Smallholders and Food and Nutrition Security

Evidence from the Food & Business Research programme

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1. Introduction

The United Nations declared 2014 the year of family farming. Despite this recognition of the important role that smallholder farmers play in sustainable development and food security, they are among the poorest and most food insecure people in the global South. They are vulnerable to climate change, institutional constraints such as sufficient access to land, markets and support services, and suffer from labour shortages and environmental degradation (Jayne *et al.* 2010). Yet, they produce 50-80 per cent of the world's food and thus play an important role in achieving sustainable development goal (SDG) 2 on zero hunger (Ricciardi *et al.* 2018; UN, undated). As such they are targeted in national and international policies that aim to alleviate rural poverty and improve food security (e.g. FAO, 2012; HLPE, 2013).

In this paper, we seek to answer the question: **in what ways can smallholder agriculture contribute to improved food and nutrition security (FNS) in their rural contexts?** This paper is part of a thematic synthesis of NWO-WOTRO's Food & Business (F&B) research programme (Box 1) that focuses on *new knowledge, insights and innovations* on improved food and nutrition security by smallholder farmers.[1] It is based on insights from 19 interdisciplinary research projects (Box 2, Annex 1).

Box 1: The Food & Business Research programme

The Food & Business (F&B) Research programme addresses persistent food and nutrition security challenges in low and middle income countries (LMICs). It focuses on the urgent and growing need for adequate knowledge and solutions for regional and local problems related to food security. F&B Research consists of two funding instruments: the F&B Global Challenges Programme (GCP) and the F&B Applied Research Fund (ARF). Both are part of the F&B Knowledge Agenda of the Dutch Ministry of Foreign Affairs. The objective of GCP is to promote research-based advanced understanding of emerging key issues in global and regional food security and their impact on local food security, and the role of the private sector. ARF aims to promote research-supported innovations that contribute to food security and private sector development in the partner countries of Dutch development cooperation. F&B Research is funded jointly by the Ministry of Foreign Affairs and the Dutch Research Council (NWO), and is managed by NWO-WOTRO Science for Global Development. This review is based on a mix of GCP and ARF projects (see Box 2).

[1] A separate article in the synthesis study series will assess the *outcomes* of these and other projects for improved FNS.

Box 2: The projects under study

The 19 projects covered by this synthesis comprise 5 projects funded through the Global Challenges Programme (GCP) and 14 projects funded through the Applied Research Fund (ARF). They were carried out between 2014 and 2019. Their activities were conducted in nine countries in sub Saharan Africa and Vietnam. Although the Calls for Proposals did not specifically target smallholder farmers, their focus areas – e.g. increasing sustainable agricultural production, ensuring equitable access to better nutrition, or devising approaches for resilient farming – all had a great bearing on the role, opportunities and constraints of smallholders in the food system.

The projects reviewed for this article all defined the improvement of FNS of smallholders and/or local communities as their long-term objective. All projects emphasised the role of the smallholder as food producer, and explored how production could be increased to contribute to local or regional food security. Some projects also considered the smallholder as consumer, exploring how they could enhance their production and/or access to food for improved FNS for their own households. All projects brought together farmers, researchers, practitioners and business stakeholders. To different degrees, they all included processes of co-creation and learning with, by and for poor smallholders (see Section 3).

Two concepts are central to this paper: smallholders and food and nutrition security (FNS). The FAO **definition of smallholders** is "those who work between less than 1 ha up to 10 ha, mainly using family labour, and using part of the production for household consumption" (FAO 2013: 1). The farmers targeted by the reviewed projects all fall within the scope of this definition. However, the FAO definition obscures differences in smallholders' socioeconomic status and accumulation capacity, which may influence what a project can achieve. We address this point in Section 2.

The **definition of food and nutrition security** (FNS) used in international policy circles evolved over the past four decades. The currently most-used definition, applied in this article, describes food security as a situation wherein "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO 2002). We distinguish four key dimensions of food security, which will be further explained in Section 3: availability, access, utilisation and stability.

After a short reflection on smallholder diversity (Section 2), we organise the main insights along the four dimensions of FNS: food availability (3.1), access to food (3.2), utilisation (3.3) and stability of the first three dimensions (3.4). Section 4 pays attention to strategies for innovation, co-creation and learning that the projects used to enhance the uptake of results related to FNS. Section 5 draws out some key insights and lessons learned on the opportunities and constraints for improving FNS through smallholder agriculture (see also Box 3) and poses some critical questions for reflection by academia, policy and practice. The paper concludes with some suggestions for the way forward (Section 6).

Box 3: Key insights

1. Smallholders are not all the same. Interventions aiming to improve their productivity, market performance and FNS should acknowledge their heterogeneity.
2. Early engagement of smallholders in project design and implementation is key to research uptake and long-term results.
3. Building on local knowledge and active farmer engagement in peer-to-peer learning, knowledge co-creation and capacity building are critical for research uptake and long-term results.
4. Introducing adapted varieties, practices and technologies that increase yield and/or prevent diseases provides opportunities for increased food availability.
5. Business prospects enhance the adoption of new crops and technologies.
6. Addressing structural constraints related to, for instance, land tenure and institutional support can be key to improve food and nutrition security.
7. Social innovation – and trust in particular – is critical for effective research uptake strategies and scaling up new technologies.
8. Higher productivity and market integration do not automatically lead to access to more and healthier food.
9. Multi-stakeholder collaboration is challenging, yet supports sustained outcomes.

2. The need to recognise smallholder diversity

As noted in the introduction, the FAO definition of smallholders obscures the differences between them. Such differences are determined by gender, age, land size, tenure rights, assets, degree of value chain integration and non-farm income, and whether farmers are subsistence- or growth-oriented. While few projects were explicit about their definition of smallholders, those that were illustrated the importance of recognising such differences. For instance, the Cassava for Food Security project in northern Uganda[2] revealed gender differences in the preferences for new cassava varieties (see Section 2.1.1), while the Treefarms project in Ghana[3] discovered that women prefer other non-timber forest products to be introduced in tree farms than men.

The Inclusive Value Chain Collaboration project[4], carried out in Ghana and South Africa, delved deeper into smallholder heterogeneity. Cocoa and oil palm smallholder farmers in Ghana self-identified no less than seven profiles. Differences were attributed to land ownership (with a category of caretakers and shareholders having no land of their own and an equivalent category of – predominantly retiring – absentee landowners, 35% of whom were female); degree of specialisation (one or more tree crops); and entrepreneurship (households that combine farming of multiple cash crops with other 'businesses'). Gender and being full- or part-time engaged in farming explain further differentiation within these groups (Ataa-Asantewaa, forthcoming). Among farmers growing macadamia and avocado in South Africa, a few (9%) formed a class of small-scale capitalist farmers. The others were classed as "petty commodity producers". These were further subdivided into a group mainly depending on welfare grants, a group depending mainly on agriculture, and a group whose main income came from non-farm jobs (mainly teaching (Olofsson, 2020). In both countries, the groups differed considerably in

[2] 'Cassava applied research for food security in Northern Uganda' (see Annex).
[3] 'Improving smallholders' food and income security by introducing non-timber forest products in reforestation schemes and tree-crop farms: A collaborative learning process in Ghana' (see Annex).
[4] 'Inclusive partnerships and innovation platforms for sustainable landscapes and greater food sovereignty among tree crop farmers in Ghana and South Africa' (see Annex).

terms of livelihood strategies, potential for capital accumulation, constraints, and ambitions. Dorward et al. (2009) refer to such strategies as 'hanging in' (surviving), 'stepping up' (growth-oriented), and 'stepping out' (accumulation of assets or savings as a pathway towards more rewarding activities).

