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Shortening food supply chain in home-grown school feeding: experiences and lessons from south central China

RESEARCH ARTICLE

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Abstract

Both home-grown school feeding (HGSF) and short food supply chain (SFSC) emphasize on proximity and aim to strengthen the competitiveness of local smallholder farmers. From a theoretical perspective, HGSF implemented as a type of SFSC could help deliver synergies. A pivotal question is how HGSF can be combined with SFSC and the benefits and drawbacks of such combination. Using an HGSF program which was implemented as an integral part of a free preschool lunch pilot in South Central China, this paper shows that HGSF and SFSC (in its full term) could be combined through one structured demand intervention. This study uses both qualitative and quantitative materials. Qualitative data were collected through focus group discussions with government and preschool staff, parents or caregivers, cooks, World Food Programme representatives and other stakeholders involved in the pilot program. The quantitative part used both small panel data and cross-sectional data from 106 smallholders. This study analyzes the design, implementation, good practices, benefits and constraints of the HGSF-SFSC model. We find that direct purchase from smallholder farmers was linked with higher income and production and dietary diversity. Moreover, this study identifies several constraints of the current HGSF-SFSC model. The policy implications for sustaining and scaling up the current pilot are discussed in the paper.

Keywords: home-grown school feeding, short food supply chain, smallholders, structured demand, alternative food networks
JEL codes: I18, I30, Q11, Q13

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1. Introduction

Many semi-subsistence smallholder farmers are trapped in a poverty trap because they are in a vicious cycle of low inputs, low productivity and lack of incentive to engage in market-oriented production (Meemken and Bellemare, 2020). Smallholder farmers' market participation has been central to food security (Montalbano *et al.*, 2018), rural development and poverty reduction (Barrett, 2008). Public institutional procurement involving food has become a popular tool for connecting large predictable markets to small-farm sector (Sumberg and Sabates-Wheeler, 2011). This has been achieved by a structured demand through government interventions. Such kind of demand creates a stable market opportunity and price benchmark for smallholder production (FAO and WFP, 2018), thereby offering greater assurance in farm planning, lowering risks for market engagement, and ultimately providing incentives to increase investment and productivity (Sumberg and Sabates-Wheeler, 2011).

Home-grown school feeding (HGSF) is of particular interest as it provides an example of such kind of an intervention to mitigate risks faced by smallholders through a structured demand. There is no consensus in the definition of HGSF. Broadly speaking, HGSF is a school feeding program that provides food produced and purchased locally (FAO and WFP, 2018). There is less agreement in the term 'locally', depending on the context it could mean, e.g. within a country or domestically produced or within the boundary of the county/township/village where the schools are located (Sumberg and Sabates-Wheeler, 2010). Globally, school feeding programs reach about 388 million children in at least 161 countries for a total investment of $40 billion a year (WFP, 2020). Over the last two decades, governments and international agencies have shown interest in linking school feeding program with local agricultural development. For example, in Brazil, local procurement has been written into legalization of the national school feeding program in 2009 (Schneider *et al.*, 2016). Recent evidence from Nepal shows that home-grown school feeding strengthened operations of the school meals program and led to a significantly higher meal provision and quality of school meals (Shrestha *et al.*, 2020).

The growing interest in linking public institutional procurement involving food to local agricultural development, along with the increased concerns to secure healthy, affordable and sustainable food production, have led researchers and policy-makers to shift focus to practices that can increase food security and boost local agricultural development without negatively impacting the environment. Motivated by such interest and concerns, policies are moving beyond the conventional food production and marketing practices. Both HGSF and short food supply chains (SFSCs) are considered as promising strategies for food security and local agrifood systems transformation for health and sustainability (FAO and WFP, 2018; González-Azcárate *et al.*, 2021). Under the above-mentioned notion of HGSF, local purchase does not necessarily mean purchase from smallholder households, nor does it mean purchase directly from smallholder farmers without other intermediaries in the supply chain. In fact, one of the objectives of WFP's HGSF program is to 'increase direct purchase from smallholders, reducing the roles of other participants in the supply chain who diminish their purchasing power' (FAO and WFP, 2018). Such objective is mostly consistent with the idea of SFSC, which is a form of alternative food network underpinned by the notion of re-establishment of the closeness between producers and consumers (Bos and Owen, 2016; Dubois, 2018; Paciarotti and Torregiani, 2021). As such, with the increasing popularity of and attention paid to the short food supply chain, there is good potential to combine HGSF with the development of SFSC in order to deliver synergies.

