particularly poorly connected. In consequence, transportation costs are high and can constitute up to 30 percent of the farm gate price. This can be discouraging to farmers even where they have a competitive advantage. Evidence suggests that government interventions to improve rural road quality and density can significantly lower transportation costs over time (OECD/UN 2011; World Bank 2017), and hence improve the functioning of markets, both on the supply and demand side, for produce, inputs, and trade.<sup>44</sup>

**Improved infrastructure connectivity boosts trade, but also increases access to basic services such as extension, medical facilities, and schools.** The poor state of transport infrastructure exacerbates distance, and isolates many areas that might otherwise hold great productive potential. Lack of availability or unaffordability of refrigerated transportation, for instance, inhibits the production and processing of heat sensitive and highly perishable agricultural products. Improving road quality and networks has more advantages beyond reduced transportation costs for agriculture, though, since it also increases access to other basic services such as agricultural extension services, medical facilities, and schools.

**The limited access to electricity in Sub-Saharan Africa remains a major constraint.** Less than 18 percent of Sub-Saharan Africa's rural population has access to electricity (World Bank 2015), yet more than 80 percent of the population dwells in rural areas where farmers rely on energy, including electricity, for many farming operations such as milling, mechanization, irrigation and lighting (e.g., small businesses). Limited access and supply of electricity thus hinders various production and processing activities<sup>45</sup>—especially for perishable products such as vegetables, meat and milk—and limits diversification and participation in existing and emerging agricultural markets. Along with roads and irrigation, investment in rural electrification has been cited among the top infrastructure investments required to improve the productivity, incomes and livelihoods of rural communities, as it is expected to have a positive effect on both on-farm incomes as well as off-farm employment opportunities. Investment in rural electrification is therefore a priority and would entail tackling various impediments such as limited competition, fair pricing, regulation and public-private partnerships to promote investments even in stand-alone off-grid supplies.<sup>46, 47</sup>

## ACCESS TO FINANCE

**Access to credit and financial services also feature among the major constraints that farmers and agribusiness enterprises experience in developing countries.** Formal financial markets often fail to reach smallholder farmers due to distance from urban markets and high transaction costs (Brooks et al. 2013; World Bank 2016). Despite agriculture's considerable contribution to employment and GDP, less than one percent of commercial bank lending in Sub-Saharan Africa is allocated to the sector (Salami et al. 2010). The lack of formal lending starves farmers and agricultural enterprises of the capital they need to increase or diversify production and invest in value addition. Table 7 shows the ranking of efficiency of operation of the formal finance sector in the ten selected Sub-Saharan countries, as reported by the World Bank's 'Enabling the Business of Agriculture' report.

**Table 7** Ranking of the performance of the *formal* finance sector in selected Sub-Saharan countries

Country	2017 ranking (out of 62 countries) 'Ease of doing business in the finance sector'
Democratic Republic of Congo (DRC)	N/A
Ethiopia	25
Ghana	38
Kenya	10
Madagascar	N/A
Malawi	20
Mozambique	47
Nigeria	42
Rwanda	41
Senegal	41
South Africa	N/A
Zambia	14

Source: World Bank (2017).

Note: 62 countries were included in total. South Africa which likely has the best agricultural finance system in Sub-Saharan Africa was not ranked. The DRC—expected to have the least developed financial services—was also not ranked.

**In the absence of formal bank sector lending, various alternative institutions have evolved to provide savings and credit facilities under a wide range of**

**regulatory frameworks, but the provision of capital remains constrained.**

These include microfinance institutions, credit unions, savings and credit cooperative organizations, electronic money (e-money) or mobile banking, and warehouse receipts, among others. Tied output-labor arrangements<sup>48</sup> appear to be relatively widely used as well (Adjognon et al. 2017). Many factors still hinder private investment in smallholder agriculture, including: (i) the high-risk profile of smallholder farmers; (ii) low productivity and returns; (iii) the above noted inadequate infrastructure and high transaction costs; (iv) unclear rights over land; (v) and weak policy and regulatory environments. There are, in addition, impediments specific to financial access, such as lack of collateral, weak coordination among different actors in the value chain, and limited financial literacy among farmers.

## **FACILITATE ACCESS TO REGIONAL AND INTERNATIONAL MARKETS**

**Elimination of non-tariff market access barriers and the strengthening of agricultural standards, marketing, and trade-support institutions and policies in Sub-Saharan Africa can promote agricultural diversification.** One pathway for improving the access to regional and international markets for a diverse range of agricultural products from Sub-Saharan Africa is to ensure conformity with the World Trade Organization (WTO) sanitary and phytosanitary standards (SPS).<sup>49</sup> While the standards are meant to ensure transparency in the safety of agricultural products sold on international markets, SPS measures have historically been a major barrier for agricultural export from developing countries since they often lack the capacity, knowledge and financial endowment to adjust to SPS requirements. There are success stories, however, like Kenya's exports of green beans presented in BOX 17.

**Despite national guarantees of animal and plant health standards, there are instances when certified goods are turned away after retesting at border facilities of recipient countries.** Even within Sub-Saharan Africa, countries have different SPS requirements and experience challenges in meeting the requirements of neighboring countries. This indicates the need for: (i) financial and technical capacity building on SPS testing and inspection facilities in Sub-Saharan Africa; (ii) the establishment and operation of certified producer organizations; and (iii) reductions in the documentation time, requirements and costs for trade and export of agricultural goods. Reducing these barriers would

### **BOX 17 GREEN BEANS EXPORTS FROM KENYA: MEETING EVER MORE STRINGENT STANDARDS**

Led by Kenya, African countries captured a significant share of a rapidly expanding but demanding export market in the European Union (EU). Success is attributed to the leading role played by private companies in establishing the industry, the Kenyan government's supportive role, secured land tenure, and the inclusion of smallholders in the supply chain, at least initially.

Private companies, through contracts and technical support with smallholders, could assure a reliable supply of beans. However, increasingly stringent food safety and other standards in the EU are forcing the sector to change and the role of smallholders is diminishing—at present, they account for only about 30 percent of the supply. Although Kenyan exports of green beans have fallen in recent years as other countries have entered the market, Kenyan companies with well-developed logistics and long experience in export markets have been able to diversify and continue to expand fruit and vegetable exports. Kenya's producers have successfully managed to diversify their range of horticultural crops, building on the experience in growing green beans for export. Fruit and vegetable exports have increased continuously over the past decade, while the share of green beans dropped from 25–30 percent in the early 2000s to today's 10 percent of the sector's exports. This diversification was enabled by the skills, logistics, market contacts, and advanced market infrastructure put in place through first movers such as green bean exporters.

*Source: World Bank (2013)*

enhance market access for diversified products and thus provide incentives for agricultural diversification.

## **STRATEGIC FOOD RESERVE POLICIES AND EXPORT BANS**

**Many countries in Sub-Saharan Africa have put in place strategic food reserve policies.** The establishment of strategic food reserve (SFR) systems to support food security and resilience is a declared objective of the African Union's Maputo Declaration. As a result, at least 19 Sub-Saharan African countries have some form of SFR using various management systems and involving various commodities, although most of them maintain public food stocks of staple grains such as maize and rice.<sup>50</sup> Implementation costs, but arguably also price-distorting impacts of such policies are important considerations. These effects can be mitigated by price transparency in line with import and export parity levels. Table 8a, 8b provide an overview of strategic food reserve systems in selected Sub-Saharan countries.

**Table 8a, 8b** Overview of strategic food reserve systems in selected Sub-Saharan countries

Indicator	Ethiopia	Kenya	Ghana	Malawi	Mozambique
Strategic food reserve (SFR) in place?	Yes	Yes	Yes	Yes	Yes
Established	1981	2002	1989	1995	N/A
Is the SFR Independent of marketing boards	Yes	No	Yes	Yes	N/A
Is the SFR involved in selling food /grains in the market?	No	Yes	Yes	Yes	No
Does the SFR involve other agencies, donors and civil society?	Yes	Yes	Yes	Yes	N/A
Types of food stored in the SFR*	1,2,3	1-5	1,2,3	1,2,3	N/A

Indicator	Nigeria	Rwanda	Senegal	Zambia
Strategic food reserve (SFR) in place?	Yes	Yes	Yes (Financial Food Reserve)	Yes
Established	1989	2010	2012	1995
Is the SFR Independent of marketing boards	No	No	No	No
Is the SFR involved in selling food /grains in the market?	Yes	Yes		Yes
Does the SFR involve other agencies, donors and civil society?	Yes	Yes		Yes
Types of food stored in the SFR*	1,2,3	1,2,3	1,2,3	1,2,3

Source: Authors own representation

1—Cereals, 2—Pulses, 3—Oil, 4—Hay, 5—Milk

**Strategic food reserve policies are often a constraint on agricultural diversification since they create a guaranteed market for a small range of agricultural commodities.** Although food reserves help to reduce food insecurity at the event of climatic or market shocks, and can help reduce price fluctuations of basic agricultural staples (for benefit of both producers and consumers), they also distort agricultural markets and highly influence the crop choice of farmers. Food reserve agencies have been criticized for acting as monopolies

who prevent the emergence of private sector grain buyers, among others. In Zimbabwe, for example, the Grain Marketing Board has a maize producer price that is currently the highest in the Southern African Development Community (SADC) region at US\$390/ton.<sup>51</sup> Despite bumper harvests due to good rains in the 2016/17 season and national grain silos being filled, this policy is likely to incentive farmers to continue (over)producing maize at the expense of a more diversified and nutritious production. Overall, it is important to devise food reserve measures in a manner that minimizes fiscal costs, ensures food safety, and reduces distortionary impacts of grain stock policies on agricultural markets (Rashid 2015; Bobenrieth et al. 2012). BOX 18 and BOX 19 describe the strategic food reserve policies in Kenya and South Africa.

**Export bans on strategic commodities are also a relatively common policy among Sub-Saharan countries.** Such policies are meant to ensure food self-sufficiency and national availability of staple crops such as maize, but if enforced over longer periods they may result in reduced producer prices and lower incomes for farmers. Lower incomes, in turn, can represent a disincentive for the production of a particular commodity. Export restrictions can also reduce income and employment opportunities for casual agricultural laborers, who are often living close to the national poverty threshold similar to smallholders (Sanogo 2014). Tanzania, Zambia and Malawi, for instance, have had maize export bans during various periods over the last decades, with farmers in Malawi indicating that they received as little as one-third of the regional-level maize price from domestic buyers as a result of huge maize stockpiles in the country. While there is not much evidence, export bans could be positive for diversification in some instances. Evidence from Tanzania suggests that as a result of maize export bans over a longer period, farmers reduced the acreage under maize, and turned to other food crops such as legumes (Makombe et al. 2016).

### 5.3 AGRICULTURAL RESEARCH AND SEED SYSTEMS

Although usually realized over a longer time horizon, returns on investment in agricultural research are high and represent an opportunity to improve the knowledge base related to diversification, nutrition and resilience. Both formal and informal seed markets and livestock breeding are crucial in providing locally adapted varieties/breeds that support diversified production, and are often more resilient to local weather conditions and hazards than non-domestic varieties and breeds found in formal markets.

### **BOX 18 KENYA: EXPANDING THE BASKET OF COMMODITIES IN THE STRATEGIC FOOD RESERVE**

In 2015, Kenya established the Strategic Food Reserve (SFR) and its associated Trust Fund as a replacement for the previous Strategic Grain Reserve. This change was instituted primarily to expand the number and type of commodities that are stockpiled, as well as to ensure farmers have a ready market for products that were available in excess in local markets in some seasons. As part of the restructuring, Kenya's SFR expanded from procuring and storing maize only (3 million 90kg bags was the reserve target), to include storage of a range of food products including beans, rice, fish, powdered milk and canned beef. The results of the change in terms of agricultural diversity are not yet known, however by providing a guaranteed market for a wider range of products—including perishable milk which is produced in excess during some seasons—will likely incentivize farmers to diversify their production base or at least to not reduce the diversity of their production.

*Source: GoK (2015)*

### **BOX 19 SOUTH AFRICA: DISCUSSIONS ABOUT THE ESTABLISHMENT OF STRATEGIC RESERVES**

South Africa does not hold strategic grain reserves and rather allows consumer driven market forces within a liberalized economy to determine the crops which are produced, stored, and processed in the country as well as their prices and availability in local markets. However, recent climate hazards such as the 2015 El Nino event have contributed to the emergence of a discussion among the South African policy makers whether a strategic grain reserve—common among other southern African countries—is needed.

Even without strategic food reserve policy or agency, South Africa remains sub-Saharan Africa's largest producer and seller of maize. Some argue that the use of a food reserve mechanism would shift the responsibility for the production and storage of any defined strategic commodity on the South African government, along with the expected additional costs and administrative requirements, as well as distortions to the internal markets for the selected commodities in terms of availability and prices. Others claim that keeping strategic cash reserves specifically for food procurements in the case of an emergency or shortage would meet the same objective than keeping physical food stocks, while playing less of an interfering role in producer and consumer markets.

*Source: Reuters (2017)*

## INVESTING IN AGRICULTURAL RESEARCH AND DEVELOPMENT

**Under the 2003 Comprehensive Africa Agriculture Development Program (CAADP), SSA countries committed to spend at least 10 percent of their budgets on agriculture** (MacNeil 2017). Since agricultural research and development (R&D) was increasingly recognized as one of the most important public goods in agriculture, the African Union's New Partnership for Africa's Development (NEPAD) set a target for government spending on agricultural R&D of at least 1 percent of agricultural gross domestic product (GDP) in 2007 (Benin et al. 2016). After stagnating during the 1990s, SSA's agricultural research spending increased by nearly 50 percent between 2000 and 2014. Notably, three countries accounted for nearly half of investments in 2014: Nigeria (US\$434 million), South Africa (US\$417 million), and Kenya (US\$274 million). Ethiopia, Ghana, Tanzania, and Uganda each spent over US\$100 million in the same year. However, underinvestment remains widespread, with 33 out of 40 countries for which data were available spending less than 1 percent of their agricultural GDP on R&D (Beintema and Stads 2017).

**Public allocations of funding to agricultural research in Sub-Saharan Africa often focus on short-term investments, and research institutes remain highly dependent on donor funds.** While research agencies in some Sub-Saharan countries have been able to raise funds from the sale of goods and services, taxes on commodities, or private sector investments, agricultural R&D budgets in SSA remain largely dependent on donor funding. Yet, until early 2000, donor priorities have often focused on structural adjustments and privatizing public activities, which diverted funding from R&D. Another challenge is that while returns to investment in R&D have shown to be substantial, benefits often materialize only in the longer-term (Beintema and Stads 2017). Policymakers however have more incentive to steer investments towards areas with short-term gains towards their constituents. Finally, outdated research facilities and equipment often impede the conduct of productive research, which compromises the quality and number of research outputs, and reduces research impact (MacNeil 2017).

**Within the already limited agricultural R&D in SSA, the share of research on the variety of foods needed for addressing nutritional deficiencies in existing diets is low—but some success stories exist.** Limited research in local or regional dietary needs likely hampers diversification and reduces nutrition outcomes.

However, high-quality examples do exist, such as IFPRI's HarvestPlus Program, or the research of the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the National Root Crops Research Institute (NRCRI). Research at the Nigeria-based NRCRI, for instance, led to the development and release of three varieties of the starch-rich Vitamin A (yellow) cassava in Nigeria. Such research initiatives are invaluable in promoting nutrition in Sub-Saharan Africa. An equally relevant example is the HarvestPlus' initiative on biofortification presented in BOX 20.

### **BOX 20** BIOFORTIFICATION IN AFRICA

The emphasis on production of calorically dense staple crops for food security has come at the expense of the production and consumption of micronutrient-rich non-staples. The process of biofortification can help provide critically needed micronutrients especially to poor rural households whose diets often largely consist of staple crops. This process increases the density of vitamins and minerals in a crop through plant breeding, transgenic techniques, or agronomic practices. The integration of micronutrient traits into breeding objectives of crop development may represent significant costs and efforts; however, subsequent costs for monitoring and maintenance are often low. When consumed regularly, biofortified crops can generate measurable improvements in human health and nutrition. It is estimated that over 20 million people in farm households in developing countries are already growing and consuming biofortified crops.

Progress was also made on integrating biofortification into regional and national policies in Africa. At the Second International Conference on Nutrition held in Rome in 2014, high-level government representatives from various SSA countries, including Malawi, Nigeria and Uganda, highlighted the role of biofortification in their national strategies to end malnutrition by 2025. Countries such as Rwanda and Zambia have also included biofortification as key aspect in their national plans and policies for agriculture and nutrition. In parallel, regional and global processes, such as the Scaling Up Nutrition Movement are working to build an enabling environment for biofortification.

*Adapted from: Bouis and Saltzman (2017)*

## **INVESTING IN SEED AND BREEDER SYSTEMS AND EASING INFORMAL SEED TRADE REGULATIONS**

**The deregulation of formal seed systems in Sub-Saharan Africa in the early 1990s ended state-owned *monopolies* in seed production, marketing, and distribution—often, though, state-controlled entities continue to play**

**a powerful role.** Since the 1990s, significant investments have been made to liberalize the seed industry, resulting in increased participation by the private sector through both local and multinational companies; in addition to informal farmer-managed seed conservation methods. However, it has been suggested that the transition towards competitive seed systems has been slow, largely due to weak enabling environments (Mabaya, 2016). A combination of policies, institutions, and supporting services are needed to improve the enabling environment for business, including seed related services where business activities can develop and thrive (Christy et al. 2009). In most countries analyzed in this report, though, government entities continue to dominate seed production and sales.

**Both public and private seed producers mainly concentrate on a few cereal crops, particularly hybrid maize and wheat.** Due to their focus on cereal crops, seed producers often do not satisfy the diversified seed needs of smallholder farmers (Bishaw and Louwaars 2012). For the evaluation of the performance of the formal seed sector in Africa, The African Seed Access Index (TASAI; <http://tasai.org>) was introduced to promote the creation and maintenance of enabling environments that will accelerate the development of competitive seed systems. Sixteen key indicators<sup>52</sup> are monitored and compared across African countries, and give an indication on which policies to focus on. These are presented in Table 9. Based on TASAI indicators, Mabaya (2016) provides a ranking of the performance of the formal seed industry, where, for example Kenya ranks 7th with 140 registered seed companies (out of which 35 are active), Zambia ranks 16th with 50 registered companies, Mozambique comes 23rd, Senegal 26th, Ethiopia 39th, Nigeria 42nd, Ghana ranks 48th with 19 registered companies, Malawi 50th with 6 companies, and Rwanda ranks 60th.

**Although the focus has largely been on improving access to formal seed markets, informal seed systems can be crucial in providing a rich diversity of seeds, including locally adapted varieties that are often more resilient to weather variations and climatic hazards.** A study by McGuire and Sperling (2016) based on 9,660 observations across five SSA countries (Zimbabwe, Malawi, Kenya, DRC and South Sudan) and covering 40 crops showed that farmers accessed approximately 90 percent of their seeds through informal systems. 50 percent of seeds were traded on local markets, and 55 percent paid for in cash (the remainder in-kind). In Kenya, for instance, farmer surveys indicate that climate risks significantly affected farmers' access to formal seed markets. The

**Table 9** Indicators of the formal seed industry in Africa

Seed indicators	Crop specific	Hypothesized impact on seed access
<b>1. RESEARCH AND DEVELOPMENT</b>		
Number of active breeders	YES	+
Number of varieties released in the last 3 years	YES	+
Availability of foundation seed	YES	+
<b>2. INDUSTRY COMPETITIVENESS</b>		
Number of active crop Seed companies	NO	-
Time it takes to import seed from neighboring countries	YES	-
Market share of top 4 companies	YES	-
Market share of current or past government parastatal	YES	-
<b>3. SEED AND POLICY REGULATIONS</b>		
Length of variety release process	YES	-
Quality of seed policy framework	NO	+
Quality of regulatory system	NO	+
Adequacy of seed inspectors	NO	+
Efforts to stamp out fake seed	NO	+
<b>4. INSTITUTIONAL SUPPORT</b>		
Availability of extension services for smallholder farmers	NO	+
Quality of national seed trade association	NO	+
<b>5. SERVICE TO SMALLHOLDER FARMERS</b>		
Concentration of rural agro-dealer network	NO	+
Availability of seed in small packages	YES	+

Source: Mabaya (2016)

most common coping strategies were local seed conservation and utilization, as well as purchasing or borrowing seeds from neighboring farmers.<sup>53</sup> Informal seed systems are hence critically important for smallholder farmers. Many SSA countries have introduced seed laws that are meant to protect farmers from low quality seeds by establishing rules and regulations regarding seed registration, exchange and certification. These laws can impede farmers' access to a diverse

range of seeds. BOX 21 gives an overview of the seed laws in SSA countries and their effect on the sales and exchange of landraces and farmer-produced seed—a factor which has a significant effect on the diversity of agricultural production, nutritional diversity, and resilience to market and climatic stressors.

### **BOX 21** SEED LAWS IN SUB-SAHARAN AFRICA COUNTRIES: REGULATION AND FLEXIBILITY

National and regional seed policies and regulations cover all important food crops: maize, rice, sorghum, millet, oats, groundnuts, sunflower and many more. Under regional policies of the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of West African States (ECOWAS) and the East African Community (EAC), seeds for these crops can only be sold in markets once they have been tested and certified.

For example, the Tanzania Seed Law states that no seed shall be offered for sale unless it is certified in accordance with national regulations. However, in recognition of the important role of informal seed systems and especially farmer-to-farmer mechanisms, the seed laws of some African countries such as Ethiopia, Malawi and Senegal still allow for the sale and exchange of seed between smallholder farmers—under certain conditions. In Ethiopia, for example, exceptions are granted to the use of farm-saved seeds, and the exchange or sale of seed among smallholder farmers or pastoralists. Uganda, Swaziland and Nigeria do not permit the sale of farm-saved seeds, but allow their exchange. In Nigeria, the seed law indicates that “Nothing in this Decree shall apply to any seed of any notified kind or variety grown by a person and delivered by him on his own premises or direct to another person for the purpose of sowing or planting,” meaning that such seed can be shared or exchanged but not sold.

Seed registration criteria remain the greatest obstacle for local seed varieties and landraces. Efforts to ease the registration of farmer varieties have been undertaken; however, only Benin has a register of local varieties that farmers can multiply and sell. In Kenya, a 2015 proclamation called for Parliament to enact legislation that recognizes and protects indigenous seeds and their use by local communities. The Uganda Draft Seed Policy from 2014 states that seed breeders can be public and private, and that farmers may also register their varieties for protection and use.

*Source: ISSD Africa (2017)*

**The importance of livestock for food security in Africa warrants greater focus on livestock diversity, and the impact of breeding systems on resilience and nutrition.** Sub-Saharan Africa is home to approximately 150 breeds of cattle, but the continued import of and cross-breeding with foreign breeds is threatening indigenous breeds that are often much more resilient to local pests,

diseases, weather conditions and climatic hazards. The most common reason for crossbreeding is that local breeds are often considered not as productive in terms of meat and milk production. Hence, imported breeds and inherent trade-offs are often preferred. However, while enhanced productivity may increase incomes in the short term, keeping ‘improved’ races may increase the vulnerability of livestock keepers and threaten food security and nutrition in the longer term. Diverse livestock and livestock genetic diversity are thus extremely important for resilience to shocks (FAO 2015b). To date, there are no specific laws governing cattle breeding. The majority of livestock reared and sold by pastoralists and agro-pastoralists are mixed or indigenous breeds including cattle, goats, camels, chickens, among others. Safeguarding livestock genetic diversity in Africa should be awarded more attention in the future.

## 5.4. AGRICULTURAL ADVISORY SERVICES, SKILLS DEVELOPMENT AND AGRIPRENEUERSHIP

- Policies that provide farmers and value chain actors with appropriate skills and knowledge to productively engage in agricultural diversification at the farm-level, as well as to realize opportunities for off-farm employment and vertical value chain diversification, are crucial.
- Agri-entrepreneurship and agricultural innovation have great potential to generate new employment off-farm and along diversified agriculture value chains, particularly for Africa’s youth. In addition, ICT infrastructure is rapidly growing, enabling access to a broad range information and services for smallholder farmers—such as financial services, meteorological and market information, or agricultural advisory and insurance services—all of which can help farmers to diversify their production.

## ENHANCING EXTENSION AND ADVISORY SERVICES

**Farmers—and also other value chain actors—require a range of agricultural, financial and entrepreneurial skills and knowledge to effectively and sustainably respond to emerging opportunities and challenges.** The rising demand for food and changing dietary preferences, rapid urbanization, increasing rural-urban connectedness, integrated agricultural supply chains, and climate change pose substantial challenges on today’s farming, but also offer new opportunities. Farmers need to be adequately equipped to provide an informed response. They need the knowledge and skills on what, when,

and how to produce nutritious food in an economically viable and sustainable manner, as well as on value addition and marketing of a wider variety of agricultural products.

**Agricultural extension and advisory services represent a key mechanism to transfer knowledge, skills and technology to farmers, and can serve as platform for promoting on-farm diversification and nutrition.**<sup>54</sup> Assessing the effectiveness of extension and advisory services in Africa remains challenging, which however is a precondition to adjust extension to achieve resilience and nutrition outcomes. For instance, while the African Forum for Agricultural Advisory Services (AFAAS) provides an important resource for strengthening capacity of public sector extension agents across the African continent, data on the number of advisory/extension workers across Africa are either outdated or missing (GFRAS 2014). It is important to note, however, that there is an observed transition from public (ministry-based) to pluralistic extension models over the past years, with public, non-profit and private sectors playing an increasingly important role in facilitating demand-driven services in a decentralized<sup>55</sup>, participatory, or even non-formal way<sup>56</sup> (FAO 2017a)—all of which promising to increase effectiveness of extension.