These differences among smallholders have significant implications for farmers' livelihood pathways and how donors, governments and development agencies approach them. Illustrative are Murphy's (2012) five notions of roles attributed to smallholder farming: 1) no place for survival smallholders in the current global economy; 2) smallholder farming as a transitional step on the way to developing the economy; 3) smallholder farming as undesirable model except for some niches; 4) smallholder farming as a good and viable business and an alternative to current farming systems especially in light of ecological crises; and 5) smallholders as having an important role from a food sovereignty perspective. With increasing attention to the role of farmers in landscape restoration and climate-smart agriculture (see 2.4.1), we suggest an additional category, namely 6) smallholders as stewards of the environment.

3. Smallholders and food & nutrition security: project findings

F&B Research and the individual projects started from the premise that smallholders play an important role in improving FNS. This section presents the new knowledge, insights and innovations about smallholders' contributions to four key dimensions of food security: *availability, access, utilisation and stability*. Drawing on various sources (FAO 2008, FAO 2017, WFP 2013), we define these dimensions as follows:

- **Food availability** = the presence of enough food through agricultural production, imports and/or food aid[5]
- **Access to food** = the ability to obtain enough food, both economically (having enough resources to buy or grow food) and physically (having physical access to food markets)
- **Utilisation** = the safety (hygienic utilisation) and quality of food which determines the nutritional status of households
- **Stability** = the continuity of food availability and access over time in the face of economic, political, natural and social shocks and stresses

3.1 Food availability

Several reviewed projects aimed to contribute to improved food availability for farmers' own consumption and local markets through **increased farm productivity**. This was targeted by identifying and introducing more resilient and high-yielding crop varieties; enhancing crop disease control; improving soil health; and irrigation. The importance of **early involvement of smallholders, business prospects, building on local knowledge and knowledge co-creation emerged as success factors in research uptake**. Food availability through imports or food aid were not researched, nor is data available on gender- or age-specific and long-term effects.

3.1.1 Resilient and high-yielding crop varieties

Three of the reviewed projects embarked on the selection of high-yielding, drought-resistant and nutrient-rich crop varieties. They made clear that **closely involving farmers** in the selection is key to identifying varieties that suit their needs, preferences and local contexts, and hence improve the adoption rates. The Cassava for Food Security project in Uganda made clear that such preferences can be gender specific. Men preferred a variety with a lot of branches, as this reduces the time needed for weeding and offers opportunities for selling cassava

[5] In some definitions, food distribution is added as another relevant factor for availability, e.g. Fraanje and Lee-Gammage (2018).

cuttings. The women – 60% of all farmers targeted by the project – chose the variety with fewer branches, because this allowed them to intercrop the cassava with, for instance, beans to help diversify the household diet. By organising taste panels, the Spider Plant project[6] in Benin and Kenya also **involved the consumers** in the selection of new cultivars. Furthermore, ethnographic research in this project documented 52 traditional recipes from 23 ethnic groups, enhancing at once the recovery of traditional knowledge. The Cashew Nut Farming project[7], also set in northern Uganda, introduced high-yielding and adapted cashew varieties. The project established seven nurseries for the dissemination of seedlings that introduced new cashew varieties among 3,200 smallholder producers.

Involvement alone is, however, not enough. **The prospect of business opportunities** also appeared to be a key factor in the adoption of new varieties and new technologies more broadly. The survival rate of cashew seedlings in northern Uganda was low, mainly because farmers did not pay much attention to them due to a lack of trust in the business potential of cashew. Local business partners in the project, however, identified that there is domestic demand from supermarkets and restaurants, and the Ugandan government is now actively promoting cashew as a new promising cash crop in its 'Operation Wealth Creation' programme that aims to transform the Ugandan agricultural sector. In contrast, farmers involved in the Cassava for Food Security project were keen to establish multiplication sites to sell clean planting material and to process surplus cassava harvested into cassava chips for local markets. Anecdotal evidence shows that some families used the extra income from the proceeds of extra cassava and cuttings to buy and grow protein-rich foods such as beans and peas, while others bought goats, pigs or poultry to improve their dietary diversity. Increased income was also used to send children to school or to start small businesses, with possible positive effects on long-term FNS. Whether this represents a wider trend has not been documented. The combined targeting of farmers and consumers in the Spider Plant project created potential for commercial marketing and already resulted in increased demand. In a different context, the importance of realistic business opportunities came to the fore in the Farmer-Led Irrigation project[8] in Mozambique. It showed that farmers start investing in irrigation if they identify clear market opportunities. For these market opportunities, they often rely on informal networks as formal support services are mostly not available.

The broader literature on factors determining the adoption of new crops, varieties and technologies confirms the importance of farmer involvement in research (e.g. Mariano et al. 2012), a gender-sensitive approach to introducing new varieties and technologies (e.g. Fisher and Carr 2012, 2015), and the prospects of business opportunities (e.g. Abebe et al. 2013). Market-related factors may play an even more important role in adoption than production-related characteristics of the innovation (Ibid). Additional factors, not documented in the reviewed projects, include the role of farmer characteristics (age, education, risk aversion) (Liu, 2013; Meijer et al. 2015; Ghimiri et al. 2015) and the (continued) role of extension services (Mariano et al. 2012). The specific role of neighbours after the initial importance of extension agencies (Krishnan and Patnam, 2013) is also resonated in the Cassava for Food Security, Farmer-Led Soil Innovation, and Sustainable Cocoa projects (see 3.1.2), while the specific role of innovation platforms (Kilelu et al. 2013) will be addressed in Section 4.2.