Even though both HGSF and SFSC have the potential to strengthen the competitiveness of local smallholders, increase their income and food security, they are often viewed as separate pathways towards sustainability. In this work, following a mixed research design, we use the case of Xiangxi to explore the direct purchase HGSF-SFSC model, which has been mostly ignored by the extant literature. This model links school feeding program directly with smallholder production and limit the participation of intermediaries to the extent possible. The objective of this study is to analyze the design and implementation of the structured demand under the most decentralized HGSF model, namely HGSF with a combination of SFSC, using recent practices in South Central China as a case study. We aim to unpack the implementation and the synergies delivered of this model. The good practices, the lessons learned and the challenges faced looking ahead are also discussed.

This study contributes to the existing literature in three important ways. First, WFP is supporting governments of different countries in testing and implementing different home-grown school feeding models. This paper focuses on a special model practiced in China (i.e. HGSF-SFSC) and thus providing more contextual experiences and lessons which facilitates comparisons across various operating models. Second, while the current literature in this strand are mainly narrative and descriptive, this study fills that gap by unpacking the good practices, opportunities and constraints of Xiangxi model using a combination of qualitative and quantitative analysis. Third, the study uses Xiangxi' case to explore HGSF from the perspective of food supply chain length and alternative food networks, which has been largely under-researched and overlooked in the previous studies.

The rest of the paper is organized as follows. In the next two sections, we present the key narratives, concepts and models of combining HGSF with SFSC. In section 4, we discuss the conceptual framework used to analyze HGSF-SFSC including its implementations, action and benefits. Section 5 presents the materials and methods for this study. Section 6 reports results and the last section concludes.

2. Home-grown school feeding and short food supply chain: what are they and why do they matter?

2.1 Home-grown school feeding

HGSF has been defined in a number of ways. We summarized three representative definitions in Table 1. Undoubtedly, the distinctive link between school feeding and local production is a common feature shared by all these definitions. The innovative element of HGSF is the link of smallholder agricultural to social protection programs through a structured demand to reduce risks and uncertainties regarding smallholders' market opportunity and market engagement. Since the emergence of HGSF in 2003, such programs have in practice focused on promotion of smallholder sector.

Sumberg and Sabates-Wheeler (2011) highlight that HGSF can achieve social protection and agricultural development with one single policy. In fact, beyond that, HGSF has good potentials to deliver a combination of benefits from the same program (FAO and WFP, 2018). For example, it is related to multiple sustainable development goals (SDGs) on the 2030 agenda, including ending poverty (SDG1) and hunger (SDG2), inclusive and equitable quality education (SDG4), the empowerment of girls (SDG5), decent work and economic growth (SDG8) and the reduction of inequality (SDG10). When it is linked with SFSC, some additional benefits could occur such as ensuring the beneficiaries are more targeted, which we will elaborate in what follows.

Table 1. Definitions of home-grown school feeding.