**Throughout Africa, farmers' access to extension and advisory services is challenged by many factors.** These factors include, among others: (i) a low extension-to-farmer ratio (often linked to lack of trained staff and inadequate infrastructure); (ii) poor access to reliable, timely and relevant information; (iii) lack of coordination between health/nutrition and agricultural interventions, extension, and advisory services; (iv) focus on technical agricultural production issues at the expense of agribusiness or value chain-related information (Fanzo et al. 2013; FAO 2017). The extent to which such services focus specifically on promoting agricultural on-farm diversification or contribute to nutrition outcomes is however less known. In Malawi, for instance, impact assessment results have shown that agricultural advisory can contribute to higher productivity and increased household food security (measured through dietary diversity indicators), but only when farmers considered advices useful (tailored to their needs and not conflicting across different advisory providers), irrespective of the type of the service provider (governmental, non-governmental, private) (Ragasa et al. 2016).

## PROVIDING BETTER AGRICULTURAL VOCATIONAL EDUCATION AND TRAINING

**While farmers require appropriate skills and knowledge to productively engage in agricultural diversification, the same is true for their ability to realize opportunities for off-farm employment and vertical value chain diversification.** The preceding chapters show, on the one hand, how important off-farm diversification is for boosting livelihood and agroecosystem resilience and nutrition, while also providing a pathway out of poverty, and, on the other hand, how higher levels of education increase opportunities for off-farm employment.

**At present, the Agricultural Technical Vocational Education and Training (ATVET) in Africa is not sufficiently developed, and represents a source of untapped potential.** Under the CAADP Framework, African countries committed, among others, to ensure delivery of quality agriculture-related education, including national capacity to design and deliver trainings relevant to farmers. However, implementation remains a challenge, and ATVET across the continent is weak due to (a) insufficiently qualified personnel who lack pedagogical and practical skills, (b) inadequate and outdated training curricula, material and infrastructure to respond to new demands, and (c) low absorption of primary and secondary school graduates in ATVET programs (NEPAD 2013). There are positive examples, though—the case of Ethiopia is presented in BOX 22.

**There are some lessons learned that can be usefully applied to the development and provision of training that enhances the capacity of farming households to engage in agriculture value chains beyond production:** (i) training curricula should be aligned to emerging trends in agribusiness, and foster skills in terms of business plan development and financial literacy; (ii) vocational training and skills development activities should be upgraded and decentralized; (iii) skills gaps and needs related to vertical and off-farm diversification should be more systematically analyzed; (iv) the technical, financial and operational capacity of extension and advisory services should be enhanced; and (v) rural farming communities—especially women and youth—can benefit from the development and implementation of strategies for rural agribusiness development/ ‘agri-entrepreneurship’ and rural employment (Dethier and Effenberger 2012; Brooks et al. 2013; FAO 2015; World Bank 2015).

## **BOX 22** AGRICULTURAL TECHNICAL VOCATIONAL EDUCATION AND TRAINING IN ETHIOPIA

Although ATVET is generally insufficient across Africa, Ethiopia is a success story. Since 2008, the development of the Ethiopian Technical Vocational Education Training (TVET) Strategy has provided a favorable policy environment for strengthening vocational training. TVET guides the functioning of national and regional ATVET colleges and ensures the implementation of various quality verification standards and procedures (e.g., Occupational Standards, Occupational Assessment and Certification procedures, the national TVET Qualification Framework).

By 2013, 25 ATVET colleges had been set up offering three-year programs to approximately 72,000 government-employed development agents on topics that range from animal and plant science, through animal health to natural resource management and conservation and cooperative schemes. Farmers and micro-and small enterprises in rural areas have already benefitted of advice by the trained development agents (NEPAD 2014). ATVET colleges have been complementing Farmer Training Centers (FTCs) that operate at the lowest administrative levels in the country (*kebele*) and that are focused on offering farmers both short-term, on-field trainings (up to 20 days) and longer, modular courses (3-6 months).

While Ethiopia's agricultural growth has been associated with the establishment of ATVET centers and FTCs, qualitative research has shown that lack of collaboration between centers, low engagement of private sector, limited budget for FTCs and development agents remain a challenge. Additionally, no systematic, rigorous country-level assessment regarding impacts of these extension systems on productivity, diversity, food security and nutrition indicators has been identified to date.

*Source: Walker and Hofstetter (2016)*

**Cooperatives and farmer organizations can also serve as platforms for the exchange of knowledge and empowerment of farmers, but remain underdeveloped.** Governments often do not grant cooperatives the required level of technical and financial support that is accorded to small and medium enterprises (SMEs), yet establishing and strengthening farmer associations—or producer groups, collectives and cooperatives—is an important mechanism for enabling farmers to access agriculture inputs at lower costs, to negotiate better contracts with aggregators and agribusinesses, and to participate in high-value supply chains (World Bank 2016). Often, one of the main functions of farmer organizations is to harness collective knowledge on a wide range of crop and livestock products, thereby stimulating diversification. Collective organization of farmers also provides opportunities for a greater quantity, wider variety and better quality of food to be sold at lower transaction costs. It further enables

economies of scale, strengthens value chains, facilitates transfer of modern technology, and attracts private investments.

**Aside from facilitating on-farm agricultural diversification, farmer organizations can also enhance vertical value chain diversification and create off-farm employment.** Farmer organizations can have a wider impact on rural communities and economies, and can support vertical and off-farm diversification in important ways: (i) by improving market access and bargaining power for niche markets that are prohibitive for individual farmers—evidence suggests that strengthening farmer institutions can help farmers to consolidate and play a more powerful role in the market place (Bakewell-Stone et al. 2008; World Bank 2017); (ii) by pooling finance to invest in production and/or value addition equipment and machinery; (iii) by facilitating farmer-to-farmer learning through platforms such as farmer or agro-pastoralist field schools.

## **SUPPORTING AGRIPRENEURSHIP AND INNOVATION**

**Agricultural entrepreneurship and agricultural innovation have great potential to create off-farm employment and employment along agricultural value chains, in particular for Africa’s youth.** A major constraint hindering the development of competitive commercial agriculture and agribusiness in Africa is the lack of skills at all levels—from vocational to postgraduate education, including management and entrepreneurial capacity (World Bank 2013). Opportunities exist in innovative mechanisms such as agribusiness incubators, accelerators and innovation hubs that nurture and build the capacity of agribusiness entrepreneurs—also referred to as ‘agripreneurs’—through mentoring and training, but also business development and financing.<sup>57</sup> Incubators can assist public and private agricultural research institutions and universities in the identification, value-addition, and ultimately commercialization of agricultural products (Sharma et al. 2012). Incubators can result in increased agricultural productivity and diversity in activities along the value chain, leading to enhanced incomes and new employment opportunities.<sup>58</sup> Examples of successful incubator models include the ABI-ICRISAT model in India presented in BOX 23, and the Timbali Technology Incubator in South Africa presented in BOX 24.

### **BOX 23 THE AGRIBUSINESS INCUBATION PROGRAM IN INDIA**

The Agri-Business Incubation (ABI) program in India was launched in 2003 through an initiative of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in partnership with the Department of Science and Technology of the Government of India. ABI is used to promote agricultural technologies developed at the ICRISAT itself, but also at other research and development centers of excellence, universities, and other institutions.

One of the ABI participants is Aakruthi Agricultural Associates of India (AAI) in the Anantapur Province of Andhra Pradesh. AAI was launched in 2004, joined forces with ABI in 2005, and in 2006 became the second venture to graduate from the incubator as a full business partner of ICRISAT for distributing ICRISAT seed in Andhra Pradesh. AAI was supported to develop a successful business model based on partnership with organizations like ICRISAT as well as with agricultural research centers, and farmer franchisees. AAI designed replicable seed business ventures with local farmers for low-cost, high-productivity seed multiplication. These seed delivery systems offer an alternative to government-supported channels and allow rapid introduction of new seed varieties, with the time between the release of new seeds and market acceptance in Andhra Pradesh reducing from as many as eight years to less than three years. AAI has now built a network of 70 farmer entrepreneurs who pay franchise fees and receive working capital advances. Over 300 farmers were engaged in seed multiplication in 2012, with 4,000 acres under production. Groundnuts, chickpeas, pigeon peas, and rice are the major crops focused on. The franchise concept has allowed for supply of seeds to better meet local demand. For example, demand for groundnut seed in Anantapur exceeds supply by 80 percent, while the gap for chickpeas is 30 percent, and that for pigeon peas is 70 percent.

The ABI supports elements such as the creation of a business plan; provision of technical knowledge, and introductions to stakeholders and financing opportunities. Links to the national research system have been crucial for AAI's success and improved credibility with government. Despite these achievements, AAI's growth remains constrained by a lack of external financing.

*Source: Sharma et al. (2012)*

## **SUPPORTING ICT-ENHANCED AGRICULTURAL ADVISORY SERVICES**

**ICT infrastructure and access to ICT in Sub-Saharan Africa has been growing rapidly, opening new markets for a variety of agricultural products and enabling smallholders to access a broad range of production-related information.** With a population of around 1 billion, the numbers of mobile

## **BOX 24** TIMBALI TECHNOLOGY INCUBATOR IN SOUTH AFRICA

The Timbali Technology Incubator (TTI) was established in 2003 in an effort to positively affect rural farmers in the Mpumalanga region of South Africa, focusing on the production of flowers. The incubator's first entrepreneurs began the incubation process in 2004, and by 2005 the TTI had grown to include 30 entrepreneurs. The incubation model was restructured in 2007 to allow for incubation support both on the Timbali site and offsite. The TTI focuses its efforts on the most vulnerable population groups in the Mpumalanga region: more than 97 percent of TTI's clients are black, and 97 percent of those are women.

TTI's work focuses on the following key areas: (i) technology transfer; (ii) access to production loan financing; (iii) basic business skills; (iv) market access; (v) logistical coordination; (vi) standardized and coordinated production processes; (vii) financial training; (viii) administrative and bookkeeping support; (ix) training and mentorship; (x) literacy education; and (xi) market-driven production. TTI uses a franchise model which allows their clients to almost immediately begin supplying customers.

Over the four year incubation process, TTI typically spends approximately R80,000 (approximately US\$5,600) on each client. While the price of cut flowers—the industry of most TTI clients—fluctuates, the typical TTI graduate produces approximately 8,000 stems per month. Estimates by TTI have shown that their clients also typically recoup the initial investment within one year.

A key outcome of TTI incubation is also product diversification: around 70 percent of entrepreneurs at TTI diversify out of cut flowers into foliage, citrus, pomegranates, a variety of vegetables, peppers, tomatoes, grapes and other crops. A noted weakness with the franchise business model, however, is that it can discourage rather than encourage innovation.

*Source: infoDev (2014)*

phone subscriptions in Sub-Saharan Africa range between 444 and 700 million<sup>59</sup>. The use of ICT in daily life, as well as for business, has increased rapidly, with numerous locally developed ICT innovations bringing improved information and efficiencies to the agricultural value chain. Promoting universal access to ICT has also been a major development objective of many African countries, with the majority of people now having access to mobile telephone services. However, rural areas still lag behind in terms of access, affordability and quality of ICTs. Access to reliable electricity remains a major constraint affecting the introduction of ICTs there.<sup>60</sup>

**Numerous agricultural mobile applications are becoming increasingly available, both from public and private service providers, offering a wide**

## BOX 25 DIGITAL AGRICULTURE IN GHANA

The Agricultural Development and Value Chain Enhancement II (ADVANCE II) Project in Ghana is a USAID funded project implemented by ACDI/VOCA. The project supports the scaling up of agricultural investments to improve the competitiveness of the maize, rice, and soybean value chains in Ghana. The project adopts a facilitative value chain approach; linking farmers to markets, finance, inputs, equipment, and information through larger commercial farmers and traders who are able to invest in smallholder production. These linkages build the capacity of smallholder farmers, helping them to increase efficiency of their agribusiness through improved production and post-harvest handling practices.

ADVANCE II supports emerging commercial agriculture and smallholders simultaneously, and uses new technologies extensively to enhance agricultural productivity. Digital smart cards are used to hold essential and sometimes private information such as participant's age, gender, phone number, farm size, yield and sales history, as well as other information that is essential for monitoring and evaluating the success of the program and informing its future direction.

Private enterprises such as Esoko have partnered with ADVANCE II to use SMS and voice messages to disseminate price, weather, and agronomic information on maize, rice, and soybeans to farmers. The information is used to apply improved agronomic practices to boost output, adapt cropping activities to changing weather, and improve price negotiations. Tablets, apps, and small projectors are used to deliver extension services, and to register farmers to collect farm data and track them online to ensure they receive the right help from the projects. Radios or voice messaging are also used as “low-tech” options, depending on the specific context. For example, radio was used in collaboration with Ghana's Ministry of Food and Agriculture, making farmers aware of the need to combat Fall Armyworm infestations. ACIDI/VOCA found this hybrid of low and high tech methods to be effective in achieving inclusive market systems development. In a related initiative, the national e-extension system—supported by the World Bank in collaboration with the Ministry of Agriculture and a local technology firm (Prepee)—is being hailed as the first of its kind in West Africa to enhance advisory services, technology transfer, and market price information through voice and data services. The program delivers agronomic advice and market information via voice, text, videos and spatial maps through smart phone enabled extension officers, with direct access to farmers on standard mobile phones to provide comprehensive. This in turn is enabling greater market participation and technology adoption, building win-win, financially sustainable business models using public-private partnership arrangements with national mobile operators AirTel and MTN for long-term impact.

*Sources: ACIDI/VOCA. Agricultural Development and Value Chain Enhancement II (ADVANCE II) Project. [www.acdivoca.org/projects/agricultural-development-and-value-chain-enhancement-ii-advance-ii-project/](http://www.acdivoca.org/projects/agricultural-development-and-value-chain-enhancement-ii-advance-ii-project/) [accessed 25.05.2018]; Goyal (2014).*

**range of services such as meteorological, market or extension information.** ICTs have particular relevance for productivity and resilience, but also market access and financial inclusion. For instance, extension messages via cell phones can foster the adoption of climate-smart agriculture practices and help raise yields. Early warning messaging can inform smallholders on how to protect crops from inclement weather, and minimize the negative effects of crisis events. ICT services can further provide farmers with information on pricing of agricultural inputs and outputs, and connect them to suppliers, buyers or storage and transport providers (World Bank 2018a). According to World Bank (2015), providing farmers with information regarding crop prices in different markets can increase their bargaining power and potential returns by 10-30 percent; the major challenge lies in linking different types of farmers with their diverging needs, market aspirations and sets of skills to different types of markets. BOX 25 provides an example of an ICT-enabled agribusiness enterprise in Ghana, but numerous other countries have similar initiatives.<sup>61</sup> Such initiatives should be further supported by African governments, in particular by fostering the connectivity of rural users and encouraging participation of the private sector in ICT infrastructure development (World Bank 2018a).

## 5.5. NATURAL CAPITAL, LAND AND WATER TENURE

- Natural resource management and climate-smart agriculture policies are key for promoting diversification through practices such as agroforestry, intercropping, crop rotations, conservation agriculture, soil fertility management, and irrigation.
- It is further important to revise natural resource tenure legislation in many countries. Widespread tenure insecurity often inhibits productive investments and promotion of diversification.
- The majority of smallholder farmers in Africa use land through customary or traditional land tenure systems that can either enable or limit the type of investment for promoting diversification. In addition, rural and urban areas are often managed in a dual rather than integrated manner that limits opportunities for linking rural farmers to urban markets.

## SUPPORTING CLIMATE-SMART AGRICULTURE PRACTICES

**Agricultural diversification can contribute to climate change adaptation and mitigation.** Most of the countries studied in this report have put in place laws,

policies and strategies to mainstream climate change adaptation and mitigation into national development or to develop stand-alone climate change plans. Agricultural diversification has been highlighted as a means of improving farmer adaptation and resilience to climate change. For example, the Kenya National Climate Change Response Strategy mentions livelihood diversification through cultivation of more drought-tolerant food crops. The Zambia National Climate Change Response Strategy also aims at “[e]nhancing farming systems that encourage crop diversification including the cultivation and consumption of indigenous and more drought tolerant food crops like cassava, millet, sorghum and sweet potatoes”. Agroforestry, intercropping and crop rotations have received increasing attention as promising climate-smart agriculture practices either through national Climate-Smart Agriculture (CSA) framework programs (for example in Kenya, Tanzania and Zambia), National Adaptation Programs of Action (NAPAs), Nationally Appropriate Mitigation Actions (NAMAs), or wider initiatives (e.g., for example within the CAADP Framework).

**Climate-smart agriculture practices such as agroforestry can support diversification** (see Chapter 2). Agroforestry can be used to tap into complementarities between trees, crops and livestock, for greater agricultural and landscape diversity, and attainment of environmental and ecosystem-related outcomes (Skole 2013; Thangataa and Hildebrand 2012). Agroforestry allows for the diversification of farm and non-farm activities. For instance, evidence from Northwest Ethiopia revealed that agroforestry can help farmers engage in other non-farm activities during the slack season (e.g., transportation of agricultural and non-agricultural goods to markets, grain milling, etc.) and allowing them to gain extra income (Kassie 2018). Kenya, Ethiopia and Zambia have promoted agroforestry practices at the national level. In Kenya, the Farm Forestry Rules enacted by the Government in 2010 require every farm to have 10 percent of the land covered by trees (Place et al. 2012). Ethiopia and Zambia committed to plant 100 million trees—among others, one million Apple-ring acacia trees (*Faidherbia Albida*), a leguminous plant providing multiple valuable ecosystem services such as nitrogen fixation and fodder.

**For CSA practices to materialize into tangible benefits for food security and nutrition, appropriate policy frameworks are needed and barriers to adoption overcome.** While CSA promises to enhance agriculture productivity and the resilience of farmers and agricultural systems to climatic stressors at the same time, its adoption in SSA is confronted with various barriers. Barriers

entail, among others, physical inputs such as land, finance, or infrastructure; and non-physical barriers such as knowledge and skills as well as policy and regulatory challenges (James et al. 2015). For instance, certain CSA practices such as agroforestry materialize economically only after a few years and require some initial investment. Besides, they often require secure land rights whose widespread lack across SSA often inhibits long-term investments in sustainable agriculture. Effective implementation of agroforestry would hence require a revision of land tenure policies in many countries, but also inter-sectorial planning and action (e.g., between ministries of environment and agriculture). While such enabling environments are largely absent from Africa's policy landscape (Place et al. 2012), there are positive examples. One success story, for instance, is the massive increase in vegetation cover or 're-greening' in the Republic of Niger thanks to Farmer Managed Natural Regeneration (FMNR), a system of protection and management of trees naturally occurring on farmland (Reij and Winterbottom 2015). Finally, there is limited knowledge of key CSA practices among farmers and particularly women who have also shown differences in terms of risk perception, knowledge sources, and adaptation strategies compared to male counterparts. These challenges underline a need for gender-sensitive CSA approaches and policies that are tailored to the diverse needs and knowledge levels of smallholders (van Campenhout 2017).

**Irrigation can significantly increase crop yields and stabilize production in Sub-Saharan Africa, but is largely underexploited.** Sub-Saharan Africa has an ample supply of irrigation water, which is however spread unevenly over a wide range of agroecological zones. Agriculture in SSA is thus predominantly practiced under rainfed systems, with only about 5 percent of its cropland being irrigated—compared to 37 percent in Asia, 14 percent in Latin America (You 2008), and a global average of 18 percent. In other words, irrigation potential is poorly exploited, leaving millions vulnerable to weather variability, climate shocks (particularly droughts), and ultimately food insecurity. Failure to exploit irrigation potential is a missed opportunity for agricultural growth, with yields in irrigated farms shown to be up to 90 percent higher compared to rainfed systems (World Bank 2015). Of the twelve analyzed countries, only South Africa and Madagascar have developed more than a small share of their irrigation potential, while other countries are largely underutilizing their irrigable land (Table 10).

**Table 10** Irrigation statistics for selected Sub-Saharan countries

Country	Acreage under irrigation (2009, in hectares)	Realized irrigation potential (%)	Global ranking–Ease of doing business in the sector
DRC	72,750	15	N/A
Ethiopia	289,530	11	34
Ghana	30,900	2	30
Kenya	103,203	29	4
Madagascar	1,086,291	72	N/A
Malawi	56,390	35	19
Mozambique	118,120	4	21
Nigeria	293,117	13	46
Rwanda	8,500	5	32
Senegal	119,680	29	42
South Africa	1,498,000	100	N/A
Zambia	155,912	30	16

Source: Svendsen et al. (2009); World Bank (2017)

**Regulations affect the ability of both small and large farms to get adequate access to water, requiring the need for amended policies.** Smallholders particularly face barriers in accessing and paying for irrigation water with preference often given to large commercial farms. Decentralized governance mechanisms such as Water User Associations (WUAs) are required to facilitate smallholder access to irrigation water, to manage irrigation infrastructure, and to solve water-related disputes. Formal permit requirements are not appropriate for all water users in all contexts. Some countries, for example South Africa (Pegasys Institute and IWMI 2017), exempt certain categories of small-scale water users from the obligation to obtain a permit, based on specific thresholds such as the volume of water used, land water use, or recognized customary water rights (Codjoe and Owusu 2011; World Bank 2016). Public investments in off-farm irrigation infrastructure and support of private investment in low-cost, on-farm infrastructure could significantly contribute to meeting increasing food demand and to enable diversification into different agricultural products. Beside capital investment, land and water tenure, sustainable water management, and equitable access to irrigation water play an important role—all of which require adequate policy and regulatory mechanisms for irrigation to be affordable and effective for smallholders without compromising environmental sustainability.

## LAND TENURE POLICIES

**In Africa, approximately 60 percent of the population secures its livelihood through farming, livestock production, and related activities. Land tenure is a major factor affecting production decisions.** Secure access to land is a precondition for farmers to develop their activities with a longer-term perspective, and to a large extent determines their investment decisions. The FAO Voluntary Guidelines on the Responsible Governance of Tenure<sup>62</sup> emphasize that "...[s]ecure land tenure also provides a valuable safety net as a source of shelter, food and income in times of hardship" (FAO 2012a). Despite land being central to agricultural development in Africa (including commercialization, sustainable intensification and diversification), development initiatives and policies in many countries often refrain from land tenure-related interventions due to the perceived sensitivity of the matter.

**Recent policies of Sub-Saharan African countries have tended towards large scale land-based investments (LSLBIs) which often come at the expense of smaller, more diversified production.** LSLBIs favor export-oriented production of a few cash crops over the production of a wide range of diversified food and livestock products that dominate smallholder production. Among the analyzed countries in this report, Mozambique, Ethiopia and Zambia are among those that have high levels of LSLBI.<sup>63</sup> Much debate has been held over the impact of LSLBI on food security, smallholder livelihoods, and agrobiodiversity. While such investments can open doors for vertical value chain diversification and consequently expand opportunities for both on and off-farm agricultural employment, the benefits are far from guaranteed. In Senegal, for example, farmers participating in a dialogue on the impacts of LSLBIs on food security indicated that LSLBIs compete with them for markets for high value crops (such as cocoa)—a competition that farmers are likely to lose given the financial and political power of large-scale domestic or foreign investors.<sup>64</sup> Emphasis is now placed on 'responsible' large scale land-based investments in the framework of responsible agricultural investments (RAI). A key principle here is the assessment of risks and benefits of prospective LSLBIs in relation to the environment, agrobiodiversity and ecosystems, as well as the consideration of alternative investment models (FAO et al. 2010).<sup>65</sup>

**The majority of smallholders in Africa access land through informal customary or traditional land tenure systems, often leading to tenure insecurity and**

**hindering productive investment.** Land tenure rights, distribution, use and management are closely linked to agricultural performance and income growth. Secure property rights over land provide the authority to decide on land use and investments, as well as incentives for sustainable resource management. While evidence is mixed on the relation between land ownership and the protection of the resource, shifting from usufruct to full ownership rights has shown to dramatically increase the incentives for farmers to invest in soil conservation and to plant cash crops or fruit bearing trees (Mikulcak 2011; Deininger et al. 2008).

**The distribution of property rights also affects food security, resilience and social cohesion, with land ownership providing smallholders with a collateral and a fallback option during times of stress.** ‘Informal’ tenure rights, that is, rights that are not codified in statutory law and hence held outside formal legal protection, are however widespread across Africa—despite many efforts to establish secure and transferable land rights. These customary rights are difficult to enforce, often prevent smallholders from developing their full productive potential, and can lead to conflicts over land and expropriation (Alden Wily 2011).<sup>66</sup> There are mechanisms to promoting and guaranteeing security of land tenure, such as through ICT-supported land registration and certification programs (e.g., World Bank 2018a). These need to be strengthened in order to protect farmers from conflicting claims while allowing them to invest.

## 5.6 NUTRITION, HEALTH, AND SOCIAL PROTECTION

Social protection and nutrition-focused policies that support the poorest and most vulnerable people also provide an opportunity to promote diversification and to enhance nutritional outcomes. In parallel, awareness-raising activities can importantly shift consumer behavior towards healthier and more nutritious foods.

### SOCIAL PROTECTION POLICIES

**Social protection policies have become an important component of support to the poorest and most vulnerable people, often incorporating cash transfers or food assistance with an increasing focus on nutrition.** Social protection measures include (a) direct welfare programs (e.g., conditional and unconditional cash transfers, school feeding programs, food aid); (b) productivity enhancing programs (e.g., cash- or food-for-work programs, subsidies); (c) market

intervention (e.g., price control); and (d) policy changes (Omilola and Kaniki 2014). Providing cash transfers can lift farmers out of extreme poverty and facilitate the uptake of a more diversified production.

**While nutrition has not always been emphasized in social protection programs, this has become increasingly the case.** Social protection programs of more and more countries entail components targeted directly to women or child nutrition, and mainstream nutrition issues across entire social protection programs. Several evaluations of cash transfer programs revealed a positive impact on nutrition. For instance the Kalomo cash transfer scheme in Zambia through which participating households reported to consume 12 percent more proteins, and 35 percent more oil daily. In South Africa, children living with

#### **BOX 26 ETHIOPIA'S PRODUCTIVE SAFETY NETS PROGRAM AND ITS IMPACTS ON NUTRITION**

In 2004, the Government of Ethiopia introduced its National Food Security Program, which includes the Productive Safety Net Program (PSNP). According to Omilola and Kaniki (2014), it is among the largest social protection schemes in Sub-Saharan Africa outside of South Africa, covering over 8 million beneficiaries since its inception. The Program has two components: public works (PSNP-PW) for capable adults, and cash transfers for those unable or too young to work. Indirect impacts on resilience, nutrition and health in participating households include:

- Ability to keep assets such as goats, which would have been sold without the program;
- Ability to purchase seeds and agricultural inputs to increase agricultural production;
- Food for household consumption;
- Increased utilization of health and education services particularly for children;
- Public works often involve land rehabilitation and conservation which enhances production.