[6] 'Utilizing the genome of the vegetable species *Cleome gynandra* for the development of improved cultivars for the West and East African markets' (see Annex).
[7] 'Introduction of cashew nut for income security for poor farmers in Northern Uganda' (see Annex).
[8] 'Unravelling the potential for farmer-led irrigation development in Mozambique' (see Annex)

3.1.2 Disease control and healthy soils

The projects that introduced new crop varieties often combined this with dissemination of agronomic practices[9] for sustained productivity gains. This was done through trainings, demonstration plots or farmer field schools. Several of these trainings focused on **disease control**. For instance, the Cassava for Food Security project taught farmers how to identify common cassava diseases and produce disease-free planting material to avoid the spread of diseases. This was a key success factor for the increased cassava yields reported above. Similarly, the Sustainable Cocoa project[10] in Sierra Leone successfully trained farmers in combatting black pod – a common disease that badly affects cocoa yields. The training not only reduced disease incidence in the project location, but – after the farmers voluntarily taught their neighbours – also in the surrounding plots; an unexpected knowledge spill-over effect with significant potential for higher cocoa yields and income. In Kenya, the Integrated Pest Management (IPM) project[11] focused on tackling common soil-borne diseases and insect pests, which can cause tomato crop losses of 80-100%. The researchers developed several biological insect pest and disease management strategies, which were validated through trials in which the farmers played a key role. A total of 14,700 farmers spread across various counties in Kenya started using the IPM practices. These outcomes were achieved by including extension officers of the Ministry of Agriculture in the trainings, using mass radio programmes and social media (WhatsApp, Telegram) campaigns for knowledge dissemination, and a fruitful partnership with plant doctors from the Centre for Agriculture and Biosciences International (CABI), who already had a strong network and an effective outreach strategy.

Other projects, such as the Farmer-Led Soil Innovations project in Uganda[12] and the Fertile Grounds project in Burundi[13], focused on **soil management** as a pathway to increased yields. These projects revealed **the importance of building on local and indigenous knowledge and knowledge co-creation**. For instance, the Farmer-Led Soil Innovations project compared local farmers' knowledge of soil fertility with lab assessments, based on which the researchers developed a soil fertility classification tool. The lab testing allowed for more targeted use of fertilisers which were adapted to specific soil qualities. The practices that individual farmers had initiated to prevent further depletion of their agricultural land were strengthened by testing the principles of conservation agriculture. The projects documented yield increases of more than 500 kg per hectare for groundnut and up to 1000 kg per hectare for maize. These are significant increases, given that average groundnut yields in Uganda are often significantly under 1 ton per hectare and maize production is on average at 2.5 tons (Jeliffe et al. 2018; Simtowe et al. 2019). The Fertile Grounds project in Burundi led to insights that enabled the development of more locally adapted fertilisers to replace the generic fertilisers that farmers use. In the Cassava for Food Security, Farmer-Led Soil Innovation, and Sustainable Cocoa projects, **farmers voluntarily started sharing the knowledge gained with farmers from neighbouring communities** who were not included in the project. Project partners claim that this is because the farmers saw with their own eyes that the measures had an effect – and in such cases, word spreads quickly.

However, **obstacles may have to be overcome for disease control measures to be adopted on a mass scale**. IPM, for instance, requires intensive training of vast numbers of farmers, while access to crop protection inputs such as mass trapping devices and botanical extracts, and additional workload may well prove significant barriers

[9] Agronomy is the science and technology of producing and using plants in agriculture for food, fuel, fibre, and land restoration. It encompasses work in the areas of plant genetics, plant physiology, meteorology, and soil science.

[10] 'Helping poor farmers grow money: sustainable cocoa productivity and socio-economic impacts of international investments in Sierra Leone' (see Annex).

[11] 'Development, validation and dissemination of Integrated Pest Management packages for Tomato Leafminer (*Tuta absoluta*) and Fusarium wilt-root knot nematode complex affecting tomato production in Kenya' (see Annex).

[12] 'Farmer-led soil innovations to sustain food production' (see Annex).

[13] 'Building on fertile grounds in Burundi' (see Annex).

too. Acknowledging that a common productivity constraint for many smallholders in sub-Saharan Africa is a lack of labour (e.g. Leonardo *et al.*, 2015), the Farmer-Led Soil Innovations project introduced principles – e.g. permanent soil cover and minimum soil disturbance – that reduce farmers' time spent in opening the land, ploughing and weeding.

To conclude, the projects have shown that, taking existing practices as a starting point, the introduction of better varieties, farming practices and technologies that increase yield and/or prevent diseases all provide opportunities for greater availability of food. Participation of farmers, reviving knowledge around smallholders' practices and tools, as well as business prospects and market opportunities favour adoption. However, the long-term challenges of scaling up the results seem to depend strongly on the individual actors and the created networks, as well as on the larger environment such as on agricultural development and food security policies. These aspects, as well as the importance of off-farm income (Frelat *et al.,* 2015), were only marginally considered in the reviewed projects.

3.2 Access to food

Access to food refers to having enough resources to buy or grow food (economic access) and having physical access to food markets. The reviewed projects focused on increased production for the market and enhancing smallholders' inclusion in value chains as pathways towards increased access to food.[14] This was based on the **assumption**, also prevalent in policy, **that increased market orientation generates extra income and that this will lead to improved access to food and hence FNS**. Hence, smallholders were seen both as producers and consumers of food. This and the next section (2.3) will partly demystify the assumption that increased market-orientation leads to improved FNS, showing that households may prioritise other expenditures than food when they acquire a higher income. Also observed was that they use the additional income for status food of lower nutritional quality. We will also show that **agricultural intensification and increasing market orientation may adversely affect FNS**. This aligns with recent wake-up calls in the literature regarding the prevailing policy narrative (see e.g. Ickowitz *et al.* 2019). Finally, we will extract lessons regarding the **enabling factors** that may enhance positive effects of value chain integration on access to food.

3.2.1 Boosting smallholders' production for the market

Four of the reviewed projects embarked on efforts to increase food production for the market. The Potato Seed Innovations project in Burundi[15] aimed to do so by introducing seed of improved potato varieties that are less susceptible to diseases and better storage facilities to reduce post-harvest losses; the Sesame Yield project in Uganda[16] by promoting good agricultural practices (use of agrochemicals, post-harvest handling and cost-benefit analysis); the Cassava for Food Security project in Uganda by introducing new high-yielding varieties that are more resistant to diseases and tolerant to drought; and the Solar Mango Drying project in Ghana[17] by improving the drying and packaging process. All these projects managed to boost farmers' income or the prospects thereof. In Burundi, farmers (many of them women) started producing and trading the new variety seed potato, achieving increases in yield between 40 to 60%. By bulking their harvest at locations near the main trade roads, some of the farmer groups gained regular access to key markets. Of the 465 farmers trained by the project, 34 managed to negotiate supply contracts with producers of ware potatoes (i.e. potatoes for human consumption).

[14] See also another article in this Thematic Synthesis Study series, 'Inclusive business for sustainable food systems: putting the last first'.
[15] 'Development of potato seed quality based innovations for small scale farmers in the three provinces surrounding Bujambura town in Burundi' (see Annex).
[16] 'Stabilizing sesame yields and production in the Lango region, Northern Uganda' (see Annex).
[17] 'Development of automated solar powered fruit drying technology for smallholder farmers in Ghana' (see Annex).