Source	Definition
WFP (2009)	'In the broadest sense, HGSF is a school feeding program that provides food produced and purchased within a country to the extent possible'
NEPAD's Comprehensive Africa agriculture development program (CAADP) in pillar 3: 'Food supply and hunger'	'… designed to link school feeding to agricultural development through the purchase and use of locally and domestically produced food'
FAO and WFP (2018): home-grown school feeding resource framework. Technical document	'HGSF constitutes a school feeding model that is designed to provide children in schools with safe, diverse and nutritious food, sourced locally from smallholders'

2.2 Short food supply chain

Although there is no unified definition of SFSC (Kneafsey *et al.*, 2013), it is generally considered as alternative food marketing networks which facilitates smooth linkage and communication between producers and consumers through limiting the number of intermediaries between producers and consumers (none or minimal) (Charatsari *et al.*, 2020). As pointed out by Aggestam *et al.* (2017) and Charatsari *et al.* (2020), such arrangement focuses on re-establishing a close and mutually beneficial relationship between food producers and consumers rather than maximizing the profit. Developing short food supply chains gained significant momentum over recent years as a result of consumers' increased perception towards pro-environmental and high-quality food choice (Giampietri *et al.*, 2016; Sellitto *et al.*, 2018), farmers' desire to regain the central position and maintain competitiveness in the food networks (Chiffoleau *et al.*, 2019), and both producers' and consumers' willingness to restore the closeness among them (Giampietri *et al.*, 2018; Sacchi *et al.*, 2022).

There are many different types of short food supply chains, such as selling at the farm-gate or at producers' shop and farmers' markets, direct selling, community-supported agriculture, collective catering, or selling to local shops and supermarkets (Aubry and Kebir, 2013). Those different types of SFSCs share a common feature: they are characterized by proximity including geographical proximity which refers to the spatial closeness among participating actors, and relation proximity meaning the closeness of interpersonal relationships between farmers and consumers (Dubois, 2018; Shaw and Gilly, 2000).

3. Combining home-grown school feeding with short food supply chain: what are the potentials?

3.1 Potentials

HGSF and SFSC have good potential to be combined when designing and implementing a school feeding program. This is because (1) they have shared emphasis on the geographic proximity; (2) they both value smallholders' market participation and opportunity in the food chain; and (3) they aim to achieve certain common goals, such as ensuring smallholders have a fair share of market engagement, and helping strengthen a more local, resilient and sustainable food system.

Implementing SFSC in home-grown school feeding could have the following benefits. First, as indicated by FAO and WFP (2018), establishing more direct relationships between farmers and consumers in an HGSF program could enable farmers to obtain higher shares of the value of final sales prices. Second, for fresh foods, such as fruits and vegetables, short food supply chains also help reduce the food losses that can occur in lengthy supply chains. Third, HGSF programs typically aim to ensure geographical proximity among producers, processors and consumers. This reduces transport distances and requirements compared with conventional food supply chains.

3.2 Operating models

Figure 1 illustrates how HGSF and SFSC could be combined in order to maximize the benefits of smallholders from the HGSF program. The upper two decentralized models imply a very close link between the sites of production and consumption. This is important in meeting 'local' taste or quality preferences in supplying very isolated schools or in supplying fresh or perishable produce. In decentralized models, funds to food purchase and procurement authority are delegated to the schools. In this model, food could be purchased from smallholders directly (upper-right) or in most cases through traders (upper-left). Following previous literature, when both the geographical and relation distance are the shortest, we refer to HGSF-SFSC in its full term. The case of Xiangxi in what follows falls into this category.

For the lower-left configuration, both the geographical and relation proximity is weak which implies a long food supply chain. As such, this is linked with a more centralized HGSF model. In contrast, in the lower-right