In addition, Ethiopia has instituted other social protection interventions such as school feeding programs for over 600,000 students in almost 1,200 schools in six selected regions. Fee waivers are provided to enable the most vulnerable to access food at schools through the program as well as other health services such as child immunization. PSNP-PW is also gender and child sensitive. Participating households are permitted to bring children to the worksite, where one person who is paid the same daily rate as all other laborers is assigned to take care of the children for the day.

*Source: Omilola and Kaniki (2014)*

grandparents receiving cash transfer were reported to be taller than children living in non-supported households, indicating that at least some of the cash was spent on nutritious food for grandchildren (Omilola and Kaniki 2014). However, the general consensus is that provision of more cash and provision of more food does not always contribute to improved nutrition, especially when money is spent on cereals, and food assistance is similarly comprised largely of staple crops. BOX 26 describes the nutrition and other impacts of Ethiopia's Productive Safety Net Program that combines cash-for-work and cash transfers.

## NUTRITION POLICY AND AWARENESS-RAISING

**Nutrition features prominently in the food security, health and resilience strategies of Sub-Saharan African countries—both at the national and regional levels.**<sup>67</sup> Current statistics and trends in nutritional status in Africa indicate a need for concerted effort in tackling malnutrition. This can only be achieved through appropriate policies and regulations on nutrition, using a multi-sectorial approach to tackle an issue that was previously the sole mandate of the health sector. A common element in national food security and nutrition policies is the establishment of an institutional framework that coordinates nutrition policy across multiple sectors with the aim of better linking agriculture, nutrition and resilience.<sup>68</sup>

**Knowledge and education on nutrition, and indeed all forms of malnutrition are a key factor in meeting food security, nutrition and health objectives.** Inaccurate beliefs, attitudes and practices related to food consumption; traditional values and food taboos; long-established dietary habits; food distribution patterns in the family; ideas about child feeding; or a lack of knowledge of food hygiene and sanitation often contribute to different forms of malnutrition (FAO 2014a). Countering these is an essential part of nutrition education and behavior change communication interventions that seek to improve individual and household nutrition knowledge as well as decision-making on nutrition and child care (e.g., Murendo et al. 2018). Nutrition education increases awareness of the benefits of consuming healthy diets, and can serve to promote the consumption of locally produced foods and indigenous species. This in turn can create incentives for greater local production of a diverse range of foods, whose availability in local markets may further spur their demand. Awareness activities can include food-based dietary guidelines, the integration of nutrition education into school curricula, community mobilization, and fruit and vegetable information campaigns (e.g., Fanzo et al. 2013).

## 6. Conclusions and Policy Recommendations

**Establishing firm linkages between the various agricultural production systems, their drivers, and their impacts on nutrition and resilience is challenging.** While there is a considerable body of research available on diversification and specialization of agricultural production, including for Sub-Saharan Africa, the exact linkages between influencing factors or determinants of production decisions and their impacts are hard to establish—mainly for two reasons. First, there are many factors at play which interact dynamically and play out differently across the diverse and multifaceted countries of Sub-Saharan Africa. Building a framework that would describe exactly what triggers the decision to specialize or to diversify, and the *exact* impact on nutrition and resilience is therefore not realistic. Second, while there is research on diversification and specialization and their impact on either resilience or nutrition, to date there is no major study that combines both outcomes. This is likely due to the relative lack of directly usable data and related difficulties in building quantitative models—by necessity through ‘next best options’—that would support the emergence of an evidence-based model.

**However, existing research does identify various factors at play, and allows for some broad conclusions about the *impacts* of specialization and diversification on resilience and nutrition.** Three impact pathways are identified through which a production decision affects resilience and nutrition outcomes. Notably, these pathways often interact and are hence not mutually exclusive. With regard to *natural resources and ecosystems pathways*, the report elicited the following results:

- (i) The impact of productive diversification is broadly positive since it can boost agroecosystem resilience through greater biological diversity and the provision of multiple ecosystem services, and nutrition through the provision of directly utilizable, diverse food products;
- (ii) While specialization is often detrimental to agroecosystem resilience due to associated land use intensification and landscape simplification, ecological trade-offs can be reduced if intensification is pursued through sustainable and climate-smart land management practices. The spatial

and temporal distribution of specialization needs to be critically taken into account, or in other words: the larger the area on which specialization occurs—at the farm, community, landscape level—and the longer the period during which specialization is practiced, the greater and longer-lasting are the negative impacts in terms of resilience.

**With a view to *income pathway*, the report elicited the following conclusions:**

- (i) Both diversification and specialization can lead to improved livelihood resilience and, arguably, nutrition, but the proximity to markets is key. The closer and the better functioning the markets, the more likely and beneficial is specialization, since produce can be readily sold, and proceeds used to purchase other foods. When markets are less accessible or functioning, the more likely and beneficial is diversification, since food produced at home will be more diverse and will reduce the need to purchase foods elsewhere. Moreover, diversification will result in reduced dependency on external inputs such as agrochemicals, which can be beneficial both for agroecosystem and livelihood resilience.
- (ii) Vertical diversification and off-farm diversification can represent strong risk management tools and are hence beneficial to livelihood resilience since they both generate income and potentially savings that can serve for social protection in the face of shocks.
- (iii) While specialization on one staple or export crop can generate higher incomes and hence foster livelihood resilience, there is a risk of malnutrition as purchasing decisions—of nutritious foods not produced on the farm—will depend on the knowledge and awareness about the nutritional value of foods offered on markets.

**Finally, in terms of impacts emerging through *food environment pathways*, which looks at the physical, socio-economic and political factors influencing food availability, affordability and acceptability, the report highlights the following:**

- (i) Diversification provides more diverse food directly available for household consumption. This leads to better nutritional outcomes particularly among children.

- (ii) Women's empowerment can lead to better nutritional outcomes, too, because it can mitigate the negative effect of low productive diversity on maternal and child dietary diversity.
- (iii) When households are connected to diversified and well-functioning markets, specialization can result in improved livelihood resilience as well as nutrition, because a diverse range of foods is available and affordable through markets. Yet, nutritional awareness, for instance, through advocacy and educational programs, is crucial to increase consumption of nutritious foods from own production and purchases.

An additional, overall conclusion is that the impacts of diversification and specialization are not linear. There are thresholds such as land size at which the potential positive impact of either production system starts to flatten or even diminish—establishing at what point that occurs will ultimately depend on the context in which food production and consumption take place.

**Some general conclusions can further be drawn from the research on drivers that act as 'push' factors for either diversification or specialization.**

As the report has shown, the natural environment or biophysical and climatic conditions, respectively, is a powerful driver of production choices, and the following conclusions emerge from the analysis:

- (i) The conditions of soil, climate and water largely determine the possibilities individual farmers have. More stable and predictable weather can favor specialization and, conversely, more erratic weather conditions can encourage diversification as a risk mitigation and adaptation strategy.
- (ii) Farmers often decide to diversify also when faced with poor biophysical conditions, since these can be improved with greater biological diversity or the introduction of livestock into cropping systems.

**Diversification, both on-farm and off-farm, is often the risk management strategy of choice in the face of climate variability, but drivers such as those linked to policy and markets are equally important.** The analysis points to the following:

- (i) Public policy drivers can be more powerful than biophysical or socio-economic ones. For example, although Malawi is prone to recurrent droughts

and high numbers of stunting among children, agricultural production is dominated by specialized maize production—largely driven by subsidies.

- (ii) In addition to input subsidies, regulatory decisions (e.g., on competition, trade) can importantly influence farmers' production decisions.
- (iii) Market infrastructure is a significant factor. When markets are too remote or perform poorly, households are more likely to opt for diversification in order to ensure dietary diversity through own production and/or risk mitigation arising from the lack of other livelihood assets.
- (iv) Market power is also important as large retailers introduce standards and supply requirements in Sub-Saharan Africa that smaller, diversified farms can hardly meet—this favors specialized farming.
- (v) Better access to services (e.g., water, energy, extension, education) can reduce some of the constraints facing smallholder farmers and, consequently, can grant them greater liberty to make the production decision that best fits their respective context.

**Finally, there are some broad conclusions stemming from the analysis of socio-economic and institutional drivers:**

- (i) Vertical coordination of farmers (e.g., through productive alliances or cooperatives) can stimulate specialization since access to input and output markets is improved, and risks of price or demand volatility are lowered.
- (ii) Abundant supply of labor in rural markets can facilitate both specialization and diversification, albeit diversification is often more labor-intensive.
- (iii) Evidence suggests that secure land tenure is likely to incentivize sustainable land management practices and productive investments, which can favor both diversification and specialization depending on other factors such as market access.
- (iv) The distribution of political power in a community matters, as powerful interest groups, usually larger land owners with specialized production systems, can shape policies in a way that benefit them.

- (v) Levels of education within and among farming households matter, as the better educated ones will likely be able to pursue off-farm diversification and better manage risks; and
- (vi) Consumers who are more aware of the importance of diverse and nutritious food drive demand for a diverse range of products, and thus encourage diversification.

## POLICY RECOMMENDATIONS

**Taking into account the analysis of the impacts and drivers of production decisions on both resilience and nutrition, as well as an in-depth policy review across several SSA countries, a range of policy conclusions emerge that can support diversification.** Although this might not (yet) be fully reflected by the policies in place, most countries in Sub-Saharan Africa recognize the value of diversification for nutrition and resilience outcomes. The group of countries analyzed provides a rich source of policy approaches and practical examples which, in combination with the literature review of impacts and drivers of specialization and diversification, lead to a range of policy recommendations that can incentivize productive diversification. These are presented in Table 11. That said, the report also highlights that any policy design or program should take into account the specific country context and potential trade-offs in terms of temporal and spatial scale of intervention, and pay particular attention to the diverse structure, needs, and capacities of its population and economy.

**Table 11** Policy recommendations in support of productive diversification

### **SUBSIDIES AND AGRICULTURAL PUBLIC EXPENDITURE:**

#### **Putting in place targeted agriculture expenditure can support diversification**

- Governments should be aware of potential negative consequences in terms of agroecosystem resilience and nutritional outcomes when supporting the production of a narrow range of staple crops. Depending on the country context, market intervention can be considered, but should focus on maintaining strategic reserves and on purchasing from less accessible areas that cannot be reached by the private sector. Public resources should focus on creating an enabling environment for diversified productive activities, such as education and infrastructure for improved market access.
- Agricultural diversification can be incentivized by input subsidies for a wide array of nutrition-sensitive commodities and the support of diversified agricultural value chains. To increase productivity while ensuring sustainable land and water management, government intervention should be accompanied by complementary services (e.g., extension and research) in support of farmers. Procurement and distribution of subsidized inputs should be based on transparent targeting of beneficiaries and be considerate of the plurality of actors and distribution systems in many countries (e.g., extension by government, non-government and private sector-entities).

### **RURAL INFRASTRUCTURE AND MARKETS:**

#### **Developing rural infrastructure and input and output markets**

- Access to international and regional markets can boost diversification. Supporting smallholders to participate in a diverse range of profitable agricultural value chains, for instance for export, is necessary for livelihood resilience and wider economic development, and requires institutional arrangements such as public-private partnerships capable of monitoring food safety requirements, but also transparency and fairness of contracts through collective action.
- Increased investments in the development of infrastructure, particularly roads and electricity, and linking farmers to local markets to support all types of diversification (on-farm, off-farm, value addition) should be supported. For instance, increased distance to urban markets in Zambia was found to support diversification because households relied on their own production for food consumption and other needs. However, such households are less likely to move out of poverty.
- Rural areas lag behind urban areas in terms of access, affordability and quality of information and communications technologies—adequate supporting policies and investments should thus be considered. Access and use of mobile phone services to commercialize production can be a major incentive for diversification but also specialization since producers gain access to new markets and to land management advice.

## **AGRICULTURAL RESEARCH AND SEED SYSTEMS:**

**Supporting the access to knowledge, to nutrition- and climate-smart technologies as well as enhancing farmers' capacity**

- Increased investment in agricultural research and development, as well as enhanced access to knowledge and technologies for a diverse range of agricultural products and practices can foster diversification and ultimately resilience and nutritional diversity.
- Easing seed laws and regulations regarding the registration, certification, and sale of indigenous or farmer-produced seeds and livestock breeds across the region could have a potential to contribute to productive diversification, and is critical to enhance agroecosystem resilience.

## **AGRICULTURAL ADVISORY SERVICES, SKILLS DEVELOPMENT, AND AGRIPRENEURSHIP**

- The provision of advisory services and timely and relevant information, as well as the support for technology adoption can be considered as crucial for greater productive diversification. This is confirmed by country analyses of Zambia and Malawi which show that an exposure to diversity-related extension messages was a key driver of diversification. Overwhelmingly positive outcomes with respect to nutritional diversity were also reported as a consequence of intensive farmer training which included nutrition advocacy.
- Strengthening farmer organizations can be an effective means of facilitating farmers' access to knowledge and information, as well as to a diverse range of inputs at lower costs and to better agricultural contracts and participation in more lucrative value chains.
- The adoption of sustainable and climate-smart agriculture (CSA) practices, including agroforestry and soil and water conservation, (a) enhances the resilience of agroecosystems, (b) fosters productivity and potentially household incomes, and (c) mitigates climate change through carbon sequestration. Evidence shows that extension messages for CSA can be successfully combined with nutrition messages to not only achieve the 'triple wins' of adaptation, mitigation and productivity, but to foster nutritional diversity at the same time.
- Agricultural advisory services should be tailored to different types of farmers and their respective socio-economic context. For instance, the benefits of diversification seem to increase with land size only up to a certain threshold. Evidence suggests that households that are too diversified tend to have worse nutrition outcomes, which could be caused by overall small production amounts of different food types. Hence management practices should be advocated that allow for diversification on smaller parcels while considering nutritional effects.

*continued*

**Table 11** Policy recommendations in support of productive diversification (continued)

### **AGRICULTURAL ADVISORY SERVICES, SKILLS DEVELOPMENT, AND AGRIPRENEURSHIP**

- Off-farm and vertical diversification could be important avenues out of poverty particularly among rural youth. To this end, it is necessary to foster the transfer of vocational and entrepreneurial skills for youth to endeavor in agricultural value addition enterprises and employment off-farm. Relatedly, support for the development of ‘farming as a business’ or agripreneurship—including improved access to credit and ICT—can create new opportunities of high attraction to rural youth.

### **NATURAL CAPITAL, LAND, AND WATER TENURE:**

#### **Providing access to productive resources**

- Households with more productive resources such as land, labor, and irrigation infrastructure tend to choose to diversify their production, as the country case studies of Zambia in Malawi attest. Conversely, the shrinking size of landholdings is a major reason for the growing importance of off-farm income streams and rural-urban migration.
- Land tenure insecurity has been shown to disincentivize the adoption of certain climate-smart practices such as soil and water conservation and agroforestry, with potentially negative outcomes on agricultural productivity and livelihood resilience. Land tenure policies and laws should, therefore, be reviewed to ensure security over land.

### **NUTRITION, HEALTH, AND SOCIAL PROTECTION POLICIES:**

#### **Enhancing nutritional awareness-raising and nutrition-centered educational programs**

- Intensifying nutritional awareness advocacy and educational programs, particularly linked to agricultural extension, is recommended to foster the consumption of nutritious foods from both own production and market purchases.

# Bibliography

- Aberman, N.L., Meerman, J., and Benson, T., eds. 2015. *Mapping the linkages between agriculture, food security and nutrition in Malawi*. Lilongwe, Malawi, and Washington DC: IFPRI.
- Adhikari, U., Nejadhashemi, A. P., and Woznicki, S. A. 2015. Climate change and eastern Africa: a review of impact on major crops. *Food and Energy Security* 4(2): 110–132.
- Adjimoti, G.O. and Tsey-Mensah Kwadzo, G. 2018. Crop diversification and household food security status: evidence from rural Benin. *Agriculture & Food Security*. December 2018(7): 82.
- AfDB (African Development Bank). 2016. *Jobs for Youth in Africa: Strategy for Creating 25 Million Jobs and Equipping 50 Million Youth - 2016-2025*. African Development Bank.
- . 2016b. *Feed Africa: Strategy for Agricultural Transformation in Africa*. African Development Bank.
- AGRA (Alliance for a Green Revolution in Africa). 2016. *Africa Agriculture Status Report 2016: Progress toward agricultural transformation in Africa*. Nairobi, Kenya: AGRA.
- AGRA (Alliance for a Green Revolution in Africa). 2017. *Africa Agriculture Status Report 2017: The Business of Smallholder Agriculture in Sub-Saharan Africa*. Nairobi, Kenya: AGRA.
- Alden Wily, L. 2011. 'The Law is to Blame': The Vulnerable Status of Common Property Rights in Sub-Saharan Africa. *Development and Change* 42(3): 733–757.
- Altieri, M.A. 2002. Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agriculture Ecosystems and Environment* 93(1-3): 1–24.
- Altieri, M.A. and Nicholls, C.I. 2006. *Agroecology and the Search for a Truly Sustainable Agriculture*. Berkeley, CA, USA, University of California. <http://www.agroeco.org/doc/agroecology-engl-PNUMA.pdf> [Accessed 21 May 2018].
- Altieri, M.A., Nicholls, C.I., Henao, A., and Marcos, A.L. 2015. Agroecology and the design of climate change-resilient farming systems. *Agronomy for Sustainable Development* 35(3): 869–890.
- Ardey Codjoe, N. S. and Owusu, G. 2011. Climate Change/Variability and Food Systems: Evidence from the Afram Plains, Ghana. *Regional Environmental Change* 11(4): 753–765.
- Aromolaran, A. B. 2004. Household income, women's income share, and food calorie intake in South Western Nigeria. *Food Policy*, 29(5): 507–530.
- Arslan, A., Cavatassi, R., McCarthy, N., Lipper, L., Alfani, F., and Kokwe, M. 2016. *Diversification under Climate Variability as Part of A CSA Strategy in Rural Zambia*. ESA Working Paper No. 16-07.
- Asante, B.O., Villano, R.A., Patrick, I.W., Battese, G.E. 2018. Determinants of farm diversification in integrated crop–livestock farming systems in Ghana. *Renewable Agriculture and Food Systems* 33(2): 131–149.
- Ashley, C. and Carney, D. 1999. *Sustainable livelihoods: Lessons from early experience*. London: DFID. [http://www.the-eis.com/data/literature/Sustainablelivelihoods\\_lessons%20from%20early%20experience.pdf](http://www.the-eis.com/data/literature/Sustainablelivelihoods_lessons%20from%20early%20experience.pdf) [Accessed 23 June 2018].
- AU (African Union). 2015. *Africa Regional Nutrition Strategy 2015-2025*. <http://www.resakss.org/node/6546> [Accessed 13 June 2018].

- 2015a. *The AU guidance note on tracking and Measuring the levels and quality of government expenditures for agriculture*. Comprehensive Africa Agriculture Development Program.
- AU (African Union), ECA (UN Economic Commission for Africa) and the AfDB (African Development Bank). 2013. *Large-scale land based investments in Africa: Synthesis report*. <http://repository.uneca.org/bitstream/handle/10855/22923/b11552153.pdf?sequence=1> [Accessed 25 June 2018].
- Aworh, O.C. 2015. Promoting food security and enhancing Nigeria's small farmers' income through value-added processing of lesser-known and under-utilized indigenous fruits and vegetables. *Food Research International* 76(4): 986–991.
- Babatunde, R. O. and Qaim, M. 2009. "The Role of Off-farm Income Diversification in Rural Nigeria: Driving Forces and Household Access." CSAE conference 2009 on economic development in Africa, St Catherine's College, Oxford, March 22–24.
- Babatunde, R. 2012. *Impact of Off-Farm Income Diversification on Agricultural Production and Efficiency of Smallholder Crop Farmers in Rural Nigeria*. African Development Bank. url: <https://www.afdb.org/en/aec-2016/papers/paper/impact-of-off-farm-income-diversification-on-agricultural-production-and-efficiency-of-smallholder-crop-farmers-in-rural-nigeria-4957/> [Accessed 6 December 2017].
- Bakewell-Stone, P., Lieblein, G., and Francis, C. 2008. Potentials for organic agriculture to sustain livelihoods in Tanzania. *International Journal of Agricultural Sustainability* 6(1): 22–36.
- Baldermann, S., Blagojević, L., Frede, K., Klopsch, R., Neugart, S., Neumann, A., Ngwene, B., Norkoweit, J., Schröter, D., Schröter, A., Schweigert, F.J., Wiesner, M., and Schreiner, M. 2016. Are Neglected Plants the Food for the Future? *Critical Reviews in Plant Sciences* 35(2): 106–119.
- Balya, C. 2007. "Supporting Smallholder Farmers to Grow in Uganda: The Story of Eagle Lager". In *Making Markets Work for the Poor in Eastern and Southern Africa*, 12-14 March 2007, Cape Town, South Africa.
- Barghouti, S., Kane, S., Sorby, K., and Ali, M. 2004. *Agricultural diversification for the poor: Guidelines for practitioners, agriculture and rural Development*. Agriculture and Rural Development Discussion Paper No. 1. Washington, DC: World Bank.
- Barrett, C.B., Bezuneh, M., and Aboud, A. 2001. Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya. *Food Policy* 26(4): 367–384.
- Barrett, C.B., Christiaensen, L., Sheahan, M., and Shimele, A. 2017. On the Structural Transformation of Rural Africa, *Journal of African Economies* 26(suppl\_1, 1 August 2017): i11–i35.
- Beintema, N. and Stads, G.J. 2017. *A Comprehensive Overview of Investments and Human Resource Capacity in African Agricultural Research*. ASTI Synthesis Report. International Food Policy Research Institute (IFPRI): Washington D.C.
- Béné, C., Godfrey-Wood, R., Newsham, A., Davies, M. 2012. Resilience: new utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes. *IDS Working Paper*. 2012(405): 1–61.
- Benin, S., M. Smale, J. Pender, B. Gebremedhin, and Ehui, S. 2004. The Determinants of Cereal Crop Diversity on Farms in the Ethiopian Highlands. *Agricultural Economics* 31(2–3): 197–208.
- Benin, S. et al. 2016. Why do African countries underinvest in agricultural R&D? In J. Lynam et al. (eds.) *Agricultural Research in Africa: Investing in Future Harvests*. International Food Policy Research Institute (IFPRI): Washington D.C.

- Bennett, E.M, Cramer, W., Begossi, A. et al. 2015. Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability. *Current Opinion in Environmental Sustainability* 14:76–85.
- Bertoni, E., Corral Rodas, P.A., Molini, V., and Oseni, G. 2016. *Heterogeneous returns to income diversification: evidence from Nigeria*. Policy Research Working Paper No. 7894. World Bank, Washington, DC.
- Berzborn, S. 2007. The household economy of pastoralists and wage-labourers in the Richtersveld, South Africa. *Journal of Arid Environments* 70(4): 672-685.
- Bhatta, B. P., and Arethun, T. 2013. “Barriers to rural households’ participation in low-skilled off-farm labor markets: theory and empirical results from northern Ethiopia” *SpringerPlus*, 2(1): 97.
- Bigsten, A., & Tengstam, S. 2011. Smallholder diversification and income growth in Zambia. *Journal of African Economies* 20(5): 781–822.
- Bilinsky, P. and Swindale, A. 2010. *Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access: Indicator Guide. (v.4)*. Washington, D.C.: FHI 360/FANTA.
- Binswanger, H. P., & von Braun, J. 1991. Technological change and commercialization in agriculture: The effect on the poor. *World Bank Research Observer* 6(1): 57–80.
- Binswanger, H. P., Deininger, K., and Feder, G. 1995. Power, distortions, revolt and reform in agricultural land relations. *Handbook of Development Economics* 3: 2659–2772.
- Bishaw, Z. and N. Louwaars. 2012. “Evolution of seed policy and strategies and implications for Ethiopian seed systems development.” In *Defining moments of Ethiopian seed sector*, edited by Wold, A. T., A. Fikre, D. Alemu, L. Desalegn, and A. Kirub. Addis Ababa, Ethiopia: Ethiopian Institute of Agricultural Research.
- Block, J.H., Henkel, J., Schweisfurth, T.G., and Stiegler, A. 2016. Commercializing user innovations by vertical diversification: The user-manufacturer innovator. *Research Policy* 45: 244–259.
- Bobenrieth, E., Wright B. and Zeng D., 2012. Stocks to use ratios and prices as indicators of vulnerability to spikes in global cereal markets. *Agricultural Economics* 44(1): 43–52.
- Bouis, H.E. and A. Saltzman. 2017. Improving nutrition through biofortification: A review of evidence from HarvestPlus, 2003 through 2016. *Global Food Security* 12(March 2017): 49-58.
- Brooks, K., Zorya, S., Gautam, A. and Goyal, A. 2013. *Agriculture as a Sector of Opportunity for Young People in Africa*. Policy Research Working Paper 6473. The World Bank Sustainable Development Network Agriculture and Environmental Services Department, June 2013.
- Buckmaster, A.D. 2012. *Going the Distance: The Impact of Distance to Market on Smallholders Crop and Technology Choices*. Master Thesis. Virginia Polytechnic Institute and State University. <http://hdl.handle.net/10919/33126> [Accessed 24 May 2018].
- Cabell, J. F. and M. Oelofse. 2012. An indicator framework for assessing agroecosystem resilience. *Ecology and Society* 17(1): 18.
- Campbell C.C. 1991. Food insecurity: a nutritional outcome or a predictor variable? *Journal of Nutrition* 121(3): 408–15.
- Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., et al. 2012. Biodiversity loss and its impact on humanity. *Nature* 486: 59–67.
- Carletto, C., Corral, P., and Guelfi, A. 2017. Agricultural commercialization and nutrition revisited: Empirical evidence from three African countries. *Food Policy* 67: 106–118.