In Uganda, the use of agrochemicals reduced leafspot disease and Gall midge in sesame, increasing productivity and income. In Ghana, the value of mangoes of 12,000 farmers is expected to increase by 140% thanks to drying and packaging. Overall, the projects report that the extra income was spent on school fees, improved housing (e.g. roofing) and setting up or expanding a business. Interestingly, more food-related expenditure has been reported in cases where the project focused on staple foods. For instance, the Potato Seed Innovations project documented that some farmer households used the extra income to buy vegetables or meat, while others bought a cow to start producing milk for household consumption and market sales. Some families in the Cassava for Food Security project in Uganda started buying protein-rich foods such as beans and peas in addition to increasing cassava consumption. In most cases, however, there was no evidence that the extra money was or will be spent on accessing more or qualitatively better food. We found no explanation for the fact that additional income from food crops was more often spent on more and better food than extra income from cash crops.

3.2.2 Smallholder integration into value chains

A second group of projects worked from the assumption that value chain integration of smallholders would result in higher income and therefore better access to food.[18] **Although some positive results of value chain integration were reported, structural constraints were also recognised and the inclusiveness of such integration and positive effects on FNS contested (see also 2.3).**

The Market-Oriented Dairy Systems[19] and Smallholder Dairy[20] projects aimed to enhance market orientation of smallholder dairy farmers in Kenya and Ethiopia by addressing constraints in institutional support and extension services. Despite a well-developed dairy network in Kenya, dairy farmers face several constraints. These include limited land area resulting from inheritance patterns, distance to the market, deficient availability and provision of inputs and services, unreliable buyers, and low and fluctuating prices. This not only prejudices farmers' market access and income, but also their FNS as they also use the milk for subsistence. In Ethiopia, dairy farmers are even more constrained. Both projects provided training on dairy husbandry, feeding, forage production and conservation, and milk hygiene, which helped increase milk production and quality. The Smallholder Dairy project furthermore addressed farmers' main concern, namely the lack of reliable markets. It did so by **organising farmers in a cooperative** to enhance bulk production, and by facilitating collaboration between the cooperative and the Kenya Cooperative Creameries, a milk processor and packager, which ensured a market for the farmers. Through the project's collaboration with the Nakuru County government, the cooperative obtained one 3,200 litres milk cooler paid for by the Kenyan Ministry of Agriculture, Livestock and Fisheries, as well as a cooler and pasteurizer of 500 litres each from the county. None of the two projects examined effects on food security, but anecdotal evidence from the Smallholder Dairy project revealed that the cooperative members had increased home consumption of milk and that they refrained from registering for food hand-outs during the 2018 drought, while they had been on the county government hand-outs list during previous drought and scarcity episodes. However, the Market-Oriented Dairy Systems project concluded that ''the transition from semi-subsistence farmers to market-oriented farmers supplying to urban markets may take decades where markets and context conditions are sub-optimal". **This suggests that addressing constraints related to deficient institutional support structures can help improve access to markets and FNS.**

[18] This is also an assumption by the Dutch government in its policy letter of May 2019 'Towards a World Without Hunger in 2030: the Dutch contribution', although it recognises that additional efforts are needed 'to ensure that higher incomes lead to more healthy diets'. https://www.government.nl/documents/parliamentary-documents/2019/10/29/food-security-letter-to-the-parliament

[19] 'Assessing and supporting input and advisory service systems for resilient market-oriented smallholder dairy systems in the Ethiopian and Kenyan highlands' (see Annex).

[20] 'Innovations for sustainable and profitable intensification of smallholder dairy in Kenya' (see Annex).

The **importance of business prospects**, already mentioned in the previous section, also appeared to be crucial in efforts to increase smallholder' engagement in markets. Making farmers shareholders in the processing unit of the Solar Mango Drying project was a significant incentive for the smallholders to commit to a steady supply to the processor as they knew they would share in the profits. In contrast, the rate of adoption in the Cashew Nut Farming project was low because smallholders were not convinced that cashew was a viable business. Apparently, private companies first need to take on a new business and create capacities for cashew collection and processing, before smallholders are willing to risk an investment of labour and financial resources. Because the farmers did not see ready market opportunities, the project's assumption that cashew production would increase farmers' income (and hence food security) was compromised.

The Inclusive Value Chain Collaboration project debunked the assumption that value integration leads to increased FNS (see also Ros-Tonen *et al.* 2019). Rather than aiming to enhance smallholder integration in value chains, the project aimed to develop a farmer-centred approach to make value chain engagement more inclusive in terms of farmer diversity and innovation capacity, food crops, and the environment. Research aimed to unravel smallholder heterogeneity and effects of value chain engagement on food production and the surrounding landscape. The project concluded that collaborations between companies and smallholders, despite increasing attention for social and environmental dimensions in the form of, for instance, community development and certified production, still pay little attention to food production for household consumption. Farmers acknowledge seasonal food insecurity, but generally underestimate food security threats associated with expanding commodities such as cocoa and palm oil. The spatial analysis conducted in this project revealed that the expansion of cocoa and oil palm in Ghana leads to less food-crop land (Asubonteng *et al.* 2019). A study on the effects of expanding oil palm on household FNS demonstrated that food prices rise where women engage in oil-palm processing rather than in food production (Vos 2017). When oil palm farmers engage in smallholder- or outgrowing schemes, they furthermore tend to lose autonomy over land, seeds and markets (Manley and Van Leynseele, 2019), which compromises food sovereignty.

As insights from the projects show, **increased access to food based on higher productivity and market integration is not a given.** In fact, very few projects reported that the smallholders used the extra income earned for buying or growing more nutritious food for household consumption (see also 3.2.1). Moreover, the critical question of who consumes the extra food within the household was typically not asked. Is additional food equitably shared among household members or possibly consumed by male of senior members only? While these details are not known, three observations can be made regarding the findings. First, projects may likely not have had the funds or the time to assess effects of the intervention on improved access to food, or it was simply too early to establish such effects. Second, the studied rural households may already have felt food secure and were able to invest in less direct livelihood needs. Third, the way in which extra income was spent may positively affect access to food and FNS more broadly in the mid and long term. Notably, diversification into non-farm activities has been reported in the literature as an effective strategy to improve FNS (see e.g. Waha *et al.* 2018; Mishra and Rahman 2018), whereas investing in children's' education is likely to improve food security in the long term (Mutisya *et al.* 2016).

