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**An Analysis of the Food System Landscape and
Agricultural Value Chains for Nutrition:
A Case Study from Sierra Leone**

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INTRODUCTION

What agriculture means for nutrition in Africa

One of the greatest challenges in development is to ensure that all people have access to sufficient and quality food to ensure food and nutrition security. The global agriculture system is the main driver to address this challenge. The global agricultural system is producing enough food, in aggregate, but access to enough food that is affordable and nutritious has been lacking, not only in poor nations but wealthy ones as well. Agricultural systems vary across the world -- from large-scale monocrop landscapes to smallholdings of farmers who typically live on less than two hectares of land. At least half of the world's food insecure is poor, smallholder farmers living in low-income countries cultivating on marginal lands without access to productivity-enhancing technologies or markets to engage in commercial agriculture (Shetty 2009).

Many in Africa live in rural areas trapped in a combination of low-productivity agriculture, poor health, and undernutrition. Africa has the highest proportion of rural poor and the greatest potential for smallholder agriculture led poverty reduction (Hawkes and Ruel, 2006). Smallholder farming is the dominant mode of agriculture in sub-Saharan Africa with 80% of its farms comprising of 2 hectares or less. However despite the rich natural resources and food diversity, agricultural growth has not kept up with population growth, and its productivity largely falls behind other regions such as Asia. The agricultural sector in Africa consists mainly of rain-fed, low-technology, low-input, non-mechanized smallholder farming (IFAD 2011) and food production has been insufficient largely due to conflict, natural disasters, crop failure and food prices.

Sensitizing agriculture investments and programs

Largely, agriculture research, programs and policy have not focused on maximizing nutrition output from farming systems and many agriculture interventions have failed to improve nutrition outcomes (Berti et al 2004). While agriculture remains the backbone of the rural economy and increasing agricultural outputs impacts economic growth by enhancing farm productivity and food availability, the emphasis has been mainly on food production and less on nutrition security. Good health, nutrition and productive agricultural systems that do not deplete natural capital are essential in the fight against poverty and are all needed to achieve food security and indeed the wider Millennium Development Goals (Oshuag 2002).

The interactions between health, nutrition and agriculture are mutual: agriculture affects health and health affects agriculture – both positively and negatively (Hawkes and Ruel 2006). If agricultural production systems are poor, there can be negative effects on health, whereas strong production systems can improve health of communities. Similarly, poor health can limit agricultural productivity but improved health and nutrition allows for improvements in agriculture outputs (Hawkes and Ruel 2006). Joint action in agriculture, health and nutrition could have benefits for food security and development and could substantially reduce risks for the poor as well as improving women's status, improving

incomes for the purchase and demand of higher quality foods as consumers, and mitigation of food prices crises (Haddad 2002; World Bank 2007). It is also clear that agriculture plays enormous roles across social, economic and environmental spheres as well

It will be crucial to better understand if and how Africa's agricultural system can improve nutrition security. Big drivers of trends in food consumption in Africa alone are the private sector, informal and formal markets, processed food and diet shifts. Innovative and sustainable approaches to improve the quality and variety of food produced around the world are being developed. Such innovations include improving livestock and small animal rearing, biofortification (e.g. orange fleshed sweet potatoes in Mozambique and Uganda), food fortification (e.g. micronutrient powders for complementary foods), and usage of agricultural biodiversity (e.g. Kenya's traditional leafy green vegetables). Agriculture-based approaches to improving diet diversity and nutrition are not straightforward and many potential solutions are in the research pipeline. Furthermore, the role of food industry and private sector will be crucial in influencing what quality foods get to market and improving nutrition along the value chain.

Nutrition-agriculture value chains

Typically, poor households subsist on monotonous staple-based diets and lack access to nutritious rich foods such as fruits, vegetables, animal source foods (fish, meat, eggs, and dairy products) or wild foods of high nutrient content. Economic constraints, insufficient supply and demand of affordable nutritious foods, lack of nutrition sensitiveness along the agricultural value chain, and limited appropriate information on nutrition for consumers to change behavior are critical factors that limit poor population's access to nutritious foods. Food and nutrient losses along the value chain, which may be caused by ineffective or inefficient harvesting, storage, processing and handling, are other factors that affect the availability, cost and hence affordability of nutrient-rich foods.

Commonly, value chain approaches discuss processes and actors involved from the producer's perspective (i.e. the supply side). Not much attention is paid to the role of informed consumers in influencing the value chains and how changing demands for specific (more nutritious) foods influence processes and outputs of value chains, i.e. the demand side (IFPRI/ILRI, 2010). A focus on both supply and demand side issues within the smallholder value chain allows for identifying entry points along the value chain for food-based interventions that improve both the supply and demand for nutritious foods.