- Carletto, C., Ruel, M., Winters, P., and Zezza, A. 2015. Farm-Level Pathways to Improved Nutritional Status: Introduction to the Special Issue. *Journal of Development Studies* 51(8): 945-957.
- Carletto, C., Zezza, A., and Banerjee, R. 2013. Towards better measurement of household food security: Harmonizing indicators and the role of Household Surveys. *Global Food Security*, 2(1): 30-40.
- Carpenter S. R., Mooney H. A., Agard J., Capistrano D., Defries R. S., Díaz S., Dietz T., Duraiappah A. K., Oteng-Yeboah A., Pereira H. M., Perrings C., Reid W. V, Sarukhan J., Scholes R. J., and Whyte A. 2009. Science for managing ecosystem services: beyond the Millennium Ecosystem Assessment. *Proceedings of the National Academy of Sciences* 106: 1305–1312.
- Cavatassi, R., Lipper, L., and Winters, P. 2012. Sowing the seeds of social relations: social capital and agricultural diversity in Hararghe Ethiopia. *Environment and Development Economics* 17(5): 547–578.
- Cervantes-Godoy, D. and J. Dewbre. 2010. *Economic Importance of Agriculture for Poverty Reduction*, OECD Food, Agriculture and Fisheries Working Papers, No. 23, OECD Publishing.
- CGIAR (Consortium of International Agricultural Research Centers). 2014. “How can sustainable intensification make farming climate-smart?” Blog (16. October 2014). <https://cafs.cgiar.org/blog/how-can-sustainable-intensification-make-farming-climate-smart#.WsdzOkxuJaQ> [Accessed 17 May 2018].
- Chamberlain, G. 1984. “Panel Data.” In *Handbook of Econometrics (Volume 2)*, edited by Griliches, Z. and M.D. Intriligator, 1248-1318. Amsterdam: North Holland.
- Chapoto, A. and Chisanga, B. 2016. *Zambia Agriculture Status Report*. Lusaka, Zambia: IAPRI. <http://www.iapri.org.zm/images/TechnicalPapers/IAPRI-Booklet.pdf> [Accessed 17 May 2018].
- Chapoto, A., Chabala, L.M., and Inungu, O.N. 2016. *A long history of low productivity in Zambia: Is it time to do away with blanket recommendations?* Working Paper No. 110. Lusaka, Zambia: IAPRI.
- Chepchirchir, R. T., Macharia, I., Murage, A. W., Midega, C. A. O., and Khan, Z. R. 2017. Impact assessment of push-pull pest management on incomes, productivity and poverty among smallholder households in Eastern Uganda. *Food Security* 9(6): 1359–1372.
- Chibwana, C., Fisher, M., and Shively, G. 2012. Cropland Allocation Effects of Agricultural Input Subsidies in Malawi. *World Development* 40(1): 124–133.
- Christiaensen, L., Demery, L., and Kuhl, J. 2011. The (evolving) role of agriculture in poverty reduction-An empirical perspective. *Journal of Development Economics* 96(2): 239–254.
- Christy, R., Mabaya, E., Wilson, N., Mutambatsere, E., and Mhlanga, N. 2009. Enabling environments for competitive agro-industries. In C. Da Silva, D. Baker, A.W. Shepherd, C. Jenane and S. Miranda da Cruz. *Agro-industries for development*, pp. 136–185. Wallingford, UK, CABI, with FAO and UNIDO.
- CIAT (The International Center for Tropical Agriculture) and World Bank. 2017. “Climate-Smart Agriculture in Zambia.” *CSA Country Profiles for Africa Series*.
- Cole, S., Giné, X., and Vickery, J. 2017. How Does Risk Management Influence Production Decisions? Evidence from a Field Experiment. *The Review of Financial Studies* 30(6): 1935–1970.

- Cook, S. 2018. *The spice of life: The fundamental role of diversity on the farm and on the plate*. Discussion Paper. IIED and Hivos, London and The Hague.
- CSO (Central Statistical Office), MAL (Ministry of Agriculture and Livestock) and IAPRI (Indaba Agricultural Policy Research Institute). 2012. *Rural Agricultural Livelihoods Survey*.
- Cunguara, B., Langyintuo, A., and Darnhofer, I. 2011. The role of nonfarm income in coping with the effects of drought in southern Mozambique. *Agricultural Economics* 42(6): 701–713.
- Czyżewski, A. and Smędzik-Ambroży, K. 2015. Specialization and diversification of agricultural production in the light of sustainable development. *Journal of International Studies* 8(2): 63–73.
- Demeke, M., Spinelli, A., Croce, S., Pernechele, V., Stefanelli, E. et al. 2014. Food and agriculture policy decisions: trends, emerging issues and policy alignments since the 2007/08 food security crisis. Food and Agriculture Organization of the United Nations (FAO): Rome.
- Danish International Development Agency (DANIDA), 2011. Agricultural input subsidies in sub-Saharan Africa, International Development Cooperation, Ministry of Foreign Affairs of Denmark, Evaluation Study 2011/2.
- Davenport, M.L. and Nicholson, S.E. 1993. On the relation between rainfall and the Normalized Difference Vegetation Index for diverse vegetation types in East Africa. *International Journal of Remote Sensing*, 14(12): 2369–2389.
- David, R.J. and Han, S.K. 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal* 25(1): 39–58.
- Davidson, K.A. and Kropp, J.D. 2017. Does Market Access Improve Dietary Diversity? Evidence from Bangladesh. In *Southern Agricultural Economics Association's 2017 SAEA Annual Meeting*. [http://ageconsearch.umn.edu/bitstream/252854/2/DavidsonKropp\\_SAEA2017\\_final.pdf](http://ageconsearch.umn.edu/bitstream/252854/2/DavidsonKropp_SAEA2017_final.pdf) [Accessed 10 June 2017].
- Davis, B., Di Giuseppe, S., and Zezza, A. 2014. *Income diversification patterns in rural Sub-Saharan Africa: reassessing the evidence*. Policy Research Working Paper 7108. World Bank.
- DFID (Department for International Development). 2001. *Sustainable Livelihoods Guidance Sheets*. Department for International Development: London, UK. [http://www.livelihoods.org/info/info\\_guidancesheets.html](http://www.livelihoods.org/info/info_guidancesheets.html) [Accessed 5 May 2017].
- De Groot, R.S., Wilson, M.A., and Boumans, R.M.J. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41: 393–408.
- Deininger, K. and D. Ali 2008, Do Overlapping Land Rights Reduce Agricultural Investment? Evidence from Uganda. *American Journal of Agricultural Economics* 90(4): 869–882.
- Deininger, K. and Feder, G. 2009. Land registration, governance, and development: Evidence and implications for policy. *The World Bank Research Observer* 24(2): 233–266.
- De Janvry, A. and Sadoulet, E. 2001. Income strategies among rural households in Mexico: The role of off-farm activities. *World Development*, 29(3): 467–480.
- Dejene, A., Midgley, S., Marake, M. V, and Ramasamy, S. 2011. *Strengthening capacity for climate change adaptation in agriculture: experiences and lessons from Lesotho*. Environment and Natural Resources Management Series 18. Rome, Italy: FAO.

- Del Ninno, C. and Marini, A. 2015. *Household's Vulnerability to Shocks in Zambia*. SP Discussion paper no. 0536. Washington, DC: The World Bank.
- De Rosa, M., Bartoli, L., and La Rocca, G. 2014. Testing Extension Services through AKAP Models. *The Journal of Agricultural Education and Extension*, 20(5): 513–535.
- Dercon, S. 2002. Income risk, coping strategies, and safety nets. *World Bank Research Observer* 17(2): 141–166.
- Dethier, J. and Effenberger, A. 2012. Agriculture and development: a brief review of the literature. *Economic Systems* 36(2): 175–205.
- De Weijer, F. and McCandless, E. 2015. Capacity development and resilience. In Greijn, H., Hauck, V., Land, T. and Ubels, J. (eds.) *Capacity Development beyond aid*. SNV The Hague and ECDPM Maastricht.
- Di Falco, S., Bezabih, H. and Yesuf, M. 2010. Seeds for livelihood. Crop biodiversity and food production in Ethiopia. *Ecological Economics* 69: 1695–1702.
- Dou, F., Soriano, J., Tabien, R. E., and Chen, K. 2016. "Soil Texture and Cultivar Effects on Rice (*Oryza sativa*, L.) Grain Yield, Yield Components and Water Productivity in Three Water Regimes." *PloS one*, 11(3), e0150549.
- Druilhe, Z. and Barreiro-Hurlé, J. 2012. Fertilizer Subsidies in Sub-Saharan Africa. Working Paper No. 12-04. FAO, Rome, Italy.
- Easton, P. and Ronald, M. 2000. *Seeds of Life: Women and Agricultural Biodiversity in Africa*. Indigenous Knowledge (IK) Notes 23. Washington, DC.: World Bank.
- Ecker, O. and Qaim, M. 2011. Analyzing nutritional impacts of policies: An empirical study for Malawi. *World Development*, 39(3): 412–428.
- Ekekwe, N. 2017. How Digital Technology Is Changing Farming in Africa. *Harvard Business Review*, May 18. <https://hbr.org/2017/05/how-digital-technology-is-changing-farming-in-africa> [Accessed 25 May 2018].
- Ellis, F. 2007. Household strategies and rural livelihood diversification Household Strategies and Rural Livelihood Diversification. *The Journal of Development Studies*, (December 2012): 37–41.
- Eshetu, F. and Mekonnen, E. 2016. Determinants of off farm income diversification and its effect on rural household poverty in Gamo Gofa Zone, Southern Ethiopia. *Journal of Development and Agricultural Economics* 8(1): 215–227.
- European Commission. 2017. *European Commission fact sheet on Caribbean bananas and the World Trade Organisation*. [http://europa.eu/rapid/press-release\\_MEMO-97-28\\_en.htm](http://europa.eu/rapid/press-release_MEMO-97-28_en.htm) [accessed 22 June 2018].
- Fafchamps, M. and Gabre-Madhin, E. 2006. Agricultural markets in Benin and Malawi. *AfJARE*, 1(0), 67–94.
- Fan, S., Babatunde O., and Lambert, M. 2009. *Public Spending for Agriculture in Africa: Trends and Composition*. ReSAKSS Working Paper No. 28. IFPRI. <http://ebrary.ifpri.org/utills/getfile/collection/p15738coll2/id/127170/filename/127381.pdf> [Accessed 24 May 2018].
- Fanzo et al. (eds.) 2013. *Diversifying Food and Diets. Using agricultural biodiversity to improve nutrition and health*, Routledge: New York.
- Fanzo, J. 2017. From big to small: the significance of smallholder farms in the global food system. *The Lancet Planetary Health* 1: 15–16.
- Fanzo, J., Marshall, Q., Wong, J., Merchan, R.I., Jaber, M.I., Souza, A. et al. 2013. *The Integration of Nutrition into Extension and Advisory Services: A synthesis of Experiences, Lessons and Recommendations*. GFRAS (Global Forum for Rural Advisory Services). Lindau, Switzerland.

- FAO (Food and Agriculture Organization of the United Nations). 1995. *Neglected crops – 1492 from a different perspective*. FAO Plant production and protection series No. 26. FAO: Rome, Italy.
- . 2003. *Crop diversification in the Asia-Pacific region*. RAP Publication 2001/03. FAO Regional Office for Asia and the Pacific. Bangkok, Thailand.
- . 2008. *The State of Food Insecurity in the World*. Rome, Italy: FAO.
- . 2009. *Food Security and Nutrition Security – What is the Problem and What is the Difference?* Summary of the FSN Forum Discussion No. 34 [www.fao.org/fsnforum/sites/default/files/files/34\\_Food\\_Security\\_Nutrition\\_Security /SUMM](http://www.fao.org/fsnforum/sites/default/files/files/34_Food_Security_Nutrition_Security_SUMM). [Accessed 17 May 2018]
- . 2011. “*Water management: technologies that save and grow.*” <http://www.fao.org/3/a-bc415e.pdf> [Accessed 17 May 2018].
- . 2012. *Making agriculture work for nutrition: synthesis of guiding principles*. Rome, Italy: FAO.
- . 2012a. *Voluntary Guidelines on the Governance of Tenure: At a glance*. <http://www.fao.org/docrep/016/i3016e/i3016e.pdf>
- . 2014. *The Comprehensive Implementation Plan on Maternal, Infant, and Young Child Nutrition*. Geneva. Rome, Italy: FAO.
- . 2014a. *Nutrition, education and awareness raising for the right to adequate food (Thematic study 6)*. Rome, Italy: FAO.
- . 2014b. *Strengthening the links between resilience and nutrition in food and agriculture. A discussion paper*. Rome, Italy: FAO.
- . 2015. *Malawi country fact sheet on food and agriculture policy trends*. <http://www.fao.org/3/a-i4491e.pdf>
- . 2015a. *Key Recommendations for Improving Nutrition through Agriculture and Food Systems*. FAO: Rome.
- . 2015b. *The Second Report On The State Of The World’s Animal Genetic resources for Food and Agriculture in brief*. FAO Commission on Genetic Resources for Food and Agriculture. <http://www.fao.org/3/a-i5077e.pdf>
- . 2016. *Madagascar and FAO: Supporting regional development for food and nutrition improvement and resilience in Madagascar*. Rome, Italy: FAO.
- . 2016a. “*Bees are bellwethers for the healthy agricultural ecosystems they help create.*” 21. May 2016. <http://www.fao.org/news/story/en/item/415259/icode/> [Accessed 16 May 2018].
- . 2016b. *Boosting Africa’s Soils: From the Abuja Declaration on Fertilizers to a sustainable soil management framework for food and nutrition security in Africa by 2030*. Rome, Italy: FAO.
- . 2016c. *Influencing food environment for healthy diets*. Rome, Italy: FAO.
- . 2017. *The state of Food Security and Nutrition in the World*. Rome, Italy: FAO
- . 2017a. *Integration of nutrition in agriculture extension services in Africa*. A desk review of country case studies, pre-service and in-service training materials. FAO, Regional Office for Africa.
- . 2018. FAOSTAT Database. Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/faostat/en> [Last accessed June 2018]
- FAOStat. FAOSTAT Database. Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/faostat/en>

- FAO, IFAD, UNICEF, WFP and WHO. 2018. *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*. FAO: Rome, Italy.
- FAO, IFAD (International Fund for Agricultural Development) and WFP (World Food Program). 2015. *The state of food insecurity in the World: Meeting the 2015 international hunger targets: taking stock of uneven progress*. Rome, Italy: FAO.
- FAO, IFAD, UNCTAD (UN Conference on Trade and Development) and the World Bank Group. 2010. *Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources*. [http://siteresources.worldbank.org/INTARD/214574-1111138388661/22453321/Principles\\_Extended.pdf](http://siteresources.worldbank.org/INTARD/214574-1111138388661/22453321/Principles_Extended.pdf) [Accessed 25 May 2018].
- FEWSNET 2013. Zambia Food Security Brief December 2013. Famine Early Warning Systems Network. [http://fewsn.net/sites/default/files/documents/reports/ZM\\_Food%20Security%20Brief\\_2014\\_final.pdf](http://fewsn.net/sites/default/files/documents/reports/ZM_Food%20Security%20Brief_2014_final.pdf) [Accessed 24 June 2018].
- Folke C. 2006. Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* 16(3): 253–267.
- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., and Walker, B. 2002. Resilience and sustainable development: building adaptive capacity in a world of transformations. *AMBIO: A Journal of the Human Environment* 31(5): 437–440.
- Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, and T., Rockström, J. 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20.
- Garrity, D.P., Akinnifesi, F.K., Ajayi, O.C., Weldesemayat, S.G., Mowo, J.G., Kalinganire, A., Larwanou, M., and Bayala, J. 2010. Evergreen agriculture: a robust approach to sustainable food security in Africa. *Food Security* 2: 197–214.
- Gasson, R. 1988. Farm diversification and rural development. *Journal of Agricultural Economics* 39(2): 175–182.
- Gebremedhin, B. and Jaleta, M. 2012. *Market orientation and market participation of smallholders in Ethiopia: Implications for commercial transformation*. Presented at the 28th triennial conference of the International Association of Agricultural Economists (IAAE), Foz do Iguaçu, Brazil, 18-2.
- Gebremedhin, S., Baye, K., Bekele, T., Tharaney, M., Asrat, Y., Abebe, Y., and Reta, N. 2017. Predictors of dietary diversity in children 6-23 months of age in largely food-insecure area of South Wollo, Ethiopia. *Nutrition* 33: 163–168.
- Geiger, F., Bengtsson, J., Berendse, F., Weisser, W.W., et al. 2010. Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. *Basic and Applied Ecology* 11(2): 97–105.
- GFRAS (Global Forum for Rural Advisory Services). 2014. *Status of Agricultural Extension and Rural Advisory Services Worldwide. Summary Report*. <https://www.g-fras.org/en/knowledge/gfras-publications.html?download=391:status-of-agricultural-extension-and-rural-advisory-services-worldwide>
- Gilbert, N. (2012). African agriculture: Dirt poor. *Nature* 483(7391): 525–527.
- Gillespie, S.R. and Kadiyala, S. 2005. *HIV/AIDS and Food and Nutrition Security: From Evidence to Action*, Food Policy Review 7. Washington, DC: International Food Policy Research Institute.
- Giertz, A., Caballero, J., Galperin, D., Makoka, D., Olson, J. and German, G. 2015. *Malawi Agricultural Sector Risk Assessment*. Agriculture global practice technical assistance paper. World Bank, Washington, DC.

- GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). 2015. *GIZ Ethiopia: Lessons and Experiences in Sustainable Land Management*. <https://www.giz.de/en/downloads/giz2015-en-lessons-experience-sustainable-land-management-ethiopia.pdf> [Accessed 21 May 2018].
- GIZ. 2015. Sustainable land management. [www.giz.de/en/worldwide/18912.html](http://www.giz.de/en/worldwide/18912.html) [Accessed 22 June 2018].
- GLOBALGAP. 2011. *Integrated Farm Assurance Standards*. [http://www.globalgap.org/cms/front\\_content.php?idart=147](http://www.globalgap.org/cms/front_content.php?idart=147) [Accessed 21 May 2018].
- GLOPAN (Global Panel on Agriculture and Food Systems for Nutrition). 2016. *Food systems and diets: Facing the challenges of the 21st century*. London, UK.
- . 2017. *Improving nutrition through enhanced food environments*. Policy Brief No. 7. London, UK.
- GoK (Government of Kenya). 2015. *Strategic Food Reserve Trust Fund*. National Treasury, Government of Kenya: Nairobi.
- Goyal, A. 2014. Expanding Africa's Digital Frontier: Farmers Show the Way. World Bank (blog). <http://blogs.worldbank.org/africacan/expanding-africa-s-digital-frontier-farmers-show-way> [Accessed 25 May 2018].
- Goyal, A. and J. Nash. 2017. *Reaping Richer Returns: Public Spending Priorities for African Agriculture Productivity Growth*. Africa Development Forum. Washington, DC: World Bank.
- Harman, L. and Chapoto, A. 2017. *FISP and FRA Reforms: Investing Savings into a Package of Smart Social Protection Schemes for Zambia*. Lusaka, Zambia: IAPRI. [http://www.iapri.org.zm/images/WorkingPapers/Harman\\_Chapoto\\_Social\\_Protection\\_paper\\_ckh.pdf](http://www.iapri.org.zm/images/WorkingPapers/Harman_Chapoto_Social_Protection_paper_ckh.pdf) [Accessed 25 June 2018].
- Hawkes, C., Smith, T., Jewell, J., Wardle, J., Hammond, R., Friel, S., Thow, A., and Kain, J. 2015. Smart policies for obesity prevention. *The Lancet* 38(9985): 2410–2421.
- Headey, D., Taffesse, A.S., and You, L. 2014. Diversification and Development in Pastoralist Ethiopia. *World Development* 56: 200–213.
- Hendrickson, J. R., Hanson, J. D., Tanaka, D. L., and Sassenrath, G. 2008. Principles of integrated agricultural systems: Introduction to processes and definition. *Renewable Agriculture and Food Systems*, 23(04): 265–271.
- Herforth, A. and Ahmed, S. 2015. The food environment, its effects on dietary consumption, and potential for measurement within agriculture-nutrition interventions. *Food Security* 7(3): 505–520.
- Hichaambwa, M., Chamberlin, J., and Kabwe, S. 2015. *Is Smallholder Horticulture the Unfunded Poverty Reduction Option in Zambia? A Comparative Assessment of Welfare Effects of Participation in Horticulture and Maize Markets*. Working Paper 96. Lusaka, Zambia: IAPRI.
- Hoddinott, J. and Yohannes, Y. 2002. Dietary diversity as a food security indicator. Discussion paper Brief; Food Consumption and Nutrition Division; Washington, DC.: IFPRI.
- Hoddinott, J., Headey, D., and Dereje, M. 2015. *Cows, Missing Milk Markets, and Nutrition in Rural Ethiopia*. Working Paper. Washington, DC.: IFPRI.
- IAPRI (Indaba Agricultural Policy Research Institute). 2016. *Rural Agricultural Livelihoods Survey: 2015 Survey Report*. [https://images.agri-profocus.nl/upload/post/RAIS\\_2015\\_Survey\\_Report\\_Finalv-\\_edited1456827249.pdf](https://images.agri-profocus.nl/upload/post/RAIS_2015_Survey_Report_Finalv-_edited1456827249.pdf) [Accessed 23 June 2018].

- . 2017. *Achieving more with less: reform and scaling down of FRA & FISP and boosting social protection*. Policy Advisory Paper. March 2017. [http://www.iapri.org.zm/images/PolicyBriefs/Smart\\_subsidies.pdf](http://www.iapri.org.zm/images/PolicyBriefs/Smart_subsidies.pdf) [Accessed 23 June 2018].
- IFPRI (International Food Policy Research Institute). 2016. *Global Nutrition Report 2016: From Promise to Impact, Ending Malnutrition by 2030*. Washington, DC.: IFPRI.
- .2015. Nutrition country profile: Malawi. International Food Policy Research Institute (IFPRI). <http://www.ifpri.org/publication/nutrition-country-profile-malawi>
- Ihab, A.N., Rohana, A.J., Wan Manan, W.M., Wan Suriati, W.N., Zalilah, M.S., and Mohamed Rusli, A. 2013. Nutritional Outcomes Related to Household Food Insecurity among Mothers in Rural Malaysia. *Journal of Health and Population Nutrition* 31(4): 480–489.
- Iizumi, T. and Ramankutty, N. 2015. How do weather and climate influence cropping area and intensity? *Global Food Security* 4: 46–50.
- infoDev. 2014. *Timbali Technology Incubator - South Africa Case Study*. Washington, DC: World Bank. [https://www.infodev.org/infodev-files/agribusiness.timbali.web\\_.pdf](https://www.infodev.org/infodev-files/agribusiness.timbali.web_.pdf) [Accessed 25 May 2018].
- IPCC (Intergovernmental Panel on Climate Change). 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
- ISSD Africa (Integrated Seed Sector Development in Africa). 2017. *The support for farmer led seed systems in African laws*. ISSD Africa Synthesis Paper. [https://issuu.com/royaltropicalinstitute/docs/9\\_synthesis\\_paper\\_-\\_the\\_support\\_for](https://issuu.com/royaltropicalinstitute/docs/9_synthesis_paper_-_the_support_for) [Accessed 25 May 2018].
- IUCN (International Union for Conservation of Nature). 2006. *Hidden Cost is Value Lost: The Economic Importance of Dryland Goods and Services in the IGAD region*. Policy Brief. [https://cmsdata.iucn.org/downloads/idrc\\_economics\\_brief\\_6\\_.pdf](https://cmsdata.iucn.org/downloads/idrc_economics_brief_6_.pdf) [Accessed 21 May 2018].
- Jamnadas R., Place F., Torquebiau, E., Malézieux, E., Iiyama, M., Sileshi, G.W., Kehlenbeck, K., Masters, E., McMullin, S., Weber, J.C., and Dawson, I.K. 2013. *Agroforestry, food and nutritional security*. ICRAF Working Paper No. 170. Nairobi: World Agroforestry Centre.
- James, B., Henry, M., Emmanuel, T., and Solomon, B. 2015. Barriers to scaling up/out climate smart agriculture and strategies to enhance adoption in Africa. FARA.
- Jayne, T.S., Chamberlin, J., and Headey, D.D. 2014. Land pressures, the evolution of farming systems, and development strategies in Africa: A Synthesis. *Food Policy* 48: 1–17.
- Jayne, T. S. and Rashid, S. 2013. Input subsidy programs in sub-Saharan Africa: A synthesis of recent evidence. *Agricultural Economics* 44(6): 547–562.
- Jayne, T. S., Yamano, T., Weber, M. T., Tschirley, D., Benfica, R., Chapoto, A., and Zulu, B. 2003. Smallholder income and land distribution in Africa: Implications for poverty reduction strategies. *Food Policy*, 28(3): 253–275.
- Jodlowski, M., Winter-Nelson, A., Baylis, K., and Goldsmith, P.D. 2016. Milk in the Data: Food Security Impacts from a Livestock Field Experiment in Zambia. *World Development* 77: 99–114.
- Jones, A.D., Shrinivas, A., and Bezner-Kerr, R. 2014. Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data. *Food Policy* 46: 1–12.