3.3 Utilisation

Only a few projects included the utilisation dimension of food security, defined as the safety and quality of food, which determines households' nutritional status. Most of those looked at the nutritional value of indigenous and neglected foods, the findings of which are discussed in another article in this series, 'Pathways to improved food and nutrition security of the poor. The promise of African indigenous foods and technologies'. The Spider Plant project in Benin is one of those that focused on neglected or 'orphan' foods that can make an important

contribution to people's dietary diversity. The spider plant (*Gynandropsis gynandra*) is used as vegetable and medicinal plant in some rural areas, but no longer known in urban areas. However, it has high potential to improve FNS and health in sub-Saharan Africa for its high pro-vitamin A and vitamin E and C content (Sogbohossou *et al.* 2019). The vegetable is usually collected from the wild, but, as discussed in Section 3.1.1, the project successfully promoted the cultivation and consumption of this plant in Benin and Kenya through farmer field schools, tasting panels, and the dissemination of recipes, and saw its demand increasing.

The Inclusive Value Chain Collaboration project examined the implications of expanding tree crops – cocoa and oil palm in Ghana and macadamia nuts and avocado in South Africa – for food production and FNS (see 3.2). Findings of research into food utilisation showed that based on experience-based indicators most tree-crop farmers in both Ghana and the Limpopo Province of South Africa felt food secure, except during the lean season. However, in South Africa only 39% of them had adequate dietary diversity scores. Although this seems to be alarming, it is still higher than among non-tree crop farmers (28%) in the same region. Gender of household head, land size, access to social grants and wage labour turned out to be factors influencing dietary diversity (Olutawayo *et al.* forthcoming). In Ghana, similar results were found among cocoa and oil-palm. Here it became clear that tree-crop farmers who grow food crops eat more varied diets than those focusing on tree crops only, as they eat part of the food crops that they produce. It was, however, also observed that diet patterns changed with increasing market orientation, with growing importance of less time-consuming foods (rice versus the traditional *fufu*) and less nutritious status food such as instant *Indomie*. This negatively affected the quality of food intake (Ataa-Asantewaa, forthcoming). This has also been reported in other studies where more 'urban' (prepared) food entered people's diet (Noack and Pouw 2015).

These results show that the integration of farmers in international value chains may increase income and food availability and access, but not necessarily their dietary adequacy. Hence policymakers should acknowledge the consequences of promoting cash crops for farmers' dietary diversity and the need to take all dimensions of FNS into account (see also Ickowitz *et al.* 2019).

3.4 Stability of food availability and access

The stability or continuity of food availability and access over time in the face of economic, political, natural and social shocks and stresses is closely linked to the overall resilience of smallholder farmers (Van Hecke 2018) as well as the resilience of the food system (Tendall *et al.* 2015). This suggests that **projects that took different dimensions affecting smallholder resilience into account, potentially contributed more strongly to sustainable improvements of food access and availability.**

Some projects considered structural issues such as land rights of smallholders, specifically women. Other projects looked at improving, simultaneously, long-term environmental and food security objectives, through strategies for farm and land management, such as agroforestry or more sustainable soil protection measures.[21]

3.4.1 Land restoration and climate change impacts

One interesting example is the Treefarms project in Ghana, which aimed to tackle multi-dimensional challenges by integrating nutritious shade-tolerant non-timber forest products (NTFPs) (black pepper, grains of paradise and honey) in Ghana's reforestation system and off-reserve tree farms. The project involved farmers, practitioners, policymakers, NGOs and value-chain actors in a gender-sensitive and stepwise collaborative learning approach throughout all phases (see also Section 4). According to the implementers, the project contributed significantly

[21] For approaches to improving the long-term environmental and economic sustainability of food systems see also another article in this synthesis study series, 'Opportunities and barriers of circular agriculture'.

to the adoption of a specific landscape restoration and climate change mitigation strategy. The introduction of shade-tolerant NTFPs and food crops are now a key element of Ghana's Forest Plantation Strategy 2016-2040. The project strategically built on a process that already foresaw co-management of forest resources by the Ghana Forestry Commission and smallholders, and managed to increase the benefits for farmers as well as re-ignite the interest in this specific reforestation scheme to restore degraded forest reserves. The Forestry Commission also institutionalised the learning platform introduced by the Inclusive Value Chain Collaboration project as a novel way of interacting with farmers and other stakeholders. These results appear to be significant contributions towards greater stability of food availability and access for smallholders in the districts in Ghana where both projects were implemented.

Several projects purposefully addressed the impact of climate change on smallholder food security, especially droughts and unpredictable weather conditions. Examples are projects that focused on identifying and introducing more resilient crop varieties (e.g. the Cassava for Food Security and Cashew Nut Farming and Sesame Yield projects in Uganda); encouraging intercropping of staple or cash crops with food crops for household consumption (same projects, plus the Treefarms projects); or building on farmers' local initiatives for conservation agriculture (Farmer-Led Soil Innovations project). Others focused on the increasing water scarcity that is a threat to smallholder resilience, for instance by looking at farmer-led irrigation initiatives that are more economical in water use than other large-scale solutions. The project that researched such initiatives in Mozambique (see also Section 3.1.1) showed clearly that grassroots initiatives can be highly innovative and promising to facilitate climate change adaptation, but that they need political recognition and support for scaling up. While farmers who adopt or initiate irrigation schemes on their own show great resilience, scaling up of such initiatives and transferring them to less adaptive smallholders remains a challenge that requires attention.[22]

The results of the projects that addressed land restoration and climate change show that these issues of high urgency and impact can find answers in locally developed and tested solutions, but that responses with impact beyond the local level require alliances of actors and political support to push them. The increased attention for climate issues and the growing sense of urgency provide a window of opportunity to highlight and build on solutions such as smallholder irrigation schemes. As will also be seen in Section 4, specific participatory approaches such as learning platforms highly contributed to their results.

3.4.2 Land rights and tenure security

Smallholders' willingness to invest in long-term ventures is, *inter alia*, dependent on their tenure security (Ravnborg *et al.* 2013). If tenure insecurity is combined with other factors that withhold people from investing in new technologies or committing to new practices, change becomes unlikely. The Cashew Nut Farming project in Northern Uganda had difficulties convincing farmers of the business prospects of cashew nuts, which negatively influenced research uptake. Furthermore, the project documentation does not mention the structural factors that impede growth and development in northern Uganda. Tenure and food security in the North are fragile. The region still feels the effects of the war that ended in 2006/7 and this still has serious effects on smallholder farmers' food security (Marshak *et al.* 2019). Twenty-five percent of households experience land disputes, which means that many of the farmers reached by the project are likely to experience tenure insecurity with assumedly negative effects on project outcomes. It has to be stated here that the project could not have been expected to fix or explicitly address these issues. However, opportunities for greater stability of food security may have been found (and might still be found) in connecting the project and its stakeholders to ongoing efforts for improving tenure security in Northern Uganda (Betge *et al.* 2019). This might also increase people's willingness to invest and commit. The same holds for the Cassava for Food Security project, also set in northern Uganda, which

[22] An article dedicated to climate-smart agriculture will be published in the series of synthesis articles in 2020/2021.

emphasised the barriers that limit especially women smallholders' control over land – even if they have some customary access rights – and over the profits generated from their labour.