The Model

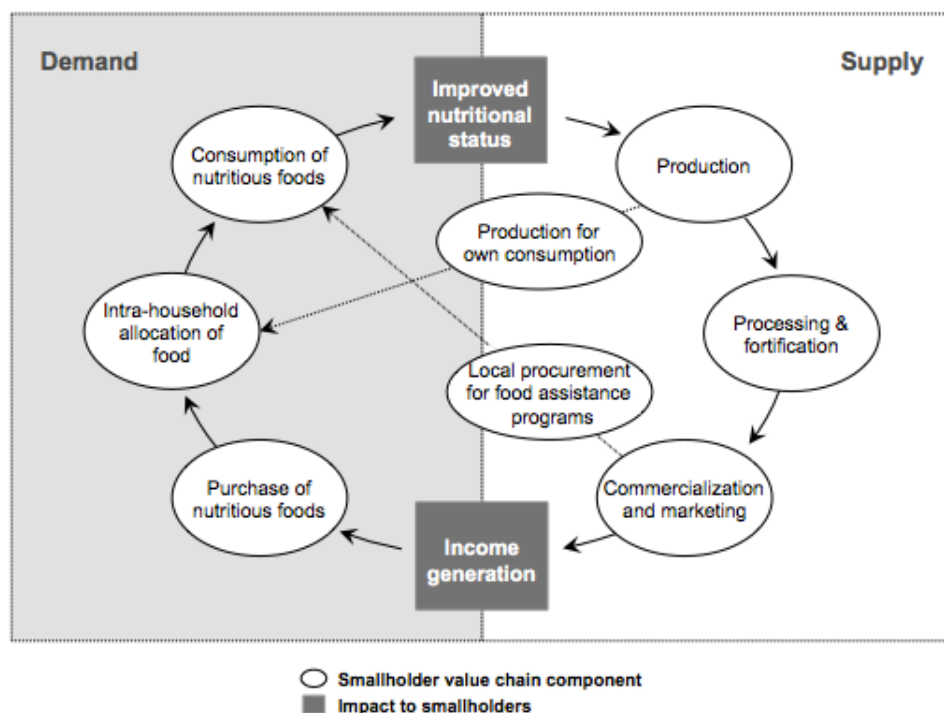
The smallholder value chain depicted in **Figure 1** illustrates several pathways linking smallholder agricultural development to improved nutritional outcomes. The framework does not attempt to capture all the different pathways but concentrates on three different primary pathways linking agriculture with food consumption and nutrition.

The most direct pathway relates to subsistence-oriented production for the household's own consumption. The other two indirect pathways result from the sale of agricultural products to generate income and from local procurement of nutritious foods produced by smallholder farmers for use in food assistance programs (Wiegiers et al, 2011).

The ultimate goal of supply-side initiatives is to improve food availability at household level and to increase household income (i.e. food access). However, evidence has shown that improvements in food supply and household income alone are not sufficient to improve nutritional status. Thus to reflect a nutrition 'lens' on the smallholder value chain, the demand side of the equation – the smallholder farmer as consumer of nutritious foods – must also be considered.

The demand side relates to household decisions regarding purchase of food, allocation of resources to different household members, and knowledge of safe and nutritious food preparation and child feeding practices. Demand-side interventions focus on awareness, behavioural change, knowledge transfer and empowerment in order to increase demand for nutritious foods and improve dietary intake. Resources controlled by women, as well as nutrition education, are critical across the entire chain. Because the smallholder value chain focuses on both demand and supply side issues, the value chain is articulated not as a linear process but as a circle which acknowledges that the smallholder farmer is both the target producer and a consumer of the nutritious foods produced. In this context, 'value' is defined not only in terms of economic impact (e.g. income earned) but also as a social impact through improved nutritional status.

Figure 1: Demand and Supply Sides of the Smallholder value chain (Weigers et al 2011)



Worldwide, women face a series of constraints across the value chain that limit their capacity to produce, generate income and ensure food and nutrition security of their household

members. Different studies have demonstrated how investments in women and gender equality lead to improved health and nutritional status of mothers and their children as well as to increased investments in education of both sons and daughters (Quisumbing 2003; UNICEF, 2007). This smallholder value chain model places strong emphasis on gender and women's empowerment, especially given women's crucial role in agriculture production and family nutrition.

This paper summarizes an operational research qualitative case study conducted in Sierra Leone to explore the programmatic challenges of linking nutrition and agriculture nationally through a food system landscape analysis, and the implementation of nutrition-sensitive value chains of two commodities – rice and vegetables.