- Joshi, P., Gulati, A., and Cummings, R. 2007. Agricultural diversification in South Asia: Beyond food security. In *Agricultural Diversification and Smallholders in South Asia*, edited by P.K. Joshi et al., 47–81.
- Kahane, R., Hodgkin, T., Jaenicke, H., Hoogendoorn, C., Hermann, M., Dyno Keatinge, J.D.H., D'Arros Hughes, J., Padulosi, S., and Looney, N. 2013. Agrobiodiversity for food security, health and income. *Agronomy for Sustainable Development* 33(4): 671–693.
- Kassie, G. W. 2018. Agroforestry and farm income diversification: synergy or trade-off? The case of Ethiopia. *Environmental Systems Research* 6(1): 8.
- Katera, L. 2016. *Driving forces of off-farm income generating activities in rural Tanzania: how accessible are they to poor households?* Working Paper 16/1. Research on Poverty Alleviation (REPOA).
- Keding, G.B. and Ng'endo, M. 2015. *Diversifying local agriculture: Agricultural diversity on smallholder farms and in local markets in western Kenya*. Bioversity International: Rome, Italy.
- Kefyalew, G.G. 2012. *Analysis of smallholder farmer's participation in production and marketing of export potential crops: the case of sesame in Diga District, East Wollega zone of Oromia regional State*. Thesis paper. Addis Ababa University, Ethiopia.
- Kennedy, G., Ballard, T., and Dop, M.C. 2010. *Guidelines for Measuring Household and Individual Dietary Diversity*. Rome: FAO.
- Kent, R. and Poulton, C. 2008. *Marginal farmers, a review of the literature*. Retrieved from [https://www.concern.net/sites/default/files/resource/2009/04/3573-marginalfarmers\\_literature\\_review.pdf](https://www.concern.net/sites/default/files/resource/2009/04/3573-marginalfarmers_literature_review.pdf) [Accessed 4 June 2018].
- Kijima, Y., Matsumoto, T., and Yamano, T. 2006. Nonfarm employment, agricultural shocks, and poverty dynamics: Evidence from rural Uganda. *Agricultural Economics* 35(s3) 459–467.
- Klasen, S., Meyer, K.M., Dislich, C. et al. 2016. Economic and ecological trade-offs of agricultural specialization at different spatial scales. *Ecological Economics* 122: 111–120.
- Kleijn, D. Kohler, F., Báldi, A., Batáry, P. et al. 2009. On the relationship between farmland biodiversity and land-use intensity in Europe. *Proceedings of the Royal Society B: Biological Sciences* (2009) 276: 903–90.
- Koppmair, S., Kassie, and Qaim, M. 2017. Farm production, market access and dietary diversity in Malawi. *Public Health Nutrition* 20(2): 325–335.
- Kremen, C. and A. Miles. 2012. Ecosystem Services in Biologically Diversified versus Conventional Farming Systems: Benefits, Externalities, and Trade-Offs. *Ecology and Society* 17(4): 40.
- Kumar, N., Harris, J., and Rawat, R. 2015. If They Grow It, Will They Eat and Grow? Evidence from Zambia on Agricultural Diversity and Child Undernutrition. *The Journal of Development Studies* 51(8).
- Kumssa, A. and Jones, J.F. 2010. Climate change and human security in Africa. *International Journal of Sustainable Development & World Ecology*, 17(6): 453–461.
- Kurosaki, T. 2003. Specialization and diversification in agricultural transformation: The case of West Punjab, 1903–92. *American Journal of Agricultural Economics*, 85(2): 372–386.
- Kusonose, Y., Mason, N.M, and Tembo, S. 2016. *Do Crop Income Shocks Widen Disparities in Smallholder Agricultural Investments? Panel Survey Evidence from Zambia*. IAPRI Working Paper No. 116. Lusaka, Zambia: IAPRI.

- Kuteya, A.N., C. Lukama, A. Chapoto, and V. Malata. 2016. *Lessons Leant from the Implementation of the e-Voucher Pilot*. Indaba Agricultural Policy Research Institute Policy Brief No. 81. Lusaka, Zambia: IAPRI.
- Kuteya, A., N. Sitko, A. Chapoto, and E. Malawo. 2016. *An In-depth Analysis of Zambia's Agricultural Budget: Distribution Effects and Opportunity Costs*. IAPRI Working Paper No. 107. Lusaka, Zambia: IAPRI.
- Kyallo, F., Anselimo Makokha, A., and Mboganie Mwangi, A.M. 2013. Overweight and obesity among public and private primary school children in Nairobi, Kenya. *Health* 5(8A3): 85–90.
- Landis, D.A. 2017. Designing agricultural landscapes for biodiversity-based ecosystem services. *Basic and Applied Ecology* 18(February 2017): 1–12.
- Lanjouw, J.O. and Lanjouw, P. 2001. The rural non-farm sector: Issues and evidence from developing countries. *Agricultural Economics* 26(1): 1–23.
- Liebman, M., Halmers, M.J., Schulte, L.A., and Chase, C.A. 2013. Using biodiversity to link agricultural productivity with environmental quality: Results from three field experiments in Iowa. *Renewable Agriculture and Food Systems* 28(2): 115–128.
- Life Sciences Research Office. 1990. Core indicators of nutritional state for difficult-to-sample populations. *Journal of Nutrition* 120 (Suppl 1): 1559–600.
- Lin, B.B. 2011. Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *Bioscience* 61(3): 183–193.
- Loayza, J.R., Toure El Hadj, A., and Niane, A.F.N. 2018. *Senegal economic update: recent growth drivers in Senegal, and the role of agriculture in developing a resilient and inclusive economy*. Washington, D.C: World Bank Group.
- Loening, J., Rijkers, B., and Soderbom, M. 2008. *Nonfarm Microenterprise Performance and The Investment Climate: Evidence from Rural Ethiopia*. Policy Research Working Papers. World Bank.
- Lorenzo, P. and Tasciotti, L. 2014. Crop diversification, dietary diversity and agricultural income: empirical evidence from eight developing countries. *Canadian Journal of Development Studies (Revue canadienne d'études du développement)* 35(2): 211–227.
- Mabaya. E. 2016. Performance of the formal seed sector in Africa: Findings from the African Seed Access Index. Invited paper presented at the 5th International Conference of the African Association of Agricultural Economists, September 23-26, 2016, Addis Ababa, Ethiopia
- Mabiso, A., Cunguara, B. and Benfica, R. 2014. Food (In)security and its drivers: insights from trends and opportunities in rural Mozambique. *Food Security* 6(5): 649–670.
- MacNeil, M. 2017. "Why agricultural research investment lags in Africa south of the Sahara", IFPRI blog from 9 June 2017. [www.ifpri.org/blog/why-agricultural-research-investment-lags-africa-south-sahara](http://www.ifpri.org/blog/why-agricultural-research-investment-lags-africa-south-sahara) [Accessed 10 August 2018].
- Makate, C., Wang, R., Makate, M., and Mango, N. 2016. Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. *SpringerPlus* 5: 1135.
- Makombe, W. and Kropp, J.F. 2016. *The effects of Tanzanian maize export bans on producers' welfare and food security*. Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2016 AAEA Annual Meeting, Boston, MA, July 31 – August 2, 2016.
- Malapit, H.J.L., Kadiyala, S., Quisumbing, A.R., Cunningham, K. and Tyagi, P. 2015. Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal. *Journal of Development Studies* 51(8): 1097–123.

- Mammo, Y. 2015. ICTs in Linking Farmers to Markets: Innovative Mobile Applications and Lessons Learned from the Past and the Future. CTA Working Paper 15/11.
- Martimore, M. and Adams, W.M. 2001. Farmer adaptation, change and crisis in the Sahel." *Global Environmental Change*, 11: 49–57.
- Martin, S.M. and Lorenzen, K. 2016. Livelihood Diversification in Rural Laos. *World Development* 83: 231–243.
- Mason, N.M., Jayne T.S., and Mofya-Mukuka, R. 2013. *A Review of Zambia's Agricultural Input Subsidy Programs: Targeting, Impacts, and the Way Forward*. Working Paper No. 77. Lusaka, Zambia: IAPRI.
- Mason, N. M. and Myers, R. J. 2011. *The Effects of the Food Reserve Agency on Maize Market Prices in Zambia*. Food Security Collaborative Working Papers 120771, Michigan State University, Department of Agricultural, Food, and Resource Economics.
- Mason, M. N. and Jayne, T. S. 2009. *Staple Food Consumption Patterns in Urban Zambia: Results from the 2007/2008 Urban Consumption Survey*. Working Paper No. 42. Lusaka: Food Security Research.
- Mazunda, J., Kankwamba, H., and Pauw, K. 2015. "Food and nutrition security implications of crop diversification in Malawi's farm households." In *Mapping the linkages between agriculture, food security and nutrition in Malawi*. 44-49. Lilongwe, Malawi; and Washington, DC: IFPRI.
- McCarthy, N. and Sun, Y. 2009. Participation by Men and Women in Off-Farm Activities: an Empirical Analysis in Rural Northern Ghana. *Contributing Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009*, 1–36.
- McCullough, E. 2017. Labor productivity and employment gaps in Sub-Saharan Africa, *Food Policy* 67: 133–152.
- McElwee, G. and Bosworth, G. 2010. Exploring the Strategic Skills of Farmers Across a Typology of Farm Diversification Approaches. *Journal of Farm Management* 13(12): 819–838.
- McGuire, Shawn and Sperling, L. 2016. Seed systems smallholder farmers use. *Food Security* 8(1): 179–195.
- Meerman, J. 2017. *Challenges to secondary data analysis of agriculture nutrition links*. FAO Background paper to this report (unpublished, available upon request).
- Meier zu Selhausen, F. 2016. What Determines Women's Participation in Collective Action? Evidence from a Western Ugandan Coffee Cooperative. *Feminist Economics* 22(1): 130–157.
- Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being. General Synthesis: a report of the Millennium Ecosystem Assessment*. Washington, DC: Island Press.
- Mikulcak, F. 2011. *The Implications of Formal and Informal Institutions on the Conservation of On-Farm Trees: An analysis from the department of Mirriah, Republic of Niger*. Master thesis in Geography, Department of Human Geography, Stockholm University.
- Minten, B., Randrianarison, L., & Swinnen, J. F. M. 2009. Global Retail Chains and Poor Farmers: Evidence from Madagascar. *World Development*, 37(11): 1728–1741.
- Mirmiran P, Azadbakht L., and Azizia F. 2007. Dietary behaviour of Tehranian adolescents does not accord with their nutritional knowledge. *Public Health Nutrition* 10(9): 897–901.
- Mofya-Mukuka, R. and Hichaambwa, M. 2016. *Factors Influencing Smallholder Crop Diversification in Zambia and the Implications for Policy*. Working Paper No. 112. Lusaka, Zambia: IAPRI.

- Mofya-Mukuka, R. and C. Kuhlitz. 2016. Impact of Agricultural Diversification and Commercialization on Child Nutrition in Zambia: A Dose Response Analysis. *Journal of Agriculture Science* 8(4)
- Mortimore, M.J. and W.M. Adams. 2001. Farmer adaptation, change and 'crisis' in the Sahel. *Global Environmental Change* 11: 49–57.
- Motbainor, A., Worku, A., Kumie, A., Seligman, H., Laraia, B., Kushel, M., et al. 2016. Level and determinants of food insecurity in East and West Gojjam zones of Amhara Region, Ethiopia: a community based comparative cross-sectional study. *BMC Public Health* 16: 503.
- Mundlak, Y. 1978. On the Pooling of Time Series and Cross Section Data. *Econometrica* 46: 69–85.
- Murendo, C., Nhau, B., Mazvimavi, K., Khanye, T., and Gwara, S. 2018. Nutrition education, farm production diversity, and commercialization on household and individual dietary diversity in Zimbabwe. *Food and Nutrition Research* 62.
- Muhanji, G., Roothaert, R.L., Webo, C., and Mwangi, S. 2011. African indigenous vegetable enterprises and market access for small-scale farmers in East Africa. *International Journal of Agricultural Sustainability* 9(1): 194–202.
- Myers, R. J. 2006. On the costs of food price fluctuations in low-income countries. *Food Policy* 31(4): 288–301.
- NEPAD (New Partnership for Africa's Development). 2004. *NEPAD study to explore further options for food-security reserve systems in Africa*. <https://reliefweb.int/sites/reliefweb.int/files/resources/nepa-afr-30jun.pdf> [Accessed 24 May 2018].
- . 2013. Review of Agricultural Technical Vocational Education and Training (ATVET) in Africa – Best Practices from Benin, Ethiopia, Namibia and Sierra Leone. NEPAD Planning and Coordinating Agency (NPCA), CAADO Unit. Midrand, South Africa. Available at: <http://www.nepad.org/download/file/fid/6414%20>
- . 2014. Implementation Strategy and Roadmap to Achieve the 2025 Vision on CAADP. Operationalizing the 2014 Malabo Declaration on Accelerated African Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihood.
- Ng'ang'a, S.K., Bulte, E.H., Giller, K.E., McIntire, J.M., and Rufino, M.C. 2016a. Migration and self-protection against climate change: a case study of Samburu County, Kenya. *World Development* 84: 55–68.
- Ng'ang'a, S.K., Van Wijk, M.T., Rufino, M.C., and Giller, K.E. 2016b. Adaptation of agriculture to climate change in semi-arid Borena, Ethiopia. *Regional Environmental Change*. 16(8): 2317–2330.
- Ngugi I.K., Gitau R., Nyoro J. 2007. *Access to high value markets by smallholder farmers of African indigenous vegetables in Kenya: re-governing markets*. Innovative practice series. International Institute for Environment and Development: London.
- Nile Breweries. 2017. *How the launch of a new beer brand impacted a country*. <http://www.sab.co.za/prosper/how-the-launch-of-a-new-beer-brand-impacted-a-country/> [Accessed 28 May 2017].
- NSO (National Statistical Office). 2015. *Statistical Year Book, 2015*. Zomba, Malawi: NSO.
- Obalum, S. E., Buri, M. M., Nwite, J. C., Hermansah, Watanabe, Y., Igwe, C. A., and Wakatsuki, T. 2012. Soil Degradation-Induced Decline in Productivity of Sub-Saharan African Soils: The Prospects of Looking Downwards the Lowlands with the Sawah Ecotechnology. *Applied and Environmental Soil Science* 2012: 1–10.
- OECD (Organization for Economic Co-operation and Development)/UN (United Nations). 2011. *Economic diversification in Africa: a review of selected countries*. OECD Publishing.

- OECD/FAO. 2016. *OECD-FAO Agricultural Outlook 2016-2025*, OECD Publishing, Paris.
- OECD/UN ECLAC. 2012. *Latin American Economic Outlook 2013: SME Policies for Structural Change*, OECD Publishing: Paris.
- Okello, J.J., Narrod, C.A., Roy, D., Okello, J.J., Narrod, C., and Roy, D. 2007. *Food safety requirements in African green bean exports and their impact on small farmers*. IFPRI Discussion Paper 00737. Washington, DC: IFPRI.
- Omilola, B. and S. Kaniki. 2014. *Social Protection in Africa: A Review of Potential Contribution and Impact on Poverty Reduction*. United Nations Development Program (UNDP).
- Otitoju, G.T., Ene-Obong, H., and Otitoju, O. 2014. Macro and Micro Nutrient Composition of Some Indigenous Green Leafy Vegetables in South-East Zone Nigeria. *Journal of Food Processing & Technology* 5(11).
- Owusu, V., Abdulai, A., and Abdul-Rahman, S. 2011. Non-farm work and food security among farm households in Northern Ghana. *Food Policy* 36: 108–118.
- Papaioannou, K.J., De Haas, M., Bent, P., Van Besouw, B., Bulte, E. et al. 2014. *Climate shocks, cash crops and resilience: Evidence from colonial tropical Africa*. CGEH Working Paper Series 76. Centre for Global Economic History.
- Papke, L.E. and Wooldridge, J.M. 1996. Econometric methods for fractional response variables with an application to 401(k) plan participation rates. *Journal of Applied Econometrics* 11(6): 619–632.
- Papke, L.E. and Wooldridge, J.M. 2008. Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics* 145(1-2): 121.
- Paternostro, S., Dabalén, A., and Pierre, G. 2004. *The Returns to Participation in the Nonfarm Sector in Rural Rwanda*. Policy Research Working Paper 3462. Washington, DC: World Bank.
- Pegasys Institute and IWMI (International Water Management Institute). 2017. *Current challenges and good practices for water use authorization systems in Africa: Experiences from Malawi, Kenya, South Africa, Uganda and Zimbabwe*. Policy Brief 5/2017.
- Pell, A.N. 1999. Integrated crop–livestock management systems in sub-Saharan Africa. *Environment, Development and Sustainability* 1(3/4), 337–348.
- Pingali, P.L. and Rosegrant, M.W. 1995. Agricultural commercialization and diversification: processes and policies. *Food Policy* 20(3): 171–185.
- Place, F., Ajayi, O.C., Torquebiau, E., Detlefsen, G., Gauthier, M., and Buttoud, G. 2012. Improved policies for facilitating the adoption of agroforestry. In M. Kaonga, ed. *Agroforestry for biodiversity and ecosystem services: science and practice*, pp. 113–128. Rijeka, InTech.
- Pritchard, M. F. 2013. Land, power and peace: Tenure formalization, agricultural reform, and livelihood insecurity in rural Rwanda. *Land Use Policy*, 30(1): 186–196.
- Quandt, A., Neufeldt, H., and McCabe, J.T.. 2018. Building livelihood resilience: what role does agroforestry play? *Climate and Development*.
- Quiroz, J.A. and Valdés, A. 1995. Agricultural diversification and policy reform. *Food Policy* 20(3): 245–255.
- Quisumbing, A.R., Meinzen-Dick, R., Raney, T.L., Croppenstedt, A., Behrman, J.A., and Peterman, A. 2014. *Gender in agriculture*. Dordrecht: Springer Netherlands.
- Ragasa, C., Mazunda, J., and Kadzandira, J. 2016. *The impact of agricultural extension services in the context of a heavily subsidized input system: The case of Malawi*. IFPRI Discussion Paper 1498. Washington, D.C.: International Food Policy Research Institute (IFPRI).

- Ramirez-Villegas, J. and Thornton P.K. 2015. *Climate change impacts on African crop production*. Working Paper no. 119. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark.
- Rashid, S. 2013. Grain Reserves & Food Security Lessons from country case studies. Food Price Volatility and Food Security. Center For Development Research, University Of Bonn, Germany. 31 January 2013.
- Reardon, T. and Gulati, A. 2008. *The Supermarket Revolution in Developing Countries: Policies for "Competitiveness with Inclusiveness"*. International Food Policy Research Institute Policy Brief (Vol. 2).
- Reardon, T., Taylor, J. E., Stamoulis, K., and Lanjouw, P. 2000. Effects of Non-Farm Employment on Rural Income Inequality in Developing Countries: An Investment Perspective. *Journal of Agricultural Economics*, 51(2): 266–288.
- Reij, C. and Winterbottom, R. 2015. *Scaling up re-greening: six steps to success. A Practical Approach to Forest and Landscape Restoration*, World Resources Institute: Washington D.C.
- Reuters (2017), 'South Africa considers strategic grain reserve as possible El Nino looms', <https://af.reuters.com/article/topNews/idAFKBN17S0ZC-OZATP?sp=true> [Accessed March 2019]
- Rideout, K., Mah, C.L., and Minaker, L. 2015. Food Environments: An Introduction for Public Health Practice. National Collaborating Center for Environmental Health, Canada.
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., et al. 2009. A safe operating space for humanity. *Nature* 461: 472–475.
- Romeo, A., Meerman, J., Demeke, M., Scognamillo, A., and Asfaw, S. 2016. Linking farm diversification to household diet diversification: evidence from a sample of Kenyan ultra-poor farmers. *Food Security* 8(6): 1069–1085.
- Ruben, R. and Van Den Berg, M. 2001. Nonfarm employment and poverty alleviation of rural farm households in Honduras. *World Development*, 29(3): 549–560.
- Ruf, F. 2014. Cocoa combined with palm wine in Côte d'Ivoire. An unexpected resilience. *Bois et Forêts des Tropiques* (321): 33–44.
- Rufino, M.C., Thornton, P.K., Ng'ang'a, S.K., Mutie, I., Jones, P.G., van Wijk, M.T., and Herrero, M. 2013. Transitions in agro-pastoralist systems of East Africa: Impacts on food security and poverty. *Agriculture, Ecosystems & Environment* 179: 215–230.
- Salami, A., Kamara, A.B., and Brixiova, Z. 2010. Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities. African Development Bank Working Paper 105, April 2010.
- Sanogo, I. 2014. Do export restrictions affect food security and humanitarian food assistance in Africa? *Bridges Africa* 3(9). International Centre for Trade and Sustainable Development.
- Sæbø, A. and Mortensen, L. M. 1996. Growth, morphology and yield of wheat, barley and oats grown at elevated atmospheric [CO<sub>2</sub>] concentration in a cool, maritime climate. *Agriculture, Ecosystems & Environment*, 57(1): 9–15.
- Schippers R. R. 2000. African indigenous vegetables. An overview of the cultivated species. Natural Resources Institute/ACP-EU Technical Centre for Agricultural and Rural Cooperation, Chatham, UK.
- Sharma, Kiran K., S.M. Karuppanchetty, and S. Aravazhi. 2012. "Developing Entrepreneurs through an Agribusiness Incubator at ICRISAT." In *Agricultural Innovation Systems: An Investment Sourcebook*. Washington, DC: World Bank.

- Sibhatu, K.T, Krishna, V.V., and Qaim, M. 2015. Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academies of Sciences* 112 (34): 10657–10662.
- Sichoongo, K., L. Mapemba, G. Tembo, and Ng'ong'ola, D. 2014. The Determinants and Extent of Crop Diversification among Smallholders. A Case Study of Southern Province of Zambia. *Journal of Agricultural Science* 6(11): 150–159.
- Silvestri, S., Douxchamps, S., Kristjanson, P., Förch, W., Radeny, M., Mutie, I., et al. (2015). Households and food security: lessons from food secure households in East Africa. *Agriculture & Food Security* 4(1): 23.
- Singh, S., Singh, D.R., Singh, L.B., Chand, S., and Dam Roy, S. 2013. Indigenous vegetables for food and nutritional security in Andaman and Nicobar Islands, India. *International Journal of Food Science & Technology* 4(5): 503–512.
- Skole, D.I., Samek, J.H. Chomentowski, W, and Smalligan, M. 2013. Forests, carbon, and the global environment: new directions in research. In D.G. Brown, D.T. Robinson, N.H.F. French, B.C. Reed (Eds.), *Land Use and the Carbon Cycle Advances in Integrated Science, Management, and Policy*, Cambridge University Press, USA. pp. 505–522.
- Svensden, M., Ewing, M., and Msangi, S. 2009. *Measuring irrigation performance in Africa*. IFPRI Discussion Paper 894.
- Swinburn, B., Sacks, G., Vandevijvere, S., Kumanyika, S., Lobstein et al. 2013. INFORMAS (International Network for Food and Obesity / non-communicable diseases Research, Monitoring and Action Support): overview and key principles. *Obesity Reviews* 14, suppl. 2.
- Swindale, A. and Bilinsky, P. 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Washington, D.C.: FHI 360/FANTA.
- Tanner, T., Lewis, D., Wrathall, D., et al. 2015. Livelihood resilience in the face of climate change. *Nature Climate Change* 5: 23–26.
- TARahaat. 2007. *Specialised Farming*. [http://www.tarahaat.com/Types\\_Specialized.aspx](http://www.tarahaat.com/Types_Specialized.aspx) [accessed 3 September 2017].
- Taylor, E. J., Zezza, A. and Gurkan, A.A. 2009. *Rural Poverty and Markets*. ESA Working Paper No. 09-05. FAO: Rome, Italy. <http://www.fao.org/3/a-ak424e.pdf> [Accessed 10 June 2017].
- TEEB (The Economics of Ecosystems and Biodiversity). 2015. *Towards a Global Study on the Economics of Eco-Agri-Food Systems*. [http://doc.teebweb.org/wp-content/uploads/2013/08/Towards-TEEBAgFood\\_15May2015.pdf](http://doc.teebweb.org/wp-content/uploads/2013/08/Towards-TEEBAgFood_15May2015.pdf) [Accessed 13 August 2017].
- Thangataa, P.H. and Hildebrand., P.E. 2012. Carbon stock and sequestration potential of agroforestry systems in smallholder agroecosystems of sub-Saharan Africa: mechanisms for 'reducing emissions from deforestation and forest degradation' (REDD+). *Agriculture, Ecosystems & Environment* 158: 172–183.
- Thornton, P.K. and Herrero, M. 2014. Climate change adaptation in mixed crop-livestock systems in developing countries. *Global Food Security* 3(2): 99–107.
- Thornton, P. and Lipper, L. 2013. *How does climate change alter agricultural strategies to support food security?* Background paper for the conference "Food Security Futures: Research Priorities for the 21st Century", 11-12 April 2013, Dublin. [http://pim.cgiar.org/files/2013/03/ClimateChangeAndFoodSecurity\\_PrioritiesForPublicResearch.pdf](http://pim.cgiar.org/files/2013/03/ClimateChangeAndFoodSecurity_PrioritiesForPublicResearch.pdf) [Accessed 21 May 2018].

- Timmer, C.P. 1997. Farmers and markets: The political economy of new paradigms. *American Journal of Agricultural Economics*, 79(2): 621.
- Tsiboe, F., Zereyesus, Y.A., and Osei, E. 2016. Non-farm work, food poverty, and nutrient availability in northern Ghana. *Journal of Rural Studies* 47(Part A): 97–107.
- Twine, W. 2013. Multiple strategies for resilient livelihoods in communal areas of South Africa. *African Journal of Range & Forage Science* 30(1-2): 39–43.
- UNU-IAS (United Nations University - Institute for the Advanced Study of Sustainability), Bioversity International, IGES (Institute for Global Environmental Strategies), and UNDP (United Nations Development Program). 2014. *Toolkit for the Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes (SEPLS)*.
- van Campenhout, B. 2017. Designing gender sensitive agricultural extension information campaigns, Available at [www.ifpri.org/blog/designing-gender-sensitive-agricultural-extension-information-campaigns](http://www.ifpri.org/blog/designing-gender-sensitive-agricultural-extension-information-campaigns)
- Verduzco-Gallo, I., O. Ecker, and K. Pauw. 2014. *Changes in Food and Nutrition Security in Malawi Analysis of Recent Survey Evidence*. Malawi Strategy Support Program Working Paper No. 6. Lilongwe, Malawi: IFPRI.
- Von Braun, J. 1995. Agricultural commercialization: impacts on income and nutrition and implications for policy. *Food Policy* 20: 187–202.
- Waddington, H., & Sabates-Wheeler, R. 2003. *How does poverty affect migration choice? A review of the literature*. Development Research Centre on Migration, Globalisation and Poverty.
- Waha, K., van Wijk, M.T., Fritz, S., See, L., Thornton, P.K., Wichern, J., and Herrero, M. 2018. Agricultural diversification as an important strategy for achieving food security in Africa. *Global Change Biology* 24: 3390–3400.
- Walker, K. and Hofstetter, S. 2016. *Study on Agricultural Technical and Vocational Education and Training (ATVET) in Developing Countries*. Swiss Agency for Development and Cooperation (SDC): Berne, Switzerland.
- Walker, B.H. and Salt, D. 2012. *Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function*. Washington, DC: Island Press.
- Weatherspoon, D.D. and Reardon, T. 2003. The Rise of Supermarkets in Africa: Implications for Agrifood Systems and the Rural Poor. *Development Policy Review* 21(3): 333–355.
- Weir, S. 1999. The effects of education on farmer productivity in rural Ethiopia. CSAE Working Paper Series 1999-07. Centre for the Study of African Economies: University of Oxford.
- Weiss, C.R. and Briglauer, W. 2000. *Determinants and Dynamics of Farm Diversification*. Working paper EWP 0002. Department of Food Economics and Consumption Studies, University of Kiel, Germany.
- Whitehead, A. 2009. The gendered impacts of liberalization policies on African agricultural economies and rural livelihoods. In Razavi, S. (ed.) *The gendered impacts of liberalization: towards “embedded” liberalism?* UN Research Institute for Social Development, Routledge: New York.
- WHO (World Health Organization). 2014. *Global nutrition targets 2025*. Policy brief. [http://www.who.int/nutrition/publications/global\\_targets\\_2025\\_policybrief\\_overview/en/](http://www.who.int/nutrition/publications/global_targets_2025_policybrief_overview/en/)
- Whyte, M. A., & Kyaddondo, D. 2006. We are not eating our own food here: Food security and the cash economy in eastern Uganda. *Land Degradation and Development*, 17(2): 173–182.