The Farmer-Led Soil Innovations project, also in Uganda (see 3.1.2), was set in a context where the same NGO leading the project is also implementing a tenure security project. As a result, the participating farmers were able to acquire a Certificate of Customary Ownership (CCO) for their land, potentially helping to protect their investments. As discussed previously, and as was also shown by this project, the prospects of economic gains motivated farmers to invest and to choose cost-beneficial options for their investments. This means that sustainability of project achievements depends on factors beyond production increases resulting from improved agricultural practices. Moreover, there are also indications that the sustainability of the results depends on continued access to the same quality of fertilisers. Even when farmers enjoy stable tenure security, changes in the quality of external inputs (which were observed during project implementation) can have a strong effect on the long-term results.

The Dutch Policy Letter to Parliament (2019) recognises the crucial role of tenure rights as a context factor that enables sustainable development. **Any investment in agriculture based food security will eventually require a minimum degree of tenure security to be sustainable**. It is important to state that tenure security should not be confused with legal title deeds or other forms of legal authorisation. The Farmer-led Irrigation project in Mozambique, for instance, revealed that farmers with informal land rights feel secure enough to make investments in irrigation. The discussion above shows that agricultural projects can and should more proactively seek opportunities to integrate tenure security into their sustainability strategies, be it by introducing land laws or by respecting local tenure security systems. In addition, deliberate efforts to invest in research take-up are needed to ensure long-term efforts. This will be addressed in the next section.

4. Learning for research uptake

All reviewed projects – as well as the F&B Research programme as a whole – acknowledge **that active farmer engagement in knowledge (co-)creation is needed to ensure research uptake and long-term results**. Considering that the ultimate goal of the projects was to contribute to long-term FNS, such approaches are key to the stability dimensions of FNS. This section addresses some key strategies, practices and approaches.[23] We thereby make a **distinction between projects that consider smallholders as beneficiaries of knowledge transfer and those that put farmers' knowledge, innovation potential and agency centre stage.**

4.1 Smallholders as active beneficiaries of knowledge

This category encompasses a broad range of approaches to enhance research take-up, ranging from phone apps, to radio programmes, demonstration plots, training (for instance in farmer field schools), learning tours, participatory mapping or active farmer engagement in the research. These experiences show, first, that active engagement of farmers and other target groups in all steps of the project cycle has a positive impact on research uptake and adoption of new technologies (see 3.1 for examples). Second, several projects revealed the importance of not only targeting smallholders, but also private actors and government agencies, in order to ensure an enabling context for farmer support and production offtake (e.g. Cassava and Sesame Yield projects in Uganda, and the Farmer-led Agroforestry project in Ethiopia). The Farmer-led Irrigation project in Mozambique

[23] The role of knowledge co-creation in transdisciplinary consortia will be addressed more extensively in a separate synthesis study article to be published in 2020/2021.

even reversed the approach and primarily targeted professionals and policymakers in the dissemination of research results. These professionals are often unaware of informal irrigation techniques and how these can be supported. Sharing insights with them created momentum for further research and mapping as a basis for policy development and institutional support. All these projects targeted various dimensions of FNS as was seen in the previous sections.

4.2 Smallholders as agents of innovation

A second group of projects went a step further and took smallholders' knowledge and innovation capacity and agency as a starting point for achieving transformative change. This entailed a different set of approaches, including action research, learning and innovation platforms and learning spaces. What they have in common is that they **encourage interactions, joint learning and mutual understanding between smallholders and private and institutional actors, with a greater focus on farmer empowerment** than is usually the case in projects that focus on knowledge transfer and research uptake.

The Land Governance project in Mozambique[24], employed community participatory and empowering action research (CPEAR) to examine how smallholders can be empowered against adverse effects of large-scale rural development on their livelihoods and food security. The CPEAR method and a video that resulted from it made male and female smallholders aware of their rights, and empowered and mobilised them to develop community action and advocacy plans for land rights, extension support for agroecology, and access to irrigation water. Assumedly this was not appealing to the government and private sector, who were not very receptive to engage in the project.

Innovation and learning platforms are other ways to put farmers' knowledge and innovations centre stage. This was particularly clear in the farmer-centred learning platform approach developed by the Inclusive Value Chain Collaboration' project in Ghana and South Africa. These learning platforms aim to create a safe space for peer-to-peer learning among smallholders and joint learning with institutional actors, private sector and researchers. The focus was on low-cost, bottom-up innovations based on farmers' own knowledge, day-to-day challenges and (limited) access to assets. Taking farmers' knowledge and bottom-up innovations into account is seen as one of the pathways to making value chain integration more inclusive (see Ros-Tonen et al. 2019). However, a focus on bottom-up innovations runs the risk of overlooking structural constraints to inclusive value chain engagement, for which partnerships with government agencies, companies, NGOs and other actors within and 'beyond' the chain are needed.

Other projects used the term "innovation platform" for their efforts to bring together farmers, extension services, the private sector, researchers, government actors and NGOs (Nutritious Pond System Farming project in Vietnam[25], Local Parboiled Rice project in Benin[26]). In such cases the focus was not on bottom-up innovations, but primarily on research uptake of innovations developed by the project. Such platforms bring actors together who normally do not engage with each other a lot, which facilitates dialogue and discussions on roles and responsibilities. In the Local Parboiled Rice project this helped to establish business links for women selling parboiled rice.

[24] 'Bridging the gaps between policy and practice on land governance, inclusive business and food security in Mozambique' (see Annex).
[25] 'Nutritious system pond farming in Vietnam' (see Annex).
[26] 'Ensuring sustainable and sustained food security by enhancing local parboiled rice value-chain competitiveness in Gogounou and Banikoara areas in Benin' (see Annex)

A different approach was followed in the 'Shrimp Farming' project in Vietnam[27], which created a learning space for both farmers and policymakers. Role-playing games were developed to trigger insight into the risks of monoculture shrimp farming and the benefits of integrated mangrove shrimp farming. Game-playing enhanced social learning among farmers, who consulted each other more often after having played the game. Combined with agent-based modelling, it helped policymakers to gain more insight into local dynamics and farmers' needs and decisions.

5. Synthesis and reflections

Smallholders are generally highly diverse, innovative and resilient actors who are frequently underestimated in terms of their innovative capacities and agency by governments, donors and development practitioners. However, despite their heterogeneity and inventiveness, many of them suffer from food insecurity and precarious livelihoods, because they face immense structural challenges and are vulnerable to external shocks through market disruptions or climatic changes. Below we summarise and elaborate on the key insights from Box 3, after which we outline a way forward in the next section.

1. Smallholders are not all the same. Interventions aiming to improve their productivity, market performance and FNS should acknowledge their heterogeneity

The reviewed projects were rarely explicit on the profiles of the smallholders included in their activities, except for some that purposefully targeted female smallholders. However, who gets involved in a project, based on which criteria, is important for what can be achieved and is likely to influence a project's effectiveness and longer-term impact. We therefore recommend that future research projects are required to take account of differences between smallholders in the project area based on gender, age, land size and rights, assets and off-farm income. They should also provide a justification for the target group, because each group has its own limitations, possibilities and aspirations.[28] Failing to sufficiently analyse and define stakeholders and target groups could even create or exacerbate conflict.