CASE STUDY

Programmatic challenges of linking nutrition and agriculture in Sierra Leone

Sierra Leone, the focus of this paper, has challenges. It ranks 180 out of 182 on the HDI and 36% of children under the age of five are stunted, 21% are underweight, and 10% are wasted (WHO LiNS 2012). Almost half (46%) of households are food insecure, according to a measure of per capita access to calories. Many more households likely lack access to diverse diets year round. Nearly 70% of the population live in rural areas where poverty is most pervasive, and the same percentage live on less than \$2 a day. Sierra Leone has gone from being a net exporter of key staple crops to a net importer. Agriculture accounts for ~50% of GDP, engaging 95% of the rural population. Production is characterized by small-scale, subsistence farming with a majority of farmers cultivating less than 2ha of land. There is strong political will to support smallholder commercialization through the Smallholder Commercialization Scheme highlighted in National Sustainable Agriculture Development Plan and signed CAADP Compact and the Government's PRSP 2008-2012 "Agenda for Change" identifies huge potential for agriculture-led, rural economic development.

The research was conducted led by REACH (Renewed Efforts against Child Hunger and Undernutrition) and conducted by Sierra Leone Agricultural Research Institute in collaboration with Wageningen University and Research Centre (WUR). REACH is a partnership jointly established by the United Nations Food and Agriculture Organization (FAO), World Health Organization (WHO), United Nations Children's Fund (UNICEF) and the World Food Programme (WFP). The REACH partnership aimed to develop and test national models to boost nutrition programmes and scale up demand for nutritious foods through purchasing locally from small-scale farmers. The project is funded by a US\$1.1 million grant from the Bill & Melinda Gates Foundation to REACH, via the United Nations World Food Programme (WFP), the host agency of this joint UN initiative. The objectives of the partnership are threefold:

1. Identify ways to link smallholders to nutrition programming;
2. Provide guidance to critical stakeholders to sustain agriculture-nutrition linkages; and
3. Facilitate coordination of agriculture-nutrition linkages at country, regional, and global levels.

STAGE 1: Mapping the agriculture-nutrition Landscape

Objective of the Mapping

To provide foundation for the operational research and the scaling up of essential agriculture and nutrition actions, a broad mapping exercise was undertaken in Sierra Leone through a country-wide survey of local communities and stakeholders involved in agriculture and nutrition in country.

Methodology

This stage of the case study was done with qualitative methodology and observations from stakeholders were of their opinions and perceptions. These observations were not complemented with other data sources for validation or verification. The research involved

two groups of respondents, namely, key informants from organizations providing agriculture and nutrition interventions, and rural consumers comprising of youth (18-35 year old men and women), adult men and adult women including lactating mothers, pregnant women.

Key informant interviews were conducted on 40 government and non-governmental organizations resulting in 120 interviews. A maximum of three interviews per organization with interviewees responding to one or a combination of the seven sections of the questionnaire, which included crop production and marketing; food processing and fortification; income generating activities; agricultural extension and nutrition education; social protection programs including school feeding and food assistance; complementary, supplementary and therapeutic feeding; and linkages between diseases and nutrition.

Focus group discussions were conducted with eight communities around the country with two communities selected from each of the four administrative regions of Northern, Southern, and Eastern provinces and the Western Area. In each of the communities selected, three focus group discussions were held with producers and consumers on their perceptions of nutrition, food security, agriculture and livelihoods.

The research tools were developed by a team of researchers from the Sierra Leone Agricultural Research Institute, Njala University, the Ministry of Health and Sanitation, and the Ministry of Agriculture, Forestry and Food Security with technical assistance provided by Wageningen University and REACH.

Data from the focus group discussions and key informant interviews were captured on tapes and transcribed by the research team.

Results

Diets, Knowledge and Perceptions of Rural Consumers about Agriculture and Nutrition

The main livelihoods are food crops (rice, cassava, sweet potato, yam, sorghum, millet), tree crops (cocoa, coffee, oil palm), vegetable production, piggery, cattle, small ruminants (goats, sheep), commercial poultry, backyard poultry, hunting, fishing, logging timber, off-farm employment, small business enterprises, and illegal business operations such as prostitution and drug dealing. These livelihoods are pursued by both men and women.

With regard to agriculture, farmers indicated that there has been a gradual increase in farm production in terms of both acreage and yields; more adoption of agricultural technologies for improved farming; gradual change of attitude to move from subsistence to commercial agriculture; increased awareness and knowledge about agriculture and nutrition technologies and innovations; and diversification of food production and feeding habits.

Rural consumers indicated that they have knowledge of what is a good diet however they don't always have access to what would constitute a diverse, nutritious diet. For them, 'a good diet is one that has cassava leaves, fish, meat, palm oil, and green hot peppers', or 'one that is sweet with palm oil, groundnut, fish, meat, beans, and eating with rice'. For many rural consumers, the perception of a nutritious diet is an extravagant use of resources. For example, a diet with little palm oil is not good enough. Palm oil could in fact form the major determinant of a good diet. There was consent in both the men and women's group

discussions that the problem is not the lack of knowledge, but that of poverty and wastage during the harvest season that affect diets in rural communities.