- Winterbottom, R., Reij, C., Garrity, D., Glover, J., Hellums, D., McGahuey, M., and Scherr, S. 2013. *Improving Land and Water Management: Creating a Sustainable Food Future, Installment Four*. World Resources Institute: Washington, D.C.
- World Bank. 2007. *Fertilizer Use in African Agriculture Lessons Learned and Good Practice Guidelines*
- . 2008. *World Development Report 2008: Agriculture for Development*. Washington, DC: World Bank.
- . 2011. *Practitioners' Toolkit for Agricultural Public Expenditure*. Washington, DC: World Bank.
- . 2013. *Growing. Africa. Unlocking the Potential of Agribusiness*. Washington, DC: World Bank.
- . 2013. *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*. Washington, DC: World Bank.
- . 2014. *An Analysis of Issues Shaping Africa's Economic Future*. Washington, DC: World Bank
- . 2015. *Are African farmers increasingly diversifying their incomes? Summary of findings from the report 'Agriculture in Africa: Telling Myths from Facts'* <http://www.worldbank.org/en/programs/africa-myths-and-facts/publication/are-african-farmers-increasingly-diversifying-their-incomes> [Accessed 5 November 17].
- . 2016a. *Emerging Stronger: Malawi Economic Monitor*. Washington, DC: World Bank.
- . 2017. *Enabling the Business of Agriculture 2017*. Washington, DC: World Bank.
- . 2017a. *Zambia Economic Brief, June 2017: Reaping Richer Returns from Public Expenditures in Agriculture*. Washington, DC: World Bank.
- . 2017b. *Harnessing the Urban Economy: Malawi Economic Monitor*. Washington, DC: World Bank.
- . 2018. *Republic of Zambia Systematic Country Diagnostic*. Report No. 124032-ZM. Washington, DC: World Bank.
- . 2018a. *Closing the Potential-Performance Divide in Ugandan Agriculture*. Washington, DC: World Bank.
- . 2018b. *World Development Indicators*. <https://data.worldbank.org/indicator/> [Accessed 28.5.2018].
- Xianchun, Z and Zhuoran, S. 2012. The Research Review of Land-Use and Land-Management Problems in the Joint of Urban and Rural Area for the Last Two Decades. International Conference on Future Energy, Environment, and Materials. *Energy Procedia* 16 (Part A): 353–358.
- You, L.Z. 2008. *Irrigation investment Needs in Sub-Saharan Africa. Africa infrastructure country diagnostic background paper no. 9*. Washington, DC: World Bank.



# Endnotes

- a. Economies of scale are defined as the advantage of large-scale production that results in lower costs per unit of output. There is a distinction between internal economies of scale and external economies of scale. Internal economies of scale are cost advantages due to conditions inside the production unit (e.g., the farm or the firm), while external economies of scale are cost advantages from greater production of a sector or region, or even an entire economy (Klasen et al. 2016).
1. Data on share of GDP from OECD/FAO (2016); data on agriculture employment for 2017 from the World Bank (2018b), modeled on ILO estimate, available at: <https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ZG> [accessed 28.5.2018].
2. Data from USDA, available at: <https://www.ers.usda.gov/data-products/international-agricultural-productivity.aspx> [accessed 28.5.2018].
3. Ihab et al. (2015) and FAO et al. (2018), for instance, note that the relationship between household food insecurity and nutritional status of adults is variable and differs between regions. To this end, PRODIVA refers to nutrition in the sense of nutritional diversity (rather than status), and underlines the importance of context.
4. UNU-IAS, Bioversity International, IGES, and UNDP (2014) provides a good overview of agro-diversity and its implications.
5. Ecosystem services are commonly understood as the benefits people obtain, directly or indirectly, from ecosystem functions, structures, and processes (Millennium Ecosystem Assessment 2005). Ecosystem functions, in turn, are the capacity of natural processes to provide goods and services that satisfy human needs (De Groot et al. 2002).
6. Geiger et al. (2010) and Kleijn et al. (2009) provide a comprehensive discussion of land use intensification and its impacts on biodiversity.
7. The study focused on productivity and market linkages for high value commodities such as coffee, cocoa, beef, dairy, sesame, nuts and fish.
8. However, it is important to note that improved income may not always lead to improved nutrition. This is the case, for example, when households lack nutritional awareness, when nutritious foods are unavailable, or where households lack equitable decision-making power on how household income will be spent.
9. Specialization also leads to higher economic gains in case farmers possess specific skills that can help them achieve efficiency in their farm production.
10. Gillespie and Kadiyala (2005) also show that improved income from agricultural specialization is associated with improved resilience due to better health, especially of those affected by diseases such as AIDS.
11. The leaves of *Telfairia occidentalis* are used to prevent diseases like diabetes and anemia or to enhance lactation in pregnant women.
12. Off-farm income and on-farm production are often complementary mechanisms that households can use to improve nutrition and resilience. For example, Babatunde (2012) shows that in Ethiopia, Ghana, Kenya, and Senegal off-farm income often complements agricultural production.
13. In reality, farmers face numerous internal and external constraints that will largely determine their success. The AGRA (2017) Africa Agriculture Status Report develops

this argument neatly: "...many smallholder farmers are simply not going to succeed as commercial farms in today's food systems. Some smallholders have opportunities to diversify into more remunerative non-farm activities, and hence may be less interested in commercial farming, while others are constrained from being more successful as farmers by poor access to markets, or because they live in areas with low agricultural potential. Yet others are constrained by insufficient personal assets and capabilities to become successful entrepreneurs in either farming or non-farm activity."

14. The dynamic interplay and mutual relationship between human activity such as land use decisions and the consequent stream of ecosystem services (or disservices such as pests) for human wellbeing can be considered a human-environment or social-ecological system.
15. However, due to the limited availability of data on erosion-induced losses in crop yield in SSA—despite the high levels of soil erosion leading to land degradation—it is difficult to establish a reliable cause-and-effect relationship between soil losses and productivity (Obalum et al. 2012).
16. In many cases physical structures have been promoted as a means to reduce environmental degradation (e.g., stone bunds, check dams), while a large emphasis has been placed on increasing mineral fertilizer application to enhance soil nutrient content for agricultural production, but uptake rates have remained comparably low (FAO 2016b). General agreement is that increasing fertilizer application without proper land management is insufficient to meet Africa's productivity targets (ibid.) and sustainable land management and land rehabilitation need to be bolstered by the incorporation of biological measures and livelihood related activities (GIZ 2015). Land degradation has therefore been a key driver of sustainable land management programmes in countries such as Ethiopia, where biological measures and climate-smart practices that promote diversification are often incorporated with broader natural resources management. Practices promoted in such initiatives include intercropping, rotations, agroforestry, fruit production and beekeeping.
17. For example, clay soils are generally well suited for rice due to their high water retention, while sandy soils are better suited for vegetable production due to their good drainage (Dou et al. 2016).
18. As indicated in the report's section on impacts of diversification and specialization, on-farm agricultural diversification can improve the overall efficiency of the farm and capture new sources of income (Pell 1999). For example, alongside the provision of manure, livestock can be used to convert low-value crops to a high-value protein that can potentially increase farm returns.
19. However, on-farm productive diversification remains a priority choice when agroecological conditions are favourable and urban integration is low. Where biophysical conditions are less favourable, such as in Malawi or Niger, households may see to diversify into off-farm activities (Davis et al. 2014).
20. In some cases, households tend to be pulled into off-farm diversification, especially if the returns are higher or less risky than on-farm alternatives—resulting in a "demand pull" to off-farm diversification, as opposed to a "distress push" when households are forced to engage in off-farm activities for lack of better alternative. Although both the "demand pull" and "distress-push" factors are recognized as important drivers, many studies assume that "distress-push" effects, such as shrinking per capita land availability, are major reasons for off-farm diversification, including migration (Kijima et al. 2006). Push or pull factors may play out differently based on the local context and may also occur simultaneously.
21. For example, in high rainfall environments, enabling diversification through subsidies has shown limited results, particularly for households with small land sizes (FAO 2016).

22. Keeping multiple species of livestock also serves as an insurance mechanism. For example, during periods when shocks such as droughts occur, households often lose more cattle compared to sheep, goats, and camel. Households are able to use income realized from some of their remaining goat and sheep stocks to restock cattle when pasture availability improves.
23. This holds particularly true for rural youth, who according to the African Development Bank (2016) often do not have the skills that match available jobs. The AfDB youth employment strategy highlights the need to create new microenterprises in high priority value chains, equipping high skilled youth to launch large-scale agribusinesses, and providing the human capital for Africa's agro-industrialization.
24. Literacy increases the potential to obtain paid employment or to generate income through self-employment using skills learned in school, thereby diversifying income sources. Literacy also increases the interest of taking up new challenges—for example, launching a new business—as a result of learning new skills or due to the need for understanding where one's personal strength is.
25. The offer of food in schools is also key. If, for example, a child is offered a limited food choice within a school, especially if the options are limited to unhealthy foods, he/she will not be able to use his/her knowledge to choose appropriately.
26. Contract farming is also of interest to processors because it tends to guarantee the supply, and thereby maximizing the utilization of their processing capacity.
27. However, for contract farming to function well, farmers often need to comply with higher standards for high-value products, as these are required to enter into agreements with buyers (e.g., supermarkets or large traders). Competition among contractors (or the buyers) in the market is a key precondition for the systems to work.
28. Background papers are available which present further details about the quantitative country analysis for Zambia and Malawi as well as for the qualitative analysis for Malawi.
29. Household food access is defined as the "ability to acquire sufficient quality and quantity of food to meet all household members' nutritional requirements for productive lives" (Bilinsky and Swindale 2010:1), where food availability is a critical component of the food environment. Both MAHFP and HDDS are internationally recognized to influence household food security, which is considered a necessary (but not sufficient) condition for achieving nutrition security (FAO 2009). MAHFP is a measure of household food security that can be used to assess changes in year-round food availability. It includes specific questions on each of the twelve months of the year, providing a detailed picture of how seasonality and other shocks affect perceived household food security over the course of a year. HDDSs are calculated by summing equally-weighted response data on the consumption of 12 food groups (cereal grain staples; roots and tubers; vegetables; fruits; meat; eggs; fish; pulses and nuts; dairy products; oils and fats; sugar; and condiments) by the family over a given recall period (either 7 days or 24 hours), with higher numbers of food groups consumed associated with better household access to calories (Hoddinott and Yohannes 2002; Kennedy et al. 2010). The MAHFP and HDDS were used as the measures of nutrition outcomes in the study, both as a proportion of the possible maximum measured in the data sources used. Both measures had values of 0-1 with 1 representing maximum HDDS and no month recorded without adequate food.
30. Data from World Development Indicators [accessed 21 June 2018].
31. For example, the African Union Heads of State Initiative 'The Comprehensive Africa Agriculture Development Programme' (CAADP), the Southern African Development Community (SADC), Common Market for Eastern and Southern Africa (COMESA) and the 'Maputo Declaration on Agriculture and Food Security in Africa'.
32. As reported by Kuteya and others (2016), an evaluation of the 2015 / 16 pilot project in the

13 districts showed that 85 percent of the recipients obtained maize seed and fertilizer while 15 percent obtained other inputs. The same study also notes that there were variations across the provinces with 10 percent of the recipients in the livestock dominant areas obtaining veterinary related inputs.

33. AER I is the driest with a rainfall of 600 mm/year, while AER IIb received 600-800 mm/year, AER IIa 800-1,000 mm/year and AER III 1,000-1500 mm/year.
34. This case was selected for its distinctive model to promote livelihoods diversification, household nutrition and resilience (conservation technologies), comprising a holistic comprehensive livelihoods approach to agriculture, consumption and improved household wellbeing for smallholder farmers. SAFI curricula comprise a one-year intensive training programme through various modules, covering aspects such as improved diversification farming technologies, integrated farming systems (crop, horticulture, livestock, tree planting), food processing, marketing/commercialisation, nutrition, food budgeting, household planning and budgeting, sanitation, energy use, income-generating activity (IGA) development.
35. The meaning of agricultural diversification used during fieldwork and analysis was, to a degree, a reduced, simplified concept, geared to facilitate dialogue with farmers during fieldwork exchanges. The term comprised as appropriate: crops, horticulture, livestock and tree planting/production, along with income-generating activities. Diversification was to be understood as a 'relative' concept, that is, production understood as more or less diversified, as exclusively specialized agriculture among smallholders in Malawi is not practiced. Further, improved conservation practices were typically integral to people's perceptions and understanding of diversification.
36. Ecosystem management practices include identifying and undertaking measures that enhance biological functions underpinning production, e.g., integrated crop-livestock-fisheries systems based on nutrient recycling among farm components (livestock manure may fertilize fish ponds, pond sediments fertilize crops and crop co-products feed livestock; or managing a diversity of varieties of the same crop to ensure resilience and improved nutrition) (Source: <http://www.fao.org/ecosystem-services-biodiversity/practices/en/> [Accessed 25 June 2018]).
37. The findings concur with those of Jayne et al. (2010). Given that the GoM is likely to continue operating in maize markets, there are several guidelines that might improve overall market performance and the following recommendations are reiterated: (i) Follow clearly-defined and transparent rules for triggering government intervention and decrease trade regulations (eliminate maize export bans, import tariff rates) to reduce disincentives for the private sector to engage in the maize market. (ii) Institute a forum for regular consultation and coordination between the private and public sectors to manage the potential need for maize imports and exports.
38. Appendix B explains the selection criteria and methodology of the analysis, and provides a brief overview of key economic parameters for the ten countries included.
39. The selected countries have agreed to, signed and/or ratified various regional and global agreements related to agriculture, food security, nutrition and resilience which have various clauses or statements related to the need for agricultural diversification; most countries have also included these into national strategies. At the African continental level, three strategies stand out: the Malabo Declaration (2014), the African Union Agenda 2063, and the Comprehensive African Agricultural Development Program (CAADP). All emphasize the need to diversify agriculture both horizontally and vertically. For instance, CAADP states that "...increased agricultural production, efficiency and diversification are central to the economic growth" and calls for diversification—both vertical and horizontal—and intensification of agricultural production, as well as value addition and creation of new on- and off-farm employment opportunities. At the global level, the importance of agricultural biodiversity is most notably highlighted by the reasoning

supporting the United Nations Sustainable Development Goal 2 ('Zero hunger'): "...[b]etter use of agricultural biodiversity can contribute to more nutritious diets, enhanced livelihoods for farming communities and more resilient and sustainable farming systems."

40. Africa Fertilizer is a joint initiative of the International Fertilizer Development Center (IFDC), the UN Food and Agriculture Organization (FAO), the International Fertilizer Association (IFA) and the African Union Commission (AUC) to facilitate exchange of information about soil fertility, fertilizers and good agricultural practices in Africa.
41. For example, voucher schemes usually allow for a greater diversity of inputs which in the long term leads to greater resilience.
42. An excellent example of an indicator and exit strategy component is an increase in farmers' knowledge and appreciation of the diverse range of agricultural inputs available and the diverse range of crops which can be grown on their farms with benefits for food security, nutrition, soil health and overall farm efficiency. Other indicators that could be used in monitoring the success of AISPs include improvements in soil fertility, increase in number of agro-dealers, improvements in the range of crop and livestock products grown in a given location, as well as the nutrition indicators, among others.
43. However, the longer an AISP is in place, the higher the risks of diversion, capture and inefficiency—these pose major political and financial challenges (Danida 2011).
44. A study on the effects of market distance on farmer crop and technology choices found that as distance to markets increases, home consumption of fruits and vegetables increases and sales to markets reduce, and that beyond a specific distance, vegetable production may cease entirely (Buckmaster 2012); this is in line with country studies on Zambia and Malawi presented in the previous chapter. While home consumption of fruits and vegetables may be good for nutritional diversity, it does not bear well for household incomes and distance to markets may ultimately prove a disincentive for diversification, meaning households will continue to apportion more land to cereals than to other crops.
45. Comparable evidence suggests that less than 30 percent of agricultural produce in Africa is processed, compared to 98 percent in high-income countries (World Bank 2015).
46. The fact that energy must be of sufficient strength to allow for the production, processing and storage of a wide variety of agricultural commodities is a further difficulty.
47. Although various donor-funded energy-related projects have been implemented across some of the countries studied (including use of decentralized micro hydro and solar projects) the sustainability of such projects and their integration into national rural electrification agency plans needs to be well elaborated.
48. Tied output-credit or 'interlinked credit' arrangements involve an output buyer or input seller advancing the farmer cash for inputs or inputs in kind at the start of the season, and being reimbursed from the farmer's harvest.
49. Phytosanitary requirements are defined as laws, decrees, or ordinances enacted to protect human, animal or plant life or health for purposes of transparency in access of domestic and international markets is the first indicator for market access. Under international trade agreements, each WTO Member is required to: notify, draft and adopt SPS measures; identify and designate a single central government authority to be responsible for the notification requirements of the SPS Agreement; publish all SPS measures; and establish an enquiry point responsible for answering queries from other WTO Members about its SPS measures and related issues.
50. However, many countries do not have strategic food reserves or strategic food reserve agencies and rely on market mechanisms to ensure availability of staple foods.
51. The members of the Southern African Development Community (SADC) have started

discussing plans for a regional strategic food reserve. With no agreement yet on the modality of such a regional food reserve, indications could be for a mix of physical, cash and possibly even stock market reserves if consensus is to be reached. The impacts of such regional food reserve on the crops and livestock which farmers produce and the prices they have not yet been evaluated.

52. Split into five categories: (i) Research and Development; (ii) Industry Competitiveness; (iii) Seed Policy and Regulations; (iv) Institutional Support; and (v) Service to Smallholder Farmers.
53. Farmer surveys were conducted by CIAT in the course of developing 31 county climate risk profiles for Kenyan counties to guide climate-smart agriculture investments and priorities at sub national level in Kenya. CIAT developed the profiles in partnership with the Kenya Ministry of Agriculture, Livestock and Fisheries (MALF) and as part of the Kenya Climate-Smart Agriculture Project (KCSAP) supported by the World Bank, and the Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL) project, supported by a grant from the Global Environmental Facility (GEF)/ Special Climate Change Fund (SCCF). The profiles are available here: <https://ccafs.cgiar.org/publications/kenya-county-climate-risk-profiles> (last accessed in March 2019)
54. <https://ccafs.cgiar.org/publications/kenya-county-climate-risk-profiles>
55. In the literature, extension systems are regarded as top-down approaches to information and technology transfer, while the term “advisory” is used to denote a participatory approach to such services. This study uses these terms as they are reported in the literature.
56. Refers to advisory/extension systems that are accountable at local levels, rather than national.
57. Farmer field schools (FFS) are among the most common emerging non-formal extension models.
58. Other agricultural financing opportunities for agricultural enterprises could include equity investments and angel investments, which may also be combined with mentorship, training and business development.
59. The activities within incubators can focus on different agricultural commodities, as well as different parts of the value chain including inputs provision (e.g., seeds and seedlings), production, storage, processing, packaging, transportation and sales.
60. 700 m according to Ericsson: <http://www.nta.ng/news/infrastructure/20171208-sub-saharan-africa-mobile-phone-subscriptions-to-hit-990m-by-2023/> And 444 million by GSMA: <https://www.gsma.com/newsroom/press-release/more-than-half-of-sub-saharan-africa-to-be-connected-to-mobile-by-2025-finds-new-gsma-study/>
61. Network coverage is another hindrance to the spread of ICT. It has been recommended that various mobile phone service providers work out arrangements to share transmission masts for better access and faster spread ICT (World Bank 2016).
62. These include: FarmDrive in Kenya, an enterprise that connects unbanked and underserved smallholder farmers to credit, while helping financial institutions cost-effectively increase their agricultural loan portfolios; M-Farm, also in Kenya, and AgoSpaces in Cameroon, both of which provide pricing data to remove price asymmetry between farmers and buyers, making it possible for farmers to earn more; Ghana-based Farmerline and AgroCenta who deploy mobile and web technologies that bring farming advice, weather forecasts, market information, and financial tips to farmers, who are traditionally out of reach, due to barriers in connectivity, literacy, or language; and Sokopepe which uses SMS and web tools to offer market information and farm record management services to farmers (Ekekwe 2017). Others are: Mobile banking app M-Birr in Ethiopia which reaches around 2 million people; Market access

app Esoko in Ghana which is available in 14 Sub-Saharan African countries; DrumNet, KACE and I-cow, Farmer helpline in Kenya which reaches several value chain actors, provides end-to-end solutions for 4,000 households; E-farming app in Kenya which provides text messages; E-vouchers in Malawi which supports farm input distribution an reaches 16,000 households; manobi in Senegal provides fishing data and reaches up to 2,000 households (Yared Mammo 2015).

63. The full title is 'Voluntary Guidelines on the responsible Governance of tenure of land, fisheries and forests in the Context of national food security'.
64. <http://www.plaas.org.za/blog/world-bank-conference-questions-large-scale-land-based-investments>
65. Loate, Lesego and Ruth Hall. 2013. "Can large-scale land-based investments foster food security?" PLAAS (Institute for Poverty, Land and Agrarian Studies), 3 December. <http://www.plaas.org.za/blog/can-large-scale-land-based-investments-foster-food-security> [accessed 25.05.2018].
66. These alternative investments include contract farming and out-grower schemes, share cropping and joint ventures between farmers, government and the private sector (AU, ECA and AfDB 2013). These could improve agricultural productivity, stimulate local markets, encourage agricultural diversification with impacts on local food security and nutrition along with various multiplier effects.
67. Land conflicts are common and recurring in relation to land with valuable resources such as minerals (notably oil, diamonds, gold, and other precious metals and minerals), ecologically suitable land (with good soils, water sources, densely forested), and with high potential for crop production, and well-developed infrastructure developments (communication, dams, irrigation) (Alden Wily 2011).
68. The Malabo Declaration commits African governments to use agriculture as a strategy to eradicate malnutrition in all its facets specifically calling for governments to "improve nutritional status, and in particular, the elimination of child under-nutrition in Africa with a view to bringing down stunting to 10% and underweight to 5% by 2025". The Malabo Implementation Strategy and Roadmap (2014) reiterates that nutrition provides a vital foundation for meeting full potential development of an individual.
69. Some of the emerging institutional settings rely on high level government involvement, for example the Office of the Prime Minister in Senegal, the Deputy Prime Minister in Ethiopia and the National Development Planning Commission in Ghana. These arrangements also incorporate civil society, professional organizations, research institutions, faith-based organizations and UN agencies.



# Appendix A: Definitions

**Commercialization** refers to the production of food or cash crops and livestock largely for sale in the market and not for own consumption, with the main motive being profit.

**Ecosystem services** are defined as the benefits provided by ecosystems to humans. Many key ecosystem services provided by biodiversity, such as nutrient cycling, pest regulation and pollination, sustain agricultural productivity.

**Food environments** are composed of the physical presence or availability of food—through well-developed local value chains or through regional or international trade—, a person’s proximity or access to local markets or food stores; whether different food items are affordable, and to what extent they are culturally and socially acceptable (Swinburn et al. 2013; GLOPAN 2016; FAO 2016c). This in turn very much depends on the food systems that feed into and shape a particular food environment. It can be thought of as the physical interface between the consumer and the food system. Herforth and Ahmed (2015) describe food environments as the range of foods which are available, affordable, convenient and desirable to people in a given context. Broadly speaking, there are four areas of the food system that influence the availability, affordability and desirability of food: agricultural production; food storage, transport and trade; food transformation; and food retail and provisioning (GLOPAN 2016). Understanding and, if needed, changing the food environment therefore means understanding and acting upon the food supply systems that underpin it.

**Food systems** include the entire range of activities, processes, people and institutions involved in the production, processing, marketing, consumption and disposal of food.

**Malnutrition** refers to an abnormal physiological condition caused by deficiencies, excesses or imbalances in energy and/or nutrients necessary for an active, healthy life. The term encompasses undernutrition, overnutrition and micronutrient deficiencies. Overnutrition is a result of excessive food intake relative to dietary nutrient requirements. Undernutrition, that is, too little food intake relative to nutrient requirements, can manifest in the form of acute malnutrition or wasting (low weight for height), chronic malnutrition or stunting (low height for age) and

underweight (low weight for age). Both over- and undernutrition can be associated with micronutrient deficiencies (shortage of minerals or vitamins) (FAO 2014).

**Nutrition** is the intake of macro and micro-nutrients in relation to the body's dietary needs. Continuous intake of inadequate food quantities needed to meet dietary energy requirements, poor absorption and/ or poor biological use of nutrients consumed results in undernutrition, whereas excessive intake of foods rich in dietary energy requirements (overnutrition) results in overweight and/ or obesity. Both under and overnutrition are challenges facing populations in developing countries (IFPRI 2016), including Africa.