2. Early engagement of smallholders in project design and implementation is key to research uptake and long-term results

Engaging farmers in project design and implementation acts as a driver towards practical, truly relevant solutions. Projects that involved smallholders from the start seemed to have fared better in creating interest and ownership, notably in the adoption of new crop varieties and agronomic practices. Being part of the research process allows farmers to witness the effects of innovations, and thus make informed decisions on which innovations to adopt. Moreover, this enables increasing or reviving their knowledge, practices and tools, which can be a starting point for context-relevant innovations. In several cases, active engagement triggered farmers to share their insights with farmers from neighbouring communities, thus reinforcing the potential impact of the project. This, in turn, is a positive factor for sustaining project outcomes. This insight is not new (e.g. Mariano et al. 2012; Noltze et al. 2012), but still seems to be insufficiently taken into account.

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[27] 'Assessing the learning effects of games on attitude of stakeholders on sustainable shrimp farming in the Mekong Delta, Vietnam' (see Annex).

[28] This is in line with recommendation from HLPE (2013, p. 11): 'To appraise the magnitude and diversity of smallholder agriculture and to inform sound policy-making, more accurate and extensive data are needed: not only on land size, but also on assets' composition (resulting from past investments), production and sources of income. Such data are currently not available at the global level, and at the national level for some countries only.'

3. Building on local knowledge and active farmer engagement in peer-to-peer learning, knowledge co-creation and capacity building are critical for research uptake and long-term results

Knowledge uptake strategies and capacity building are key to sustained outcomes**.** Projects that had clear knowledge-uptake strategies and invested in capacity building appeared to have better outcomes. The assumption that better knowledge alone will lead to changed behaviour towards positive FNS impact, is too easily made. Dedicated and continued capacity building and training of farmers and enhancing joint learning in learning and innovation platforms are necessary.

4. Introducing adapted and better varieties, practices and technologies provides promising opportunities for increased food availability

This synthesis showed that introducing improved varieties, farming practices and technologies that increase yield, prevent crop diseases and/or enhance soil fertility provide substantial opportunities for greater food availability.[29] Improving smallholders' integration into markets and value chains, however, proved a harder nut to crack.

5. Business prospects enhance the adoption of new crops and technologies

Perceived business prospects and reliable markets are key to motivating farmers to invest in new crops, practices and innovations. Farmers need to feel assured that they take manageable risks while having clear opportunities for financial gain. Put differently, farmers seem less keen to invest in new crops, practices or technologies if they think this will only benefit household consumption. Strong private business partners can help farmers to identify and access business opportunities and help convince farmers to participate in projects in the first place.

6. Addressing structural constraints related to, for instance, land tenure and institutional support can help improve market access and food and nutrition security

Constraining context factors that are often outside of project influence can negatively influence smallholders' capacities for strategic action compared to those of organised agribusiness. These include lacking access to means of production, credit facilities and knowledge; a suboptimal policy and institutional environment (e.g. limited extension services, unfavourable trade laws, a lack of climate change policies); lacking infrastructure; and, importantly, absence of secure land rights. We stress that investments in agriculture-based food security require a minimum degree of tenure security to be sustainable.[30] Agricultural research projects should therefore more proactively seek opportunities to integrate tenure security into their sustainability strategies.

A 'context' factor that was addressed by many projects is the impact of climate change and environmental degradation. Project results suggest that answers can be found in locally developed and tested solutions (e.g. conservation agriculture, irrigation), but that broad responses require alliances of actors as well as political support to push them.

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[29] This finding will be elaborated in the article in this series that focuses on the outcomes for smallholder FNS [link to be inserted later].

[30] The Dutch government emphasises its commitment to ensuring land rights, especially for women and youth, because 'guaranteed land (user) rights are a crucial precondition for sustainable agricultural development and local food security'. Policy letter dated 6 June 2019 'Towards a world without hunger in 2030: the Dutch contribution'.

7. Social innovation – and trust in particular – is critical for effective research uptake strategies and scaling up new technologies

The diversity of results regarding the ability to create truly participatory approaches is likely to have been influenced by a variety of factors. One positive factor might have been the involvement of at least one partner (e.g. an NGO) with substantial experience in facilitating processes of social change. An important lesson from the different projects seems to be that in developing contexts where people often do not show high levels of trust in external actors, a seemingly technical process aimed at increasing food availability is very much a social intervention. Technical success therefore does not automatically translate into broad uptake and scaling.

8. Higher productivity and market integration do not automatically lead to access to more and healthier food

Even in cases where farmers succeeded to access markets and improve their productivity, the extra income did not automatically result in improved access to food and households' food and nutrition security. This causal relationship (higher income leads to improved FNS), is a persistent assumption in most research projects as well as in policy. Yet, it needs to be seriously questioned. Only a handful of projects gave anecdotal evidence of households enjoying more and/or better quality food. In two cases, the opposite happened: increased income led to the consumption of less nutritious status foods. It is possible that the way in which the extra income was spent – on children's education, or setting up a business – may positively affect access to food and FNS in the mid and long term. We therefore recommend further in-depth study of the relationship between income and FNS. Future research projects need the necessary resources to appraise the effects of their innovations on FNS, also after project closure, to create an evidence base. Moreover, we urge policymakers to acknowledge the possible negative consequences of promoting cash crops for farmers' dietary diversity and to take all dimensions of FNS into account, including dietary diversity (utilisation) and stability. There should be clear guidance, specifically for research projects, to take possible negative effects into account to ensure Do-No-Harm principles.

9.Multi-stakeholder collaboration is challenging, yet supports sustained outcomes.

A basic assumption of many projects was that multi-stakeholder partnerships and broad stakeholder participation are needed to create results that are sustainable and benefit smallholders. This is in line with findings from the literature which indicate that smallholders' willingness to invest in specific crops and methods depend on the perceptions they have not only of the crops, but also of the other actors involved in a certain scheme (Reincke *et al.* 2018). While many projects attempted to involve a variety of stakeholders, they also found a key challenge in this aspect of the work. Not all stakeholders could be motivated in the same way, and particularly political buy-in and support were not always easy to garner.

6. A way forward

The positive results of the projects deserve to be widely shared and taken up by other actors and in other projects and programmes. Yet how can approaches from different projects be combined to increase effectiveness and efficiency?