The causes of malnutrition as perceived by key informants were divided into three categories, namely, those related to food insecurity at the household level, those related to poor utilization of food in the household, and those related to inappropriate feeding practices at the household level. According to the key informant interviews and focus groups, lack of knowledge on nutrition, and poor infant feeding practices driven by taboos and wrong beliefs were two of the major causes of malnutrition.

Effects of Agriculture Interventions on Nutrition

The organisations that participated in the study supported two major areas of agricultural interventions below:

- **Crop production:** organisations are enhancing the capacity of farmers (inputs, training, technology etc) to increase their production while also lobbying for an enabling environment from government.
- **Marketing:** there is effort by Government and Non-Governmental Organizations to link farmer groups with private companies, thus removing some of the marketing constraints encountered by business entrepreneurs. The efforts include working with local manufacturing companies along the food value chain for commodity crops like rice, cassava and vegetables, organizing temporary markets for farmers at the farm gate, rehabilitation of old markets and the construction of new community markets, construction of stores and drying floors, and building capacity of business entrepreneurs in business management.

STAGE 2: Ensuring value chains work for nutrition – Sierra Leone as a case study

Objective of the case study

A detailed intervention analysis on value-chain factors and opportunities in a few specific, high potential cases identified from the mapping exercise was conducted in Sierra Leone. The intervention analysis mainly concentrated on rice value chains, small-scale commercial vegetable production initiatives, and their potential for improving nutrition. The main objectives of the analysis were to (1) assess the nutritional impact of the rice value chain development and small-scale commercial vegetable production on smallholder producers and their families; and (2) identify the key entry points for improving nutrition for smallholder producers and their families involved in rice and/or vegetable production.

Methodology

Due to the missing nutritional baseline, the intervention analysis was written as a qualitative approach, and should be regarded as an exploratory study. In this study three main entry points to improved nutrition were identified. These were (1) production-related, which increases food availability and diversity; (2) processing and packaging related, which increases income, shelf-life, and nutritional value, and (3) marketing related, which increases income through sale of agricultural commodities. These entry points can only contribute to nutrition if, as in points 1 and 2, the increased income is used for nutritious foods. The data was collected through a series of interviews in the different households, which were chosen randomly in four communities from different chiefdoms of each district, as well as with the different organizations present in the area. The intervention analysis concentrated on two areas in Sierra Leone. The rice value chain was analyzed in the Kambia district, and the small-scale commercial vegetable production was analyzed in the Koinadugu district.

Results

Kambia and the rice value chain

Kambia district is located in the Northern Province of Sierra Leone. Its inhabitants are predominantly Muslim. The district has been identified as the main district for rice production, which also constitutes the main income source. The main rice grown is upland rice, with smaller amounts of swamp and riverine rice. Rice production is a livelihood strategy dominated by men. Women mostly participate in the production of other crops or provide labor. As a result, men are the main earners and controllers of money from the rice value chain. More than half of the produced rice is sold; the remaining is used for household consumption. The income from rice is mainly used for non-food purchases. Rice is the main staple food in Kambia, and the typical diet mainly consists in starchy foods.

The main actors in the rice value chain are NGOs, FBOs (farmer based organizations), ABCs (agricultural business centres), the Ministry of Agriculture, local and international traders, and individual farmers. These organizations mainly work in training, supply, processing, and marketing support, and for the most part do not collaborate with health institutions. The nutritional impact of the rice value chain on production has been discussed with regard to the characteristics, the nutritional impact, and the entry points for improved nutrition and health. According to key Informants and farmers, there has been an increase in production over the last decade. The adoption level of new technologies has increased due to awareness of added value of these technologies. The farmers are working more with the extension workers and are learning more about best practices. There has also been an

increase in the availability of new variety seeds. Unfortunately despite an increase in overall production, the availability of rice for own consumption has not adequately improved. This is because production levels are still low, most of the rice produced is sold, and there has been an increase in household sizes.