**Off-farm diversification** refers to the establishment of alternative activities that are non-farm with the aim of tackling agriculture-related risks and to ensure a steady income (Eshetu and Mekonnen 2016). Examples include: business activities and professional work in sectors such as security, construction, transport, etc. (Gasson 1988).

**On-farm productive diversification** refers to the shift from the dominance of one crop or livestock type to the production of a wider range of agricultural commodities in a farm, community or region, to meet the ever-increasing demand for food (Asante et al. 2018). In other words, productive diversification is the change that enables farmers to concentrate on areas of agriculture that comprises of producing a variety of plants and rearing new breeds of livestock, and adopting a farming practice to directly or indirectly provide their food (Joshi et al. 2007). Agricultural diversification can be used as an income increasing strategy, a farm efficiency strategy and more so in the context of weather variability, climate hazards, pests, diseases and market uncertainties; as an adaptation, risk minimization and resilience strategy.

**Overweight** (and obesity) are defined as abnormal or excessive fat accumulation that may impair health. It is normally calculated based on weight to height ratio in both children and adults. This form of malnutrition results from expending too few calories for the amount consumed from food and drinks and increases the risk of non-communicable diseases later in life.

**Resilience.** There is no standard definition of resilience. Definitions of resilience tend to center on the ability of systems and its components, which entails people or assets, to anticipate, respond, and recover from stresses or hazardous events in

a way that maintains, if not improves, essential system structures and functions (e.g. Walker and Salt 2012). Resilient communities or systems hence possess three specific capacities, namely (1) the ability to prepare for or prevent negative impacts of hazards (coping or absorptive capacity); (2) the ability to adjust, modify or change characteristics and actions to moderate potential future impacts from hazards (adaptive capacity); and (3) the ability to create a fundamentally new system to avoid negative impacts from hazards (transformative capacity) (e.g. de Weijer and McCandless 2015).

**Simpson's Diversity Index** is a measure of diversity which considers the number of species present, as well as the relative abundance of each species. As crop or livestock species richness and evenness increase, so increases diversity. In this report, the Simpson Diversity Index is primarily calculated based on area coverage (or weight in the case of animals), but in some cases is also calculated on the basis of economic value of production for the sake of comparison.

**Specialized farming** is defined as concentration on only a few enterprises in which farmers have acquired special knowledge in order to gain a greater degree of production efficiency within the overall system. It refers to instances where farmers focus on one or a few farm activities or commodities such as growing specific food or cash crop or rearing specific type of livestock (i.e., sheep, goats, pig or dairy cattle), with the aim of achieving greater economic gain as a result of improved efficiency.

**Stunting** refers to a child who is too short for his or her age. Stunting is the failure to grow both physically and cognitively, and is the result of chronic or recurrent malnutrition.

**Subsistence agriculture** refers to the growing and production of agricultural crops and livestock by the farmer largely for own consumption, rather than for sale in the market.

**Vertical value chain diversification** refers to the upstream activities associated with a particular crop and/or livestock. It starts from primary production of farm products through processing, storage, transportation, distribution and finally to the finished products. Vertical diversification therefore gives more emphasis to intra and inter-sector linkages (that is, farmers, the marketing and manufacturing unit) (FAO 2003).

**Wasting** refers to a low weight for height—generally the result of weight loss associated with a recent period of inadequate caloric intake and/or disease. In children under five years of age, wasting is defined as weight-for-height less than -2 standard deviations below the WHO Child Growth Standards median.

# Appendix B: Methodology

The report employs quantitative and qualitative approaches.

## LITERATURE REVIEW (Chapters 2, 3, and 5)

**Chapter 2, 3, and 5 on impacts, drivers and policies are based on extensive, systematic literature review of both academic and grey literature.** The review focused on the topics agricultural diversification, nutrition, resilience, and policy, and was centered, though not exclusively, around 10 countries in Sub-Saharan Africa, namely: Senegal, Ghana, Nigeria, Democratic Republic of Congo (DRC), Ethiopia, Kenya, Rwanda, Madagascar, South Africa, and Mozambique. Examples and studies of diversification-related policies, impacts and drivers from countries other than the 10 focus countries were also included as necessary to ensure comprehensive coverage of the subject of the report.

### **The country selection was informed by seven criteria:**

1. Availability of literature on research topics based on specific keywords, used to determine the availability of information to inform the report. Countries with existing literature on the selected research areas were selected over those which lacked literature.
2. The total population of a country was used to ensure favorable representation of sub-Saharan Africa's population. To achieve this, the ten focus countries combined had to represent over 50 percent of the total population of Sub-Saharan Africa.
3. The Simpson's Diversity Index (SDI) indicates the degree of diversification in agricultural production value and area covered by specific crops at the national level. It was used to select a mix of both highly diversified and undiversified (specialized) countries for comparison. The SDI was calculated based on area coverage (or weight in the case of animals) and on the economic value of production.
4. The Economist's global food security indicator was used to select countries with moderate to high food security based on food availability, affordability, quality, and safety.
5. Global hunger and food vulnerability indices were used to select countries with moderate to high food hunger and food vulnerability.

6. To ensure regional balance, countries were selected from the four regions in Sub-Saharan Africa: West Africa, Eastern Africa, Southern Africa and Central Africa. Language was applied as a factor of selection to ensure equal representation of anglophone, francophone, and lusophone countries.
7. Countries with a mix of different policy frameworks and contexts were selected to contrast different agricultural development and food security policies and their impacts on resilience and nutrition.

An initial assessment of the available literature was performed in Scopus. The literature review aimed to find information regarding drivers and policies of agricultural diversification, nutrition, and resilience. While links exist, the topics are not always linked to one another. An initial assessment of the literature available was performed in Scopus to develop a query using the key words agricultural diversification, nutrition, resilience and policy, as well as other search terms that emerged. Other search engines used for the study included the following:

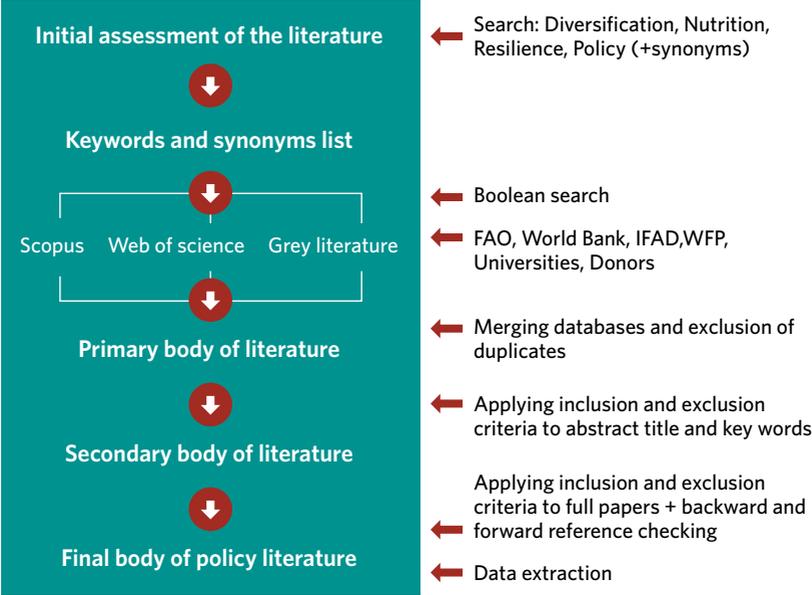
- Web of Science (WoS)
- World Bank Open Knowledge Repository
- CGIAR Space
- IFPRI
- Africa Portal
- EBSCO host Academic Search
- Science Direct
- FAO
- AGRIS
- EU
- DFID
- IFAD
- WFP
- USAID
- World Bank Documents and Reports

A stepwise search method was applied, first using key words and then countries of ex-ante interest, and then policy. To identify relevant literature and minimize the exclusion of relevant information, the reference lists of key studies were also searched and reviewed. The “forwards citation” utility in Google scholar was also applied to find papers that cited these studies. The reference lists of documents previously reviewed were used as an entry point for identification of further relevant literature on the same subject.

The data collection process is depicted schematically in Figure A.1. First, an initial assessment was performed in Scopus to develop a query using the key words Specializ\*, Specialis\*, Nutrition\*, Resilien\*, Africa\* Agricultur\*, Policy\*, Commercialization\*, and On-Farm\* /Off-Farm\*. Grey literature was retrieved

by searching Google scholar and the websites of a host of organizations including the International Food Policy Research Institute (IFPRI), the Food and Agriculture Organization (FAO), the World Food Program (WFP), the International Fund for Agricultural Development (IFAD), the World Bank, and World Health Organization (WHO) that were selected based on Google Scholar search using the key words listed above.

**Figure A.1** Literature review methodology



**QUANTITATIVE ANALYSES: ZAMBIA AND MALAWI (Chapter 4)**

In addition to the 10 countries, Zambia and Malawi, which have strong input subsidy programs, were selected for in-depth quantitative and qualitative analyses. The analyses are presented in Chapter 4. Detailed background papers are available for both quantitative analyses.

**Data and variables**

**For the quantitative analyses, longitudinal data are used.** For Zambia, the case study is based on the Rural Agricultural Livelihood Survey (RALS), collected by

the Indaba Agricultural Policy Research Institute (IAPRI), in collaboration with the Zambian Central Statistical Office (CSO), and the Ministry of Agriculture and Ministry of Livestock and Fisheries. RALS is a nationally representative rural farm household panel data. Data was collected in 2012 covering the 2010/11 agricultural season and targeting 8,090 households, and in 2015 covering the 2013/14 agricultural season. Of the panel households, 7,254 were re-interviewed. The attrition rate of 17.9 percent was mainly attributed to households that had moved out of the study area. For Malawi, the analysis uses the Integrated Household Panel Survey (IHPS), a nationwide representative longitudinal survey with data collected in 2010 and 2013. Urban households were removed from the sample before the analysis, leaving 2,387 and 2,947 rural based households in 2010 and 2013 respectively.

**To measure the level of diversification, the Simpson's Diversity Index (SDI) is calculated.** The SDI has been used in several studies to measure the level of diversification (e.g., Mofya-Mukuka and Hichaambwa 2016; Aslan et al. 2016). More diversified households have a higher SDI. The SDI is 0, if a household has only one source of income, thus complete specialization. The index is computed as follows:  $D_k = 1 - \sum_{(i=1)}^N P_{i,k}^2$ . Where,  $D_k$  is the SDI for economic unit  $k$ ;  $P_{i,k}$  the share of the total gross income from economic activity  $i$  for household  $k$ ;  $N$  is the number of economic activities, and  $\sum_{(i=1)}^N P_{i,k}^2 = 1$ . The SDI was calculated as follows:

- **Crop Production Diversification Index** is calculated using the proportion of area planted of each field crop including cereals, roots and tubers, industrial cash crops, pulses, fruits, and vegetables.
- **Crop Income Diversification Index** is calculated using the gross value of all field crops including cereals, roots and tubers, industrial cash crops, pulses, fruits, and vegetables.
- **Agricultural Income Diversification Index** is calculated by adding gross value of livestock income, which included income from cattle and small livestock, to the gross value of crop income.
- **Livelihood Diversification Index** is calculated by summing gross farm/agricultural income and income from remittances, formal and informal employment, and businesses.

**To examine the causal effects of agricultural diversification on nutrition security, two nutrition indicators are used:** Months of Adequate Household

Food Provisions (MAHFP) and Household Dietary Diversity Score (HDDS). Both were calculated as proportion of the possible maximum measured in the data set and have values between 0-1, with 1 representing maximum HDDS and no month recorded without adequate food.

- **Months of Adequate Household Food Provisions (MAHFP)** is a measure of household food security that can be used to assess changes in year-round food availability. It includes specific questions for each of the twelve months of the year, providing a detailed picture of how seasonality and other shocks affect perceived household food security over the course of a year.
- **Household Dietary Diversity Score (HDDS)** is calculated by summing equally-weighted response data on the consumption of 12 food groups (cereal grain staples, roots and tubers, vegetables, fruits, meat, eggs, fish, pulses and nuts, dairy products, oils and fats, sugar, and condiments) by the family over a given recall period (either 7 days or 24 hours), with higher numbers of food groups consumed when household have better access to calories (Hoddinott and Yohannes 2002; Kennedy et al. 2010).

**To approximate household resilience, a range of variables is used.** There are variations between Zambia and Malawi, due to the use of different household survey datasets and availability of variables. The indicators are measured as a ratio of the possible maximum outcome value, resulting in indices with values between 0 and 1:

- Household food production as measured by the value of food crops harvested by the household, available for Zambia and Malawi.
- Household income from all farm and non-farm activities, available for Zambia and Malawi.
- Value of household productive assets (value of livestock and farm implements) based on 2015 prices is available for Zambia.
- The amount of food stocks is available for Malawi.
- To measure agroecosystem resilience the Soil Quality Index and Canopy Greenness Index are used for the analysis for Malawi. The Soil Quality Index is calculated as an average of the values assigned to nutrient availability, nutrient retention availability, rooting conditions, oxygen availability to roots, excess salts, toxicity and workability, obtained from the Harmonized World Soil Database v1.2.<sup>1</sup> The Canopy Greenness Index represents the

total change in greenness (integral of daily Enhanced Vegetation Index, EVI, values) within primary growing season, averaged by district. The dataset was available upon request from MODIS Land Cover Group at Boston University. The EVI is one of the vegetative indices that are used to measure the presence of green vegetation on land, hence the extent to which the ecosystem/natural environment is maintained in a preserved state. It has a practical range of 0 (no vegetation) to 1 (maximum cover).

## Empirical model

**To overcome the shortcomings of both fixed and random effects estimators, correlated random effects (CRE) are applied.** To evaluate the determinants of diversification using the longitudinal data, at first a fixed effects model is used:

$$Y_{it} = \alpha_i + X_{it}\beta + \mu_{it} \quad (1)$$

Where the variable  $\alpha_i$  captures all the household unobserved, time-constant factors that affect  $Y_{it}$ . The underlying assumption in the fixed effects specification is the existence of correlation between independent variables and unobserved heterogeneity. If the unobserved heterogeneity is uncorrelated with any of the explanatory variables in all time periods, then estimating equation (1) using fixed effect is not efficient. This calls for the estimation of the random effects model, specified as follows:

$$Y_{it} = \beta_0 + X_{it}\beta + \varepsilon_{it} \quad (2)$$

Where  $\varepsilon_{it} = \alpha_i + \mu_{it}$ . Even though the random effects specification allows the inclusion of time-constant variables, the assumption that the fixed effect factor is uncorrelated with the explanatory variables is often not plausible. Similar to Muyanga et al. (2010), we overcome the shortcomings of both fixed and random effects estimators by using the correlated random effects (CRE) or the Mundlak-Chamberlain device proposed by Mundlak (1978) and Chamberlain (1984), where we include time average variables for all time variant explanatory variables. Using the CRE,  $\varepsilon_i$  is modelled as follows:

$$\varepsilon_i = \delta + \bar{X}_i + \tau_i, \quad \tau_i | \sim N(0, \sigma_\tau^2) \quad (3)$$

Where  $X_i$  represents the time-averaged  $X_{it}$  over the various panel periods. This model allows to control for unobserved time-constant heterogeneity as with fixed effects as well as measure the effects of time-invariant independent variables. However, the CRE estimator requires the model to have a standard normal distribution, and strict exogeneity conditional on  $\alpha_i$ .

**Since the dependent variables are fractions with values from 0 to 1, fractional response models were used**, as developed by Papke and Wooldridge (1996) with Correlated Random Effects (CRE). They applied the method of quasi-maximum likelihood estimation (QMLE) to obtain robust estimators of the conditional mean parameters with satisfactory efficiency properties. The CRE were utilised in the analysis of the panel data in order to control for unobserved heterogeneity by including time averages of all the explanatory variables in the model. Using CRE we preferred the fractional probit over the logit as recommended by Papke and Wooldridge (2008). As right-hand side, explaining variables, we use available variables in the datasets representing human, physical, natural, financial, and social capital of the Sustainable Livelihoods Approach as well as environmental conditions as represented by climatic factors such as rainfall, location of households and access to markets and other services.

## QUALITATIVE STUDY: MALAWI (Chapter 4)

**A qualitative study was conducted in several districts in Malawi to analyze and gain an in-depth understanding of drivers and impacts of diversification.** The qualitative study applies a mixed-methods analysis and a triangulation of methods, including focus group discussions (FGDs), key informant interviews (KIIs), in-depth household case studies, and participatory tools (such as the “motivational and driving forces matrix” and the “gender-based seasonal calendar, decision-making and division of labor tool” and visual tools were used to obtain views, experiences, perceptions and opinions of main areas of enquiry for the report). Intensive daily team debriefings were conducted after each day’s fieldwork, facilitating in-depth systematic review of findings to capture key conclusions.

**The sampling strategy for the study was purposive—focus areas of the qualitative study included two study sites in two agriculturally diverse districts.** In Lilongwe district the study focused in the Mpingu and Malingunde extension planning area, where the project School of Agriculture for Family

Independence (SAFI) operates. This initiative promotes a diversified livelihood approach, including diversified production systems through farmer field schools. The second site was identified in nearby Dedza district, characterized by highly diversified production.

### **Endnotes**

1. Harmonized World Soil Database v 1.2: <http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/> [Accessed in March 2019]

# Appendix C: Regression Results of Determinants of Diversification—Zambia and Malawi

Tables C.1 and C.2 present the regression results for the analysis: what drives diversification in Zambia and Malawi, respectively. The drivers of diversification are clustered according to the Sustainable Livelihood Assets Framework: Human capital, physical and natural capital, financial capital and market access, and policy environment. The analysis for Zambia includes an additional category: environmental and biophysical effects. The results are presented in a simplified form in Chapter 4. Detailed background papers, developed by IAPRI, are available for both quantitative analyses.

## ZAMBIA

**Table C.1** Zambia—Determinants different types of diversification

Drivers of Diversification	Types of Diversification			
	Crop Production	Crop Income	Agriculture Income	Livelihood
	Coefficients	Coefficients	Coefficients	Coefficients
<b>HUMAN CAPITAL</b>				
=1 if female headed household	-0.0091	-0.0079	-0.0031	0.0111
Age of household head	-0.0007	-0.0008	-0.0003	0.0008
Level of education household head in years	0.0016	0.0018	0.0007	-0.0025
Household full time adult equivalents	0.0052*	0.0002	0.0025	0.0024
<b>PHYSICAL AND NATURAL CAPITAL</b>				
=1 if household received crop diversification related extension advice	0.0128*	0.0139**	0.0112*	0.0126**
Productive assets (Log value, lagged)	0.0074**	0.0042		
Farm size	0.0055***	0.0024*	0.0036***	0.0027**
Tropical Livestock Units	0.0015**	0.0007		
=1 if household used minimum tillage	0.0378***	0.0006	-0.0111	-0.0071

=1 if some household field in wetland	0.0161	0.0178*	0.0147*	0.0118
=1 if household irrigates some fields	0.0073	0.0600***	0.0433***	0.0412***
<b>FINANCIAL CAPITAL AND MARKET ACCESS</b>				
Number of loans obtained by household	0.0523***	0.0398***	0.0337***	0.0326***
Hours to nearest urban center with at least 500,000 inhabitants	0.0056***	0.0006*	0.0003	-0.0002
=1 if head/spouse related to the village authorities	0.0132	-0.0005	-0.0006	0.0072
=1 if any member belongs to economic group	0.0152	0.0217**	0.0193***	0.0150**
<b>POLICY ENVIRONMENT</b>				
Total district farmer FISP fertilizer receipts (log value, lagged)	-0.0024	0.0011	-0.0009	-0.0011
FRA district maize purchases (log value, lagged)	-0.0098***	-0.0103***	-0.0035	-0.0005
<b>ENVIRONMENTAL CONDITION</b>				
Expected moisture stress (# of 20-day periods with <40mm rain)	-0.0397***	0.0420***	-0.0541***	-0.0246***
Agroecological zones, base=Zone I				
Agroecological zones, IIA	0.0001	0.0396***	0.0238***	0.0158*
Agroecological zones, IIB	0.0700***	-0.0055	-0.0214*	-0.0308**
Agroecological zones, III	0.0336**	0.0243*	0.0168	-0.0139
Number of observations	14,501	14,501	14,501	14,501

Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ ; the level of statistical significance of coefficients increases with the number of (\*). For agroecological zone IIA, IIB and III the coefficients present the incremental effect compared to agroecological zone I.

## MALAWI

**Table C.2** Malawi—Determinants of different types of diversification

Drivers of Diversification	Types of Diversification		
	Crop Income	Agriculture Income	Livelihood
	Coefficients	Coefficients	Coefficients
<b>HUMAN CAPITAL</b>			
=1 if household is female headed	0.0289***	0.0294***	0.0372***
Age of household head	0.0001	0.0004	0.0004*
Adult equivalents	0.0003	0.0021	0.0032
=1 if trained in sustainable agriculture in the past	0.0232**	0.0241**	0.0231**

FINANCIAL CAPITAL AND MARKET ACCESS			
Number of FISP vouchers received	0.0164*	0.0185**	0.0211***
Number of FISP vouchers received squared	-0.0031*	-0.0032**	-0.0034**
=1 if household participation in cereal markets (lagged value)	-0.0185	-0.0172	-0.0241**
=1 if household participation in legume markets (lagged value)	0.0585***	0.0535***	0.0473***
=1 if household participation horticultural markets (lagged value)	-0.0186	-0.0152	-0.0067
=1 if household participation in industrial cash crop markets season (lagged value)	-0.0559***	-0.0611***	-0.0691***
NATURAL AND PHYSICAL CAPITAL			
Farm assets (log value)	0.0063*	0.0142***	0.0168***
Farm size in hectare	0.0341***	0.0220**	-0.0016
Farm size in hectare (squared value)	-0.0061***	-0.0050***	-0.0022*
=1 if keeps livestock	0.0030	0.0204**	0.0208***
=1 if household cultivated in dry season	0.0082	0.0097	0.0214**
=1 if household irrigated in rain season	0.0440*	0.0462*	0.0486*
POLICY ENVIRONMENT			
ADMARC maize price (MK/MT) (lagged value)	-0.0012*	-0.0011*	-0.0017***
Distance to nearest ADMARC center (log value)	0.0215***	0.0198***	0.0185***
Distance to auction floor (log value)	0.2501***	0.2279**	0.2630***
Distance to auction floor squared (log value)	-0.0371***	-0.0339***	-0.0379***
Distance to Boma of residence (log value)	-0.0065	-0.0011	0.0031
<b>Number of observations</b>	<b>4,704</b>	<b>4,755</b>	<b>4,931</b>

Source: IAPRI, estimations are based on Malawi Integrated Household Panel Survey, 2010 and 2013

Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ ; the level of statistical significance of coefficients increases with the number of (\*).



# Appendix D: Impacts of Diversification on Food Security and Resilience Outcomes

## IMPACTS OF DIVERSIFICATION ON FOOD SECURITY OUTCOMES IN ZAMBIA

**Empirical analysis of impact of diversification on resilience and food security outcomes is potentially problematic due to endogeneity problems because of reverse causality as demonstrated in the conceptual framework.** Arslan et al. (2016) note that household diversification outcomes are the results of actions taken in response to vulnerability of income and consumption under imperfect market conditions and risk aversion. Thus, to assess the impact of diversification simple bivariate relationships are presented. Table D.1 shows bivariate relationships between the type and level of diversification, HDDS, and Months of Inadequate Food Provisions (MIHFP), respectively.

**The analysis shows largely a positive relationship between diversification and improved food and nutrition security in Zambia (Table D.1).** The average value of MIHFP reduces as diversification of all types increases. This relationship shows a positive effect of diversification of household food provisions. The average MIHFP is 3.13 among the households which are highly diversified in crop income sources compared to 3.8 among poorly diversified households. For HDDS, the results show no apparent relationship between crop production and agricultural income diversification and HDDS, but reveal a positive relationship between crop income and livelihood diversification and HDDS. The average HDDS among households which are highly diversified in crop income sources is 7.11 compared to 6.60 among poorly diversified households. Households which are highly diversified in livelihood activities have an HDDS of 7.04 compared to 6.73 of the least diversified households. This is likely due to increased income from crop sales and other livelihood strategies allowing household to purchase more diversified foods.

**Table D.1** Bivariate Relationship between different types of diversification, as measured by the Simpson’s Diversity Index, and HDDS and MIHFP

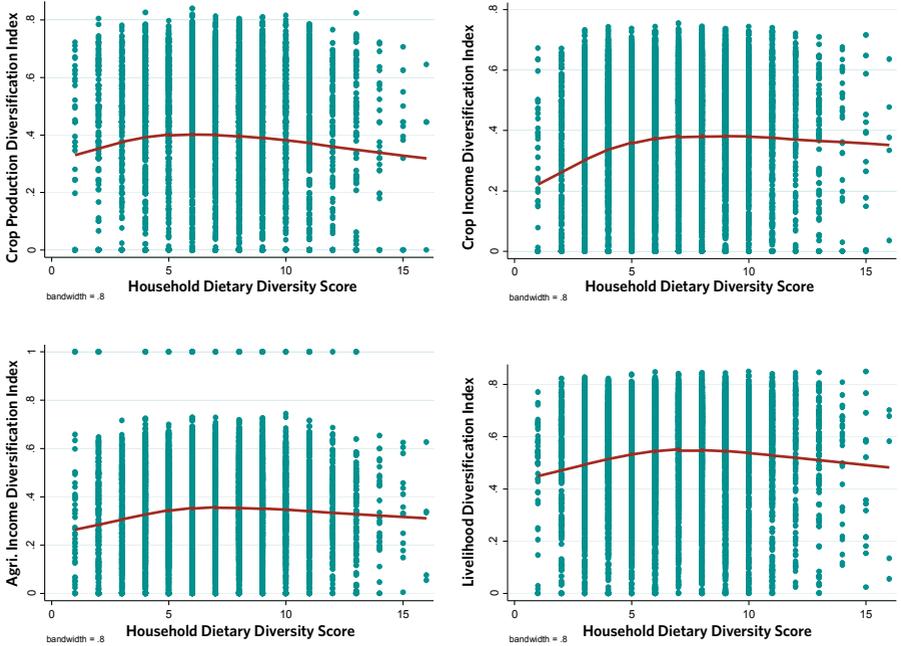
Type and level of diversification		Household dietary diversity score (HDDS) Mean	Months of Inadequate household food provisions (MIHFP) Mean
<b>Crop Production Diversification Index</b>	Low (<0.3)	7.01	3.64
	Medium (0.3-0.6)	6.71	3.46
	High (>0.6)	6.91	3.24
<b>Crop Income Diversification Index</b>	Low (<0.3)	6.60	3.80
	Medium (0.3-0.6)	6.87	3.42
	High (>0.6)	7.11	3.13
<b>Agricultural Income Diversification Index</b>	Low (<0.3)	6.64	3.77
	Medium (0.3-0.6)	7.05	3.33
	High (>0.6)	6.90	3.22
<b>Livelihood Diversification</b>	Low (<0.3)	6.73	3.77
	Medium (0.3-0.6)	6.82	3.41
	High (>0.6)	7.04	3.16

Source: IAPRI, computations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

**The trend relationships between the type and level of diversification and HDDS shows a non-linear relationship (Figure D.1).** The results show a non-linear relationship between diversification of all kinds and HDDS: At low levels of diversification, the impact of diversification is positive which tends to diminish as HDDS increases. The effect reaches an optimal level of about 0.4 SID for crop production, crop income and agriculture income. The optimal effect is about 0.6 for livelihood diversification. The impact of diversification on higher levels of HDDS appears negative for all types of diversification. After a threshold, increasing the level of diversification reduces the HDDS.