Food and nutrition security is multi-dimensional and can therefore usually not be addressed by changing one specific factor (Reincke *et al.* 2018). Improving FNS by and for smallholders requires an integrated approach. A combination of the aspects addressed in the different projects is likely to have the best effect on food security. For example, rigorous scientific expertise that improves productivity combined with multi-stakeholder engagement that ensures integration of context-embedded knowledge and practices. This will help to create

buy-in and support as well as enable the inclusion of vulnerable groups. Defining research and development objectives and generating knowledge together *with* stakeholders instead of *for* them increases the relevance of the solutions. Bringing different stakeholders together in a fashion that enables women and men, smallholders and businesses, administrators and policymakers to contribute meaningfully is a daring but promising concept. Lastly, explicit efforts to change context factors such as tenure rights, unreliable markets, or the effects of climate change can help to carry results beyond a project timeframe.

Combining rigorous research with practical, output-oriented work and capacity building for advocacy – hence merging an output- and process-oriented approach – seems to be promising. We therefore call on donors to support initiatives that facilitate such integrated approaches and recommend that any such approach is rigorously monitored on process and results to enable adaptive programming and learning.

The synthesis study showed that promising answers can be found in locally developed and tested solutions. Yet it also makes clear that partnerships and reliable political support are needed to achieve impact beyond the local level. The Covid-19 crisis, which emerged after the reviewed projects were finalised, generates many new and extremely urgent questions about FNS worldwide. We call on decision-makers to use the current crisis as an opportunity to design agricultural development and food security policies that guarantee long-term support to smallholders. Given their poverty, they may be disproportionately affected by this crisis, while their importance as local food producers is multiplied.

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Annex 1. Reviewed projects

ARF projects included:

Cassava for Food Security in Uganda

'Cassava Applied Research for Food Security in Northern Uganda'

Harriet Mbabazi (Oxfam Uganda)

https://www.nwo.nl/en/research-and-results/research-projects/i/40/14140.html

Spider Plant in Benin

'Utilizing the genome of the vegetable species Cleome gynandra for the development of improved cultivars for the West and East African markets'

Edgar Deguenon (Hortitechs Developpement, Benin)

https://www.nwo.nl/en/research-and-results/research-projects/i/59/12559.html

Cashew Nut Farming in Uganda

'Introduction of cashew nut for income security for poor farmers in Northern Uganda'

Hellen Acham (North East Chili Producers Association, Uganda)

https://www.nwo.nl/en/research-and-results/research-projects/i/90/11690.html

Integrated Pest Management in Kenya

'Development, Validation and Dissemination of Integrated Pest Management Packages for Tomato Leafminer (Tuta absoluta) and Fusarium wilt-root knot nematode complex affecting tomato production in Kenya'

Geoffrey Ongoya (Koppert Biological Systems Ltd, Kenya)

https://www.nwo.nl/en/research-and-results/research-projects/i/37/13737.html

Farmer-Led Soil Innovations in Uganda

'Farmer-led soil innovations to sustain food production'

Roelof van Till (ZOA, Uganda)

https://www.nwo.nl/en/research-and-results/research-projects/i/11/12211.html

Fertile Grounds in Burundi

'Building on fertile grounds in Burundi'

Geoff Andrews (ZOA, Burundi)

https://www.nwo.nl/en/research-and-results/research-projects/i/89/11689.html

Farmer-led Irrigation in Mozambique

'Unravelling the potential for farmer-led irrigation management in Mozambique'

Wouter Beekman (Resiliência Moçambique Lda, Mozambique)

https://www.nwo.nl/en/research-and-results/research-projects/i/33/14133.html

Potato Seed Innovations in Burundi

'Development of potato seed quality based innovations for small-scale farmers in the three provinces surrounding Bujambura town in Burundi'

Pierre Nahayo (CAPAD, Burundi)

https://www.nwo.nl/en/research-and-results/research-projects/i/13/12213.html

Sesame Yield in Uganda

'Stabilizing sesame yields and production in the Lango Region, Northern Uganda'

Francis Alacho (Africa Innovations Institute, Uganda)

https://www.nwo.nl/en/research-and-results/research-projects/i/62/12562.html

Solar Mango Drying in Ghana

'Development of automated solar-powered fruit drying technology for smallholder farmers in Ghana'

Kwasi Etu-Bonde, Sustenance Agro Ventures, Ghana)

https://www.nwo.nl/en/research-and-results/research-projects/i/49/12549.html

Smallholder Dairy in Kenya

'Innovations for sustainable and profitable intensification of smallholder dairy in Kenya (ISPID)'

Godfrey Nyang'ori (Mt Clara Mtakatifu Mwangaza Centre, Kenya)

https://www.nwo.nl/en/research-and-results/research-projects/i/31/14131.html

Treefarms in Ghana

'Improving smallholders' food and income security by introducing non-timber forest products in reforestation schemes and tree-crop farms: a collaborative learning process in Ghana'

Valerie Fumey Nassah (Research Management Support Centre (RMSC) of the Forestry Commission, Ghana)

https://www.nwo.nl/en/research-and-results/research-projects/i/42/14142.html

Land Governance in Mozambique

'Bridging the gaps between policy and practice on land governance, inclusive business and food security in Mozambique'

Amade Suca (Action Aid, Mozambique)

https://www.nwo.nl/en/research-and-results/research-projects/i/12/12212.html

Local Parboiled Rice in Benin

'Ensuring Sustainable and Sustained Food Security by Enhancing local parboiled rice value-Chain Competitiveness in Gogounou and Banikoara areas in Benin' (PARCR)

Jean Kpetere (DEDRAS, Benin)

https://www.nwo.nl/en/research-and-results/research-projects/i/80/13180.html

GCP projects included:

Sustainable Cocoa in Sierra Leone

'Helping Poor Farmers Grow Money: Sustainable Cocoa Productivity and Socio-Economic Impacts of International Investments in Sierra Leone'

Maarten Voors (WUR)

https://www.nwo.nl/en/research-and-results/research-projects/i/09/11509.html

Market-oriented Dairy Systems and Ethiopia and Kenya

'Assessing and supporting input and advisory service systems for resilient market-oriented smallholder dairy systems in the Ethiopian and Kenyan highlands'

Laurens Klerkx (WUR)

https://www.nwo.nl/en/research-and-results/research-projects/i/94/14294.html

Inclusive Value Chain Collaboration in Ghana and South Africa

'Inclusive partnerships and innovation platforms for sustainable landscapes and greater food sovereignty among tree crop farmers in Ghana and South Africa'

Mirjam Ros-Tonen (UvA)

https://www.nwo.nl/en/research-and-results/research-projects/i/12/11512.html

System Pond Farming in Vietnam

'Nutritious system pond farming in Vietnam'

Marc Verdegem (WUR)

https://www.nwo.nl/en/research-and-results/research-projects/i/08/11508.html

Shrimp Farming in Vietnam

'Assessing the Learning Effects of Games on Attitude of Stakeholders on sustainable shrimp farming in the Mekong Delta, Vietnam'

Arnold Bregt (WUR)

https://www.nwo.nl/en/research-and-results/research-projects/i/37/12837.html