Some NGOs are providing the farmers with seeds for production diversification, but this is not having a nutritional impact because upland farmers are growing other starchy, low nutrients staples after the rice harvest. In the present situation, the impact of rice production on the nutrition intake and status of smallholders and their families is limited, but several potential entry points were identified along the rice value chain to improve their nutritional status:

- **Nutritional impact of the production component:** Improving the nutrient content of rice is a good entry point for improving nutrition via rice value chain development. This can be done by using fertilizer, crossbreeding and improved agricultural practices. One crucial point is to educate farmers on nutrition in order for them to understand the importance of crop choices and their effects, and encourage them to further diversify their crops. As there is low crop diversity in this district, and the cash crops (ie. Rice) are male dominated, the implementation of a home-garden project targeted at women may contribute to increasing nutrition at a household level.
- **Nutrition impact of the processing/packaging-related component:** After harvesting, the rice goes through several processes before it is ready to be sold. Traditional methods are still widely used to process rice. The most common processes carried out in this area include: threshing, winnowing, steaming & parboiling, drying, milling, sorting and finally the rice is bagged and transported for sale or storage. Processing rice can have several positive impacts: increased income by adding value to the product, increased food availability through increased shelf life, increased nutritional value of the rice. To improve the impact of processing on the nutritional intake and status, this study identified several entry points. In addition to the need to improve drying and storage (in terms of facilities and knowledge) and to increase access to milling machines, the main entry point relates to fortification during the parboiling process. Fortification of rice with micronutrients such as iron and zinc during the parboiling process can significantly improve the nutritional quality of rice.
- **Nutrition impact of the marketing component:** Selling the product is mainly done in markets and they are open to both men and women. The main obstacles preventing farmers to access markets include long distances, poor infrastructures and a poor transportation system. Nutrition could be potentially increased by using increased income from the sale of agricultural commodities. However this has not been the case as most income is spent on non-food purchases. Most of the money spent on food is used to buy starchy nutrient poor staples because other food items are expensive. While agricultural interventions that support smallholder commercialization have the potential to reduce malnutrition through increased income, evidence has shown that increased income alone does not necessarily translate into improved nutrition. These interventions should be combined with nutrition interventions.

Koindagu small-scale commercial vegetable production and its impact on nutritional status

The Koindagu district is known for its vegetable production. It is, like Kambia, located in the Northern Province and is geographically the largest district. In this area women are mostly responsible for vegetable production while men are involved in cattle farming or trading. Vegetable production contributes to about 50% of the household income. This income is largely controlled by men and few of the vegetables grown are consumed by the farmers.

The main actors in this region involved in small-scale commercial vegetable production are farmers, FBOs, ABCs, local traders, wholesalers, VSLs (Village Loaning and Sales groups), the government and NGOs. Most farmers in the area, both men and women, are organized into farmer field school groups, where they receive trainings concerning nutrition, health and agricultural techniques. The main challenges in collaboration between the various key actors are unwillingness of farmers to participate in interventions implemented by NGOs and the Ministry, mostly because experienced farmers doubt the expertise of field staff. Besides, cultural beliefs and taboos prohibit community members from participation or adherence to messages and newly gained knowledge. Also there is a lack of collaboration among NGOs which results in a lot of NGOs doing the same things. Finally, transport poses a major challenge to all key actors in Koinadugu, due to a lack of infrastructure.

Vegetable production has recently become the main livelihood and income source in Koinadugu. The main reasons for this shift to vegetable production for (mostly female) farmers are the possibility for continuous cropping due to seasonal differences between various crops and the high income that can be obtained with vegetable production as compared to other crops. However, continuous cropping and burning of land leads to nutrition depletion of the soil and subsequently lower yields. Further, during the dry season there is not enough water available, since a good irrigation system is lacking. Another downside of vegetable production is the high level of pests and weed infestations.

The farmers indicated that even though productivity has increased over the years, the actual food availability within the household has decreased. The main reasons are increases in household population and lack of labor to cultivate available land. According to the Ministry of Agriculture, more diverse crops are being produced as compared to previous years. This crop diversification has however not translated into a diversified diet. Reasons for this are that the majority of the vegetables is sold instead of being used for own consumption.

Another pathway via which production leads to increased food availability as well as to diversification according to NGOs is the implementation of backyard farming by women's groups in some of the communities. This backyard farming implies women growing vegetables on very small-scale for home consumption. Finally, impact on nutrition via production is also achieved at school level. CAUSE Canada and CRS have implemented a school gardening programme. Within this programme children learn how to grow and prepare vegetables and are educated on the nutritional value of these crops.

As for the Kambia district, several entry points were identified along the vegetable value chain for improved nutrition:

- **Nutritional impact of the production component:** Secured land access is one of the main points to be addressed as especially women can only rent land for one year. Improved access to labor would allow farmers to use more land. Access and

training on how to prepare traditional vegetables and other seeds or food support to maximize nutritional content should also be considered. A direct impact on nutrition can be brought forth by scaling up school gardening programs, and by improved cooperation of farmers in FBOs. The government has already begun offering workshops to increase farmer knowledge and on the preparation of various crops for improved nutritional status.