**Household diversification is expected to reduce hunger incidences in a household because it provides alternatives foods and income sources to rely on in times of low food provisions.** Figure D.2 confirms this hypothesis as the number of months of inadequate food provision decreases with increasing diversification. These results are higher for agricultural diversification, indicating that increased alternative income from agriculture sales provides households with alternative income to purchase more foods.

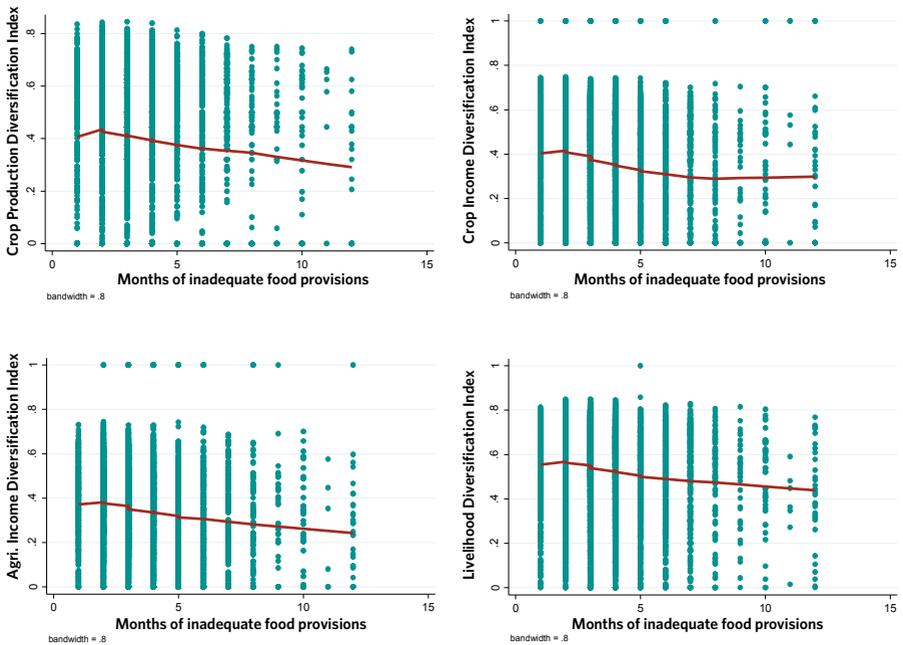
**Figure D.1** Relationship between all types of diversification and HDDS



Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: Lowess smoother was applied: a locally weighted regression to provide locally weighted scatterplot smoothing

**Figure D.2** Effect of diversification on number months of *inadequate* food provisions



Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: Lowess smoother was applied: a locally weighted regression to provide locally weighted scatterplot smoothing

**There are a range of other factors that enhance food and nutrition security.**

The analysis also assesses the relationship between other factors and food and nutrition security. Several other factors are important such as access to markets, kinship ties, membership in economic groups, level of education of the household head, and the amount of livestock owned. In addition, living in high rainfall areas, such as agroecological zone IIA and III in Zambia, helps households achieving food security compared to households living in dry areas such as agroecological zone I. The results also show a general positive impact of agroecological conditions on food security. Households in the high rainfall areas in agroecological zones III and IIA are more likely to eat diversified diets and experience fewer months of hunger compared to those in drier agroecological zones IIB and I. On the other hand, receiving FISP and selling maize through FRA appears to have no significant effect on HDDS and have a negative impact on MAHFP. Household shocks such as number of chronically ill adults increase the

number of months of hunger. Additionally, being a female-headed household and reduces the probability of improving food security.

## IMPACTS OF DIVERSIFICATION ON RESILIENCE IN ZAMBIA

**Resilience outcomes tend to be higher with increasing levels of diversification.**

Table D.2 summarises the relationship between the level and type of diversification on key resilience indicators: total household income, value of assets, and food production measured by the value of food crops produced by the household. The resilience outcomes are measured as a ratio of the possible maximum outcome value, resulting in values between 0 and 1. The results show that more diversified households, in terms of agriculture and livelihood diversification, have high mean household income. The relationship between productive assets and diversification tends to be negative, that is, higher levels of diversification seem to correspond with lower mean values of productive assets, except livelihood diversification. Mean food production tends to increase with increasing crop production and livelihood diversification.

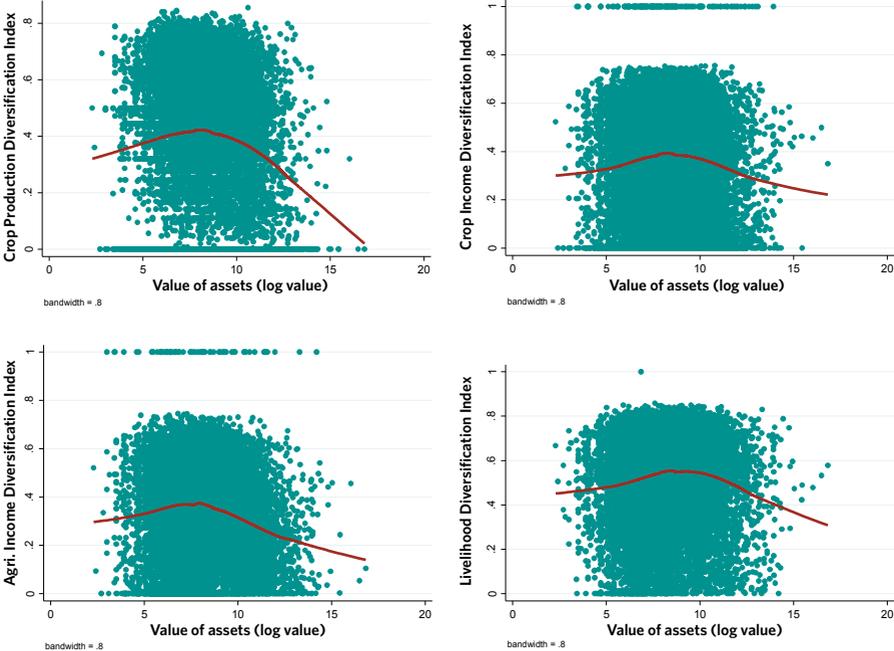
**Table D.2** Bivariate relationship between diversification and resilience Indicators: Income, Assets, and Food Production

Type of Diversification	Level of Diversification	Mean Resilience		
		Income	Value of assets	Food production
<b>Crop Production Diversification Index</b>	Low (<0.3)	0.45	0.46	0.53
	Medium (0.3-0.6)	0.47	0.46	0.60
	High (>0.6)	0.45	0.45	0.64
<b>Crop Income Index</b>	Low (<0.3)	0.45	0.46	0.57
	Medium (0.3-0.6)	0.46	0.46	0.61
	High (>0.6)	0.45	0.46	0.56
<b>Agricultural Income Index</b>	Low (<0.3)	0.46	0.47	0.56
	Medium (0.3-0.6)	0.45	0.45	0.61
	High (>0.6)	0.44	0.43	0.57
<b>Livelihood Index</b>	Low (<0.3)	0.47	0.45	0.52
	Medium (0.3-0.6)	0.46	0.45	0.59
	High (>0.6)	0.45	0.47	0.60

Source: Rural Agricultural Livelihoods Survey 2012 and 2015 and authors' estimations

**The relationship between resilience indicators and different types of diversification appears non-linear.** Relationships between resilience indicators and different types of diversification are presented in Figures D.3, D.4, and D.5. Figure D.3 presents the analysis results of the impact of diversification on asset endowment. The results show a non-linear relationship between wealth status measured by value of productive assets of a household and all types of diversification. The trend shows gradual increase in assets with increased diversification up to around 0.4 Simpson’s Diversity Index, and then a decline. The results show that beyond a certain level of wealth, the impact of diversification on enhancing the value of assets is negative.

**Figure D.3** Relation between different types of diversification and household wealth status (measured as value of assets)



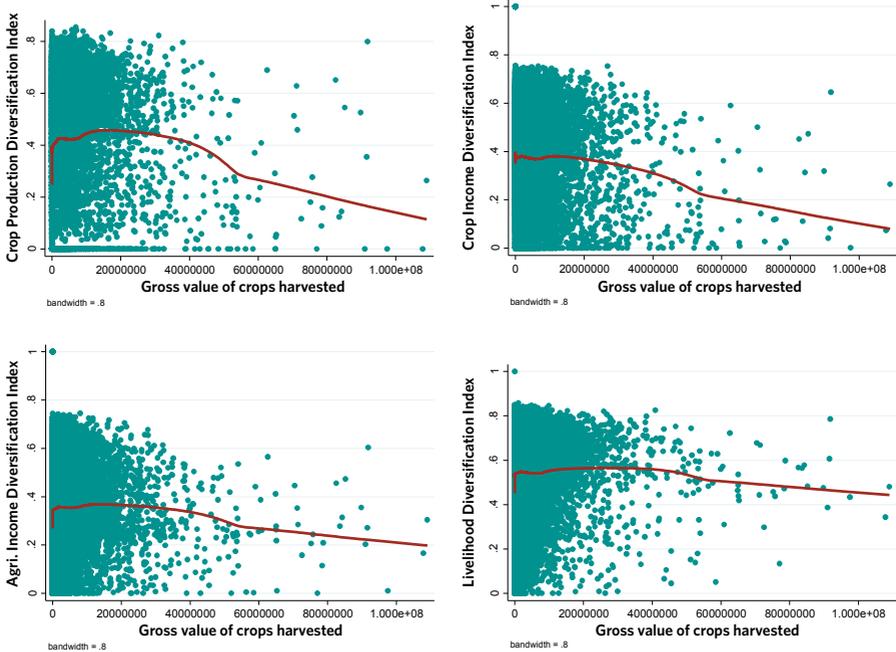
Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: Lowess smoother was applied: a locally weighted regression to provide locally weighted scatterplot smoothing

**The relationship between diversification and food production appears non-linear.** Figure D.4 shows the impact of diversification on food production

measured by total harvest of all food crops. The results show a non-linear relationship between diversification and food production. At lower levels of food production, diversification appears to have a positive effect but results in a declining effect as food production increases. This impact is more pronounced for crop production and crop income diversification compared to the impact of agriculture diversification and livelihood diversification.

**Figure D.4** Relations between different types of diversification and household food production (measured as value of crops harvested)



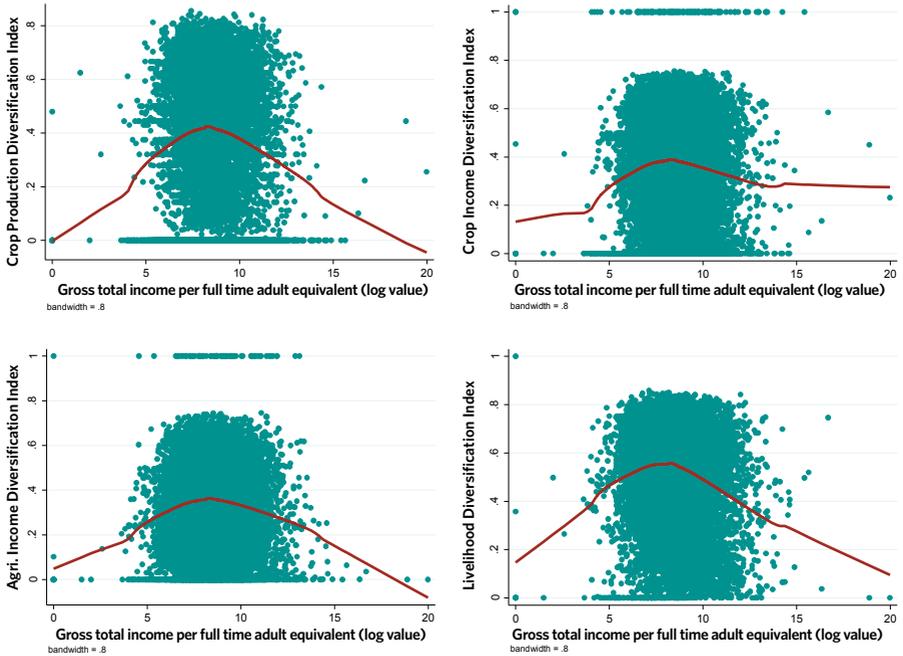
Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: Lowess smoother was applied: a locally weighted regression to provide locally weighted scatterplot smoothing

**The relationship between diversification and household income appears non-linear.** Figure D.5 shows the impact of diversification on household income measured by all on-farm and off-farm activities. The results are similar to the results of impact on HDDS showing an optimal impact level of an SDI value of around 0.4 for crop production, crop income, and agricultural income diversification. For livelihood diversification, the impact on household income

is highest around a value of SDI of 0.6. At higher levels of income, increasing diversification reduces the probability of increasing household income.

**Figure D.5** Relation between of different types of diversification and household income



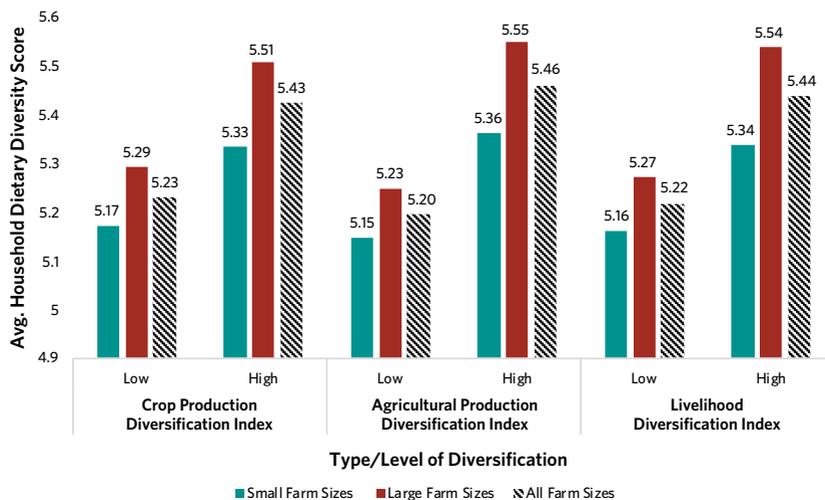
Source: IAPRI, estimations are based on Rural Agricultural Livelihoods Survey 2012 and 2015

Note: Lowess smoother was applied: a locally weighted regression to provide locally weighted scatterplot smoothing

**A range of other factors are known to impact household resilience, which is confirmed by the analysis.** Demographic factors that have significant impact on resilience are gender of the household head, which has a negative impact on all measures of resilience; age has a negative impact on food production diversification, and full time adult equivalent has a positive impact. Other social economic factors important for household resilience to shocks are: number of hours to the nearest urban centre, where fewer hours to the nearest urban centre relate to higher likelihood of increasing household asset base, food production and total household income. Kinship ties to the village headman has positive impact on assets. FRA prices have a negative effect on resilience and receiving FISP has a negative effect on increasing household income.

## IMPACTS OF DIVERSIFICATION ON NUTRITION IN MALAWI

**Figure D.6** Relationship between diversification and average Household Dietary Diversity Score by farm size category



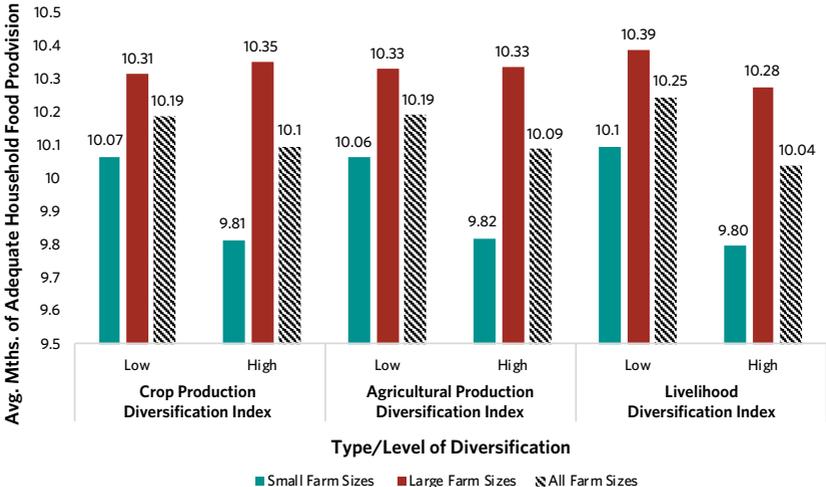
Source: IAPRI, computations are based on Malawi Integrated Household Panel Survey, 2010 and 2013

Notes: “Low” and “High” refer to low and high levels of diversification. The label “Small farm size” and “Large farm size” is based on a household ranking by farm size. Small farms are part of the bottom 50% of households and large farms part of the top 50% of households. “All farm sizes” refers to all households.

**To examine the impact of diversification on households, the values of HDDS, MAHFP and resilience indices are compared for households with high and low diversification indices.** Predicted values of diversification indices are used to rank households according to their diversification levels, and group them into two equal groups, with low and high diversification indices. The resulting groups are used to compare the average values of the HDDS, MAHFP, and resilience indices, and identify trends. In Figure D.6 households are differentiated by farm size category, and by diversification index. High levels of diversification are consistently positively and significantly associated with higher level of HDDS regardless of farm size category. This is not the case with MAHFP (Figure D.7). The MAHFP indicator declines for households with small land sizes and high levels of diversification. For households with large land endowments, the MAFHP indicator either slightly increases, remains constant, or declines with increasing crop, agricultural or livelihood diversification, respectively. The

results are largely corroborated when farmers are categorized by wealth and asset value rather than land size. Except, for farmers in a high wealth category, the MAHP is also found to slightly decline from 10.77 to 10.59, and 10.75 to 10.60, and 10.80 to 10.55 with increasing crop production, agricultural income and livelihoods index, respectively.

**Figure D.7** Relationship between diversification and average MAHF score, by farm size category



Source: IAPRI, computations are based on Malawi Integrated Household Panel Survey, 2010 and 2013

Notes: “Low” and “High” refer to low and high levels of diversification. The label “Small farm size” and “Large farm size” is based on a household ranking by farm size. Small farms are part of the bottom 50% of households and large farms part of the top 50% of households. “All farm sizes” refers to all households.

## IMPACTS OF DIVERSIFICATION ON RESILIENCE IN MALAWI

Higher levels of diversification are associated higher levels of resilience as measured by household income, food production and food stocks. In Tables D.3, the income, food production and food stocks indices which approximate livelihood resilience, are compared between households with low and high levels of diversification. Households are categorized by farm size, to identify different impacts of diversification across different household types. Higher levels of all types of diversification result into higher levels of income, food

production, and food stocks, regardless of the household farm size. The situation is different when comparing households by wealth category. For households with higher asset values, food production index and household income index tend to decline with increasing diversification. This could indicate that wealthier farms are known to specialize to enhance their livelihoods.

**Table D.3** Impact of diversification on resilience—approximated by household income, food production, and food stocks indices—by farm size and wealth category

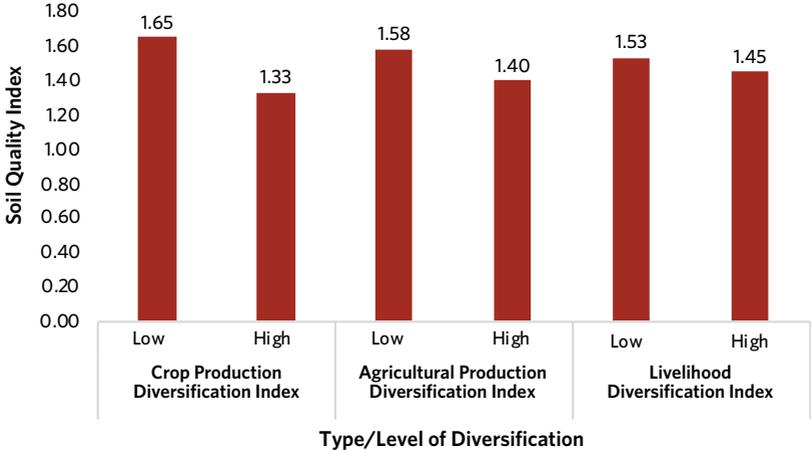
	Average value of resilience indices					
	Crop Production Diversification Index		Agricultural Income Diversification Index		Livelihood Diversification Index	
	Low	High	Low	High	Low	High
<b>Household income index</b>						
All households	1.20	1.27	1.18	1.28	1.18	1.28
Small farm size	1.18	1.26	1.25	1.21	1.10	1.32
Large farm size	1.14	1.34	1.16	1.31	1.13	1.35
Low wealth category	1.08	1.32	1.08	1.31	1.02	1.36
High wealth category	1.37	1.20	1.34	1.23	1.38	1.20
<b>Food production index</b>						
All households	0.39	0.52	0.40	0.50	0.40	0.50
Small farm size	0.37	0.48	0.45	0.42	0.47	0.41
Large farm size	0.33	0.61	0.34	0.61	0.34	0.60
Low wealth category	0.27	0.56	0.27	0.56	0.27	0.55
High wealth category	0.52	0.49	0.53	0.47	0.56	0.45
<b>Food stocks index</b>						
All households	0.64	0.86	0.64	0.85	0.63	0.85
Small farm size	0.56	0.77	0.58	0.75	0.61	0.72
Large farm size	0.74	0.89	0.71	0.91	0.69	0.93
Low wealth category	0.56	0.94	0.56	0.93	0.59	0.90
High wealth category	0.73	0.77	0.70	0.79	0.71	0.79

Source: IAPRI, computations are based on Malawi Integrated Household Panel Survey, 2010 and 2013

**The analysis shows that diversification, specifically diversification in crop production, promotes agroecosystem resilience.** The Soil Quality Index and growing season Canopy Greenness Index are used to assess the impacts of

diversification on agroecosystem resilience. Figure D.8 shows that the Soil Quality Index is smaller, which represents higher quality, among households with higher levels of diversification. The effect is most pronounced for diversification in crop production, where low and high level of diversification decreases the index from 1.65 to 1.33, compared to livelihood diversification which decreases the index from 1.53 to 1.45. This implies that diversification, specifically crop diversification, promotes soil quality through improving nutrient availability, retention ability, rooting ability, oxygen availability, and workability and reducing excess salts and toxicity (which are the elements the Soil Quality Index is composed of). In the case of canopy greenness, Figure D.9 shows a linear relationship between crop production and agricultural income diversification with the Canopy Greenness Index, which increases steadily with increased diversification. This increase is steeper for crop production diversification, from 18.0 and 7.5 EVI points per unit increase in diversification index. The figure does not show any effect of livelihood diversification on growing season canopy greenness.

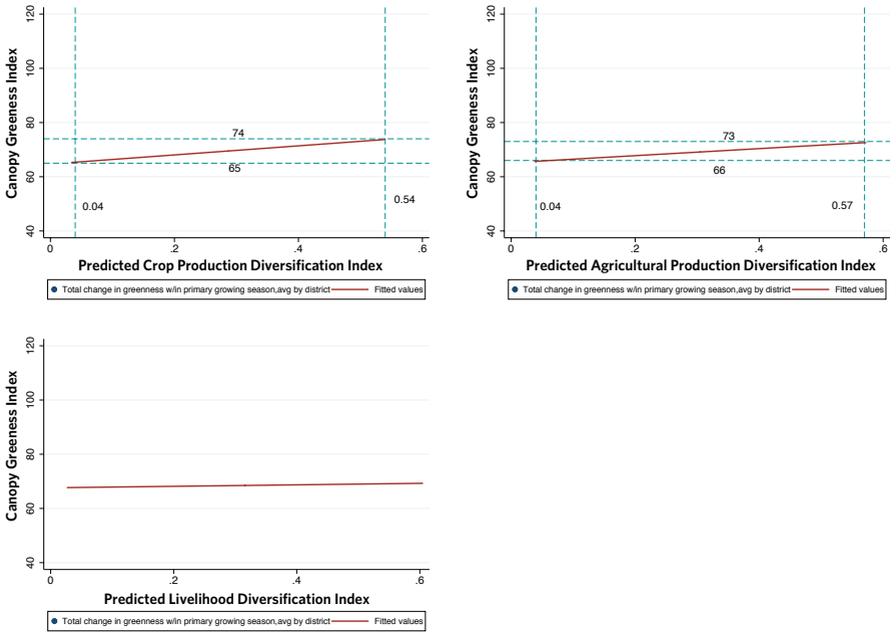
**Figure D.8** Impact of diversification on Soil Quality Index



Source: IAPRI, computations are based on Malawi Integrated Household Panel Survey, 2010 and 2013

Notes: “Low” and “High” refer to low and high levels of diversification below and above 0.5, respectively.

**Figure D.9** Impact of diversification on growing season Canopy Greenness Index



Source: IAPRI, computations are based on Malawi Integrated Household Panel Survey, 2010 and 2013