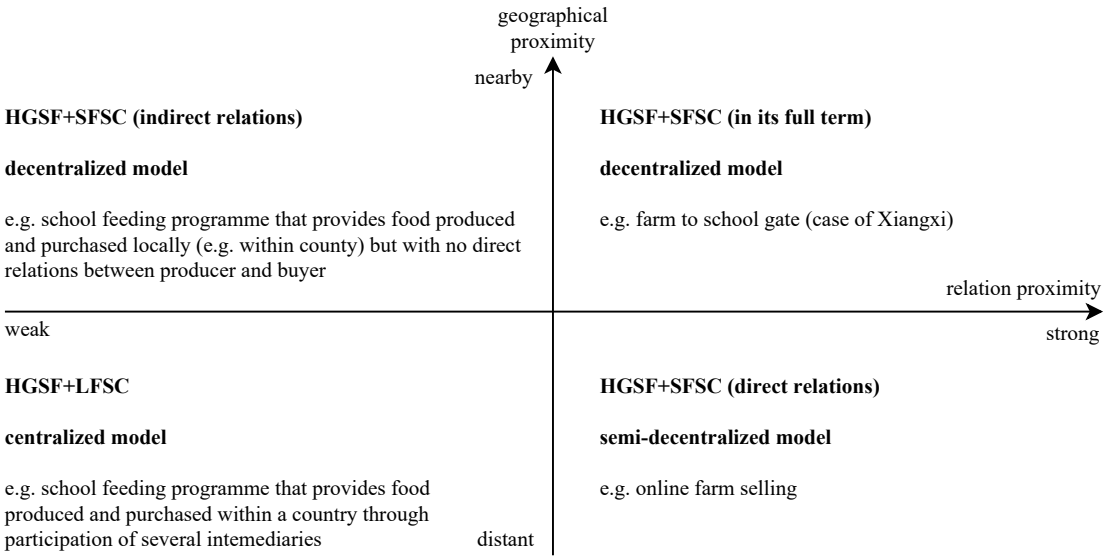

Figure 1. Home-grown school feeding operating models: combining home-grown school feeding with short food supply chain.

model, the spatial distance is long while the relation proximity is strong, which means a home-grown school feeding program that provides food produced within a broader geographical boundary with minimal intermediaries.

There is no one-size-fits-all operating model – each model has its own advantages and trade-offs. The choice of choosing a certain model is based on local specific contexts and objectives. Decentralized models are advantageous in terms of strengthening local-to-local linkages that benefits the smallholders as well as consumers, i.e. children at school. This model is easier for supplying fresh food that is suitable to local habits and tastes. In contrast, centralized models are more applicable for large quantity purchase and for foods which are easier to be stored such as cereals. In addition, under centralized scheme, quality control could be facilitated by standardized procedures.

Noticeably, in practice, schools and contract smallholders tend to adopt hybrid strategy in order to guarantee flexibility. Given that consumers simultaneously buy from both short and conventional food distribution networks, farmers often adopt hybrid strategies to distribute their products and exploit the opportunities offered from both types of supply chains. Similarly, in light of the seasonal shortage and coordination risk between school and small-scale farmers, schools are seeking hybrid structure in which decentralization and centralization structures coexist, thus maintaining a flexible approach. In fact, previous study suggests that foodstuffs for school feeding were largely procured through traders, despite that HGSF may increase the share of value purchased directly from smallholders (Gelli *et al.*, 2021).

4. Conceptual framework

Drawing from the conceptual framework of Tan (2019), we aim to unpack the interactions among various stakeholders involved using a simple framework as shown in Figure 2. We use this framework to analyze the implementation, good practices as well as challenges of HGSF-SFSC model.

4.1 Enabling environment

Two aspects are important in creating an enabling environment for the successful development and implementation of an HGSF program.