- **Nutritional impact of the processing/packaging component:** Processing and packaging can be very important tools as they can increase income, increase food availability through increased shelf life, which would also allow for more household consumption, and preservation techniques which can make vegetables and fruits available all year. Currently, there is almost no processing of vegetables taking place. Small minorities practice some forms of processing by drying their vegetables and by making tomato paste. However since processing is often not done correctly, or done using unhygienic equipment, spoilage rates are still high. These processing methods mainly target women, as they are primarily responsible for this. However, more research is needed on traditional processing and conservation methods. It could also be suggested to introduce processed traditional vegetables into urban markets to be sold at a cheaper price than other low nutrient “fast foods”. A lack of cool rooms is another extremely important problem, as very high spoilage rates are prevalent. Due to this, most of the crop is immediately taken to the market and sold, leaving little or nothing for home consumption. Affordable cool room storage is being provided in market vicinity by different organizations.
- **Nutritional impact of the marketing component:** There are markets in the area, ranging from local markets to markets in Freetown. Most vegetables are sold in Freetown by both men and women. For the most part, almost all of the produced vegetables are sold. The main challenges faced when selling at the market is the poor infrastructure and transportation, lack of storage and cooling facilities, and price volatility. Marketing can have an impact on nutrition mainly by obtaining better prices for vegetables sold, if the income is used for food items. However prices are still mainly determined by wholesalers who monopolize their position. Improved infrastructure, access to transport and closer markets, as well as storage facilities could all play a part in improving nutrition through the resulting higher income. Access to transport and storage facilities as well as closer markets would also decrease spoilage rates of transported vegetables and increase the production amount. The fact that Koinadugu is known for its vegetable production results in traders coming straight to the district, which is favorable for opening other markets. Training in bargaining and negotiating is also being offered.

DISCUSSION and CONCLUSION

Summary of Case Study

The mapping study examined the perception of communities and roles of organizations of the Sierra Leone food system and linkages between nutrition and agriculture. The detailed intervention analysis has looked at both the nutritional impact of rice value chain development and small-scale commercial vegetable production on smallholder producers and their families and the potential entry points for improving nutrition. This research used various pathways along the value chain for identifying how rice and vegetable production initiatives could contribute towards improving nutritional intake and status. Current agriculture interventions on rice value chain development and small-scale commercial vegetable production focus predominantly on the production and income side of the smallholder value chain and clearly this is insufficient to improve the nutrition intake and status. Partly this is because nutritional considerations are not an integral part of these interventions and partly because it takes time to change behaviour.

Major observations

Gender inequalities prevailing in rural areas

Women are considered as men's property. They have no access to land's ownership nor credit. There is also evidence of low representation of women in decision-making concerning land and credit acquisition, use of productive resources and the sale of farm produce. Yet women carry the heaviest burden of household responsibilities in the rural household. On each component of the value chain (rice and vegetables), the main challenge might be empowering women to make informed decisions on feeding and caring practices, and improving women status, enabling them to access land and credit, to participate in decisions about the allocation of the household's budget.

Limited awareness of appropriate preparation methods

Diversifying dietary intake by providing small-scale farmers with a variety of vegetable seeds did not have the desired effect, since almost all of the produce is sold instead of using some of the crops for own consumption. The main reasons for this, besides need for money, are that women do not know how to use these vegetables and farmers and their families prefer their traditional diet. Education on how to prepare the vegetables and on their nutritional value should be provided.

Failure to include highly nutritious crops in diets

Even when small-scale farmers are aware of the importance of highly nutritious crops, they still cannot always include these crops in their diet due to high prices or limited availability. Increased income from production is often used to pay debts instead of being spent on food.

Low shelf life of vegetables

Another challenge in small-scale commercial vegetable production is the shelf-life of vegetables. Especially due to lack of proper storage and good transport facilities vegetables spoil easily. Therefore, farmers sell all their produce, even if they are aware of the nutritional value, due to the perishable nature of the crops. Currently there are no initiatives promoting processing of vegetables.

High levels of illiteracy

High levels of illiteracy continue to have negative implications on awareness, access and adoption of technology. Illiterate farmers are unlikely to take initiatives in venturing into new grounds of technology adoption.

Recommendations

Nutrition education: Nutrition education and communication strategies should be incorporated along the value chain that target behaviour change in order to increase male and female smallholders' knowledge about the nutritional significance of the foods they produce and purchase and to enable them to make better production and consumption decisions. A largely unanticipated challenge is that most women are unaware of proper preparation methods of most vegetables which lead to losses of important micronutrients. Interventions should thus not only emphasize the importance of vegetable consumption, but also provide education on proper preparation methods of these vegetables. For example knowledge (of men and women) on safe and nutritious preparation of vegetables should be improved when providing vegetable seeds. In addition, school gardening programmes should be expanded to stimulate children in learning how to grow and prepare vegetables and about the nutritional value of these crops.

Processing: Programmes should strengthen food processing and value addition of foods produced by farmers. For example initiating and supporting scale-up processing of vegetables to enhance added value and shelf-life. Promote and support improved methods of parboiling of rice and possibly fortification of rice with micronutrients such as iron and zinc during the parboiling process would also enhance the nutritional value of rice, a staple food in Sierra Leone.

Access to credit: Financial constraints to cover initial investment costs of adopting new technologies are critical. Reliance on external grants is not sustainable in the long term. The inherent fear of formal loans, the need for collateral, and the consequences of default in repayment tend to counter efforts to empower farmers to access credit, especially women farmers are discriminated against as compared to their male counterparts.

To prevent distress sale of rice and to allow both rice and vegetable farmers to buy sufficient farm inputs in time for the planting season, strengthen existing credit initiatives and include requirements related to maternal and child preventive health, care services or school enrolment. Flexible and convenient credit facilities that allow poor households to borrow funds to cover emergencies would result in smoothing and stabilization of household consumption which is crucial in reducing vulnerability to hunger, malnutrition and disease. Farmers also need financial support to invest in income generating activities such as processing or fortification.

Design of holistic value chains: The study observed that there was inadequate attention to value/market chain during the planning and implementation of project proposals by NGOs and community based organizations espousing the initiative. Most of the existing interventions address only one step of the value chain, being too restrictive and specific and

therefore have very little impact. For example, many production interventions do not address processing, fortification, packaging and marketing issues, which makes it difficult for farmers to add a real value to their produce.

Poor infrastructure is also a major constraint, but at present, there has been much emphasis in Sierra Leone on commercializing agricultural production hence adequate production and distribution of food has become a high priority. Providing agricultural inputs- seeds and fertilizers- to farmers and working on improving infrastructures- like irrigation systems, storage facilities or processing equipment - are a necessity to achieve this goal. Unfortunately, the needed infrastructure is presently inexistent or poorly organized.

Coordination of key actors: The present goal of the Ministry of Agriculture, Forestry and Food Security is to move from subsistence to commercial farming. The MAFFS is a leading provider of interventions and initiatives in agriculture and nutrition and is currently involved in a number of interventions. The MAFFS in collaboration with the MoHS can take a lead in the coordination of agricultural production and nutrition interventions in the country and can closely work with NGOs such as Cooperazione Internazionale (COOPI), ACDI/VOCA, Concern Worldwide, the Binkolo Growth Centre in the Northern Region and other which are already involved in providing interventions that aid production, processing and nutrition. There is a need for effective coordination between organizations involved in agriculture/nutrition activities. The present Nutrition Technical Committee should be strengthened by including other actors.

Conclusion

Integration of markets and value chains into the global nutrition framework

The links between what is produced on the farm, the consumer who buys that food, and the income received by the producer does not stop at production (Hawkes and Ruel 2010). Food is stored, distributed, processed, retailed, prepared and consumed in a range of ways that affect the access, acceptability and nutritional quality of foods for the consumer. Value chains are thus fundamental to consumption, dietary and nutrition perspectives and not only in terms of the supply of foods. Little emphasis has been given to how consumers can play a role in influencing value chains and how changes in the demand for specific foods can influence the processes and outputs of value chains. There has also been little attention given to how actors, particularly women along the value chain can be better informed on enhancing the nutritional value of local foods. Food and nutrition systems need to be rethought by creating new business paradigms that engage smallholder farmers from a livelihoods perspective but also from a health and nutrition perspective.

The research undertaken in this project aimed to understand the role markets and value chains play in improving nutrition and dietary diversification both directly, through an increase in the production of nutritious foods sourced from smallholders in Sierra Leone, and indirectly, through an increase in income for smallholder farmers. Similarly, smallholder farmers can diversify their diet and improve their nutritional status either by producing more nutritious foods directly or by accessing more nutritious and diverse foods in markets through a rise in their disposable incomes. Evidence has shown that smallholder

commercialization can have both positive and adverse effects on nutritional status (World Bank, 2007; Jaleta et al., 2009; Bouis and Haddad, 1990).

When generally examining the value chain model presented, in the case of Sierra Leone, rice and vegetable production systems could fit into both the direct pathway related to *subsistence-oriented production for the household's own consumption* as well as the indirect pathway, resulting from the *sale of agricultural products to generate income*. The Sierra Leone analysis has identified various pathways through which rice and vegetables production, processing and marketing could contribute to improving nutritional status and health. These include increased food availability and diversity for own consumption through crop diversification and improved production, increased income from the sale of agricultural commodities as a result of added value, improved shelf life and stability of supply, and improved nutritional value through processing and packaging. Some organizations are already conducting agricultural interventions, but little evidence could be found on an improvement of the nutritional intake among smallholders involved in rice and vegetable production. This was most apparent in the rice value chain, where traditional and religious practices hindered any behavioral change. Several obstacles were identified, and future interventions should address them. Almost all the crop is sold, and the income used mainly for non-food purchases. Parboiling, which increases the nutritional content of rice is not widespread, and only practiced by a few smallholders. In the case of the small-scale commercial vegetable farmers, most of the produce was sold, and therefore there was little to no improvement of the household dietary diversity. The preparation of the local vegetables leads to losses of important micronutrients, and any increased income is mainly spent on non-food purchases.

Many entry points have been identified to further concentrate on improving nutrition through agricultural practices and access to markets in the Sierra Leone case study. These are, incorporating nutritional education and communication strategies along the value chain and improving the knowledge of men and women on nutritious preparation of vegetables. Expanding school programs is also very important. Scaling up the initiative on increasing the shelf life of foods would mean a greater availability for home consumption as well as a higher income. Promoting and supporting parboiling of rice is also important as rice is the main staple in Sierra Leone. Overall, agricultural interventions would achieve greater impacts when coupled with nutritional interventions. More efforts should be made on producing a year round production of nutritious foods, improving shelf life, and promoting educational strategies. Agriculture and health actors would benefit from jointly developing nutrition indicators to insert into the value chain that address both nutrition and agriculture. While a single intervention targeting only one component of the value chain is likely to have a limited impact, addressing all the identified issues, with several interventions at different levels of the chain can make a real difference.

Understanding the challenges and gaps in the value chain from a nutrition perspective is critically important and the analysis on the rice and vegetables chains in Sierra Leone provide a local context on how these commodities move along the value chain and where, potentially, the chains can be improved from a nutrition perspective. Much of the analyses done within this project examined the supply side of the value chain – from production to distribution to consumption. Often, in Africa, smallholder farmer producers are the same as the consumers, and more often, these farmer consumers are women. The analysis done in

this project highlights the opportunities for engaging women in value chains, and their potential role as “change agents” to ensure that nutrition is better integrated along the value chains as producers and consumers (IFPRI/ILRI, 2010).

Evidence for acting at scale

To date, the adaptation of value-chain concepts to nutrition has been limited; a few examples exist and those that actually measure the nutritional impact, within a value-chain approach, are currently limited (Hawkes and Ruel 2011). However, more studies are underway and more projects are beginning to integrate nutrition into value-chains -offering considerable potential for enhancing efforts to improve nutrition. They also provide a framework within which opportunities for leveraging agriculture for nutrition can be identified and implemented. The nascent field of value chains for nutrition should center on identifying and implementing interventions to develop value chains for enhanced nutrition and on identifying opportunities to do so (Hawkes and Ruel 2011).

From the Sierra Leone model, in-country experts recommended one area for immediate scale-up: transformation of smallholder enterprises from subsistence entities to commercial businesses complemented with nutrition education. This includes farming, processing, fortification, and marketing initiatives on-going in the food value chain. Plans for transformation are already underway in Sierra Leone by the smallholder commercialization program in the Ministry of Agriculture, Forestry and Food Security. Other organizations and actors involved in providing interventions in agriculture and nutrition must integrate the transformation process as an integral component of their interventions and/or actions.

In light of the foregoing, the government of Sierra Leone in collaboration with the Food and Agriculture Organisation of the United Nations launched a national wide project to mainstream food and nutrition security and the right to food into the smallholder commercialisation programme (SC), as a means of guiding the government’s dual objective of wealth creation and improvement of food and nutrition security. The project, funded by the Federal Republic of Germany, to a tune of about US\$2.5 million, is the first large scale initiative directly addressing the issues and implementing the recommendations presented from the formative research in this paper. Among the keys strategies in the project are: the development of food based dietary guidelines as an integral part of a nutrition education and communication strategy; developing capacity in nutrition by integrating food and nutrition security and the right to food in the certificate, diploma and degree training curricula of the faculty of agriculture at Njala University as well as in the in-service training programmes for agriculture extension staff, farmer field schools (FFS), farmer based organisations (FBOs) and agriculture business centers (ABCs); promoting proven practices that link agriculture to nutrition (such as community, clinic and school gardens; community based cooking demonstrations; small livestock promotion and others) for adoption at both policy and programme implementation stages; and technical support for policy processes and coordination of food and nutrition security at national and district levels. This project offers an opportunity for adaptation of the value-chain concepts to nutrition in Sierra Leone, it is thus a significant first step. However, the magnitude of the problem would require more investment and resources than what the three years project can offer hence the need to sustain this kind of support and ensure effective mainstreaming of food and nutrition security in the smallholder commercialisation programme.

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