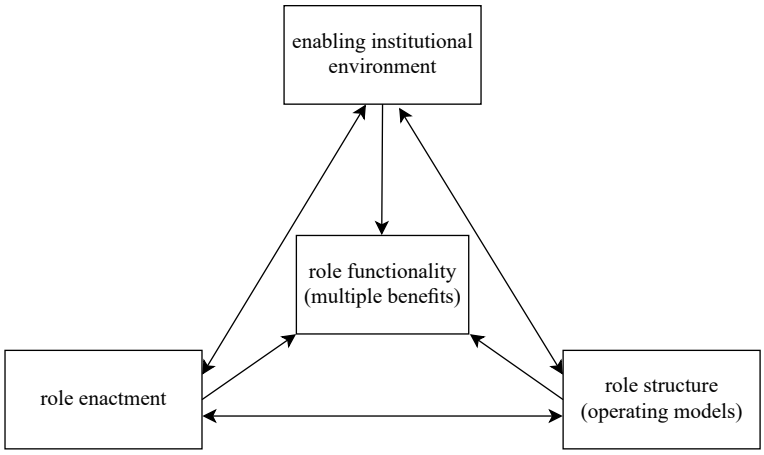

Figure 2. Conceptual framework

First is vision and political commitment. Stakeholders need to reach to consensus on how agriculture and school feeding program can be integrated in one single instrument to lift population out of poverty and hunger. This is the prerequisite for taking the institutional and operational measures. The long-term changes and expected multiple benefits are also important for governments to develop their visions and commitment. HGSF program has been proved to be linked with multiple, long-term benefits that are aligned with the SDGs. More and more governments are seeing HGSF as an investment in human capital and a productive social safety net, which mobilizes sustainable political support and participation.

Second is the consensus that HGSF is a point of convergence for many initiatives across multiple sectors. This enables the planning and designing of effective HGSF programs during the context analysis and assessments. An HGSF program assists in identification of opportunities to integrate mutually supporting interventions, programs and investments such as policies or plans regarding education, nutrition and food safety, gender equality, agriculture, agribusiness and social protection. As such, 'HGSF programs have good potential to be part of a comprehensive package of interventions aimed at addressing multiple needs identified by governments' (FAO and WFP, 2018, p9).

4.2 Role structure

HGSF, as a way to structure the demand, can be implemented in a variety of ways. The operating models chosen determine the degree of centralization or decentralization of different processes along the food supply chain as indicated in Figure 1. It also determines the extent to which smallholders will benefit from the program. In section 3, we discussed the different combination of HGSF with food supply chain, and identified four types of operating models according to different composition of geographical and relational proximity. Procurement authorities, such as schools, municipalities, regional/central government and caterers, can purchase food from farmers or their associations directly. In addition to this, they can also buy from intermediary traders. To the extent possible, HGSF should seek to reduce the number of intermediaries and the stages in the food supply chain to maximize farmers' benefits from the program (FAO and WFP, 2018).

4.3 Role enactment

Role action refers to action taken by various actors to achieve a certain goal, i.e. satisfying the structured demand in this case. For government, its main action is to coordinate the implementation of HGSF and to provide the complementary interventions and supply side interventions. Smallholders are responsible for delivering the required quantity and quality of food that meets the food safety and quality standards at agreed time. Schools act as the pointers for nutrition knowledge training as well as the supply side interventions

including provision of input such as seeds and fertilizer. They also play an active role in creating a school meal menu from which local smallholders benefit. Preschool principals can be trained to modify the recommended menus using seasonal recipes that depend on fresh produce which are locally available (Fernandes *et al.*, 2016).

4.4 Role functionality

The core function that brings different actors together is the structured and stable market created by the HGSF and the multisectoral benefits that may be generated from the program. For smallholders, HGSF can generate extra income through increased market participation, thereby assisting in poverty reduction. It also helps facilitate their investments in healthy, diverse food production. For schools, they can accumulate social capital by engaging in social safety net programs. School children can benefit from meals that are diverse, local and seasonal, contributing to improved nutrition safety, better education and gender equity. At the community level, HGSF can boost local economy and agricultural development as well as help build food systems that are sustainable, inclusive, local and resilient.

5. Materials and methods

5.1 Regional context and the broad program background

Xiangxi Autonomous Prefecture is located in Hunan Province in the South Central China. As an ethnic minorities autonomous prefecture, Xiangxi had a high level of poverty incident rate at the time the program was implemented. The majority of the rural residents in Xiangxi were left-behind children and left-behind elderly as the majority of young adults have migrated out to cities. Connecting to local market was costly because of the transportation constraints. The left-behind elderly were mostly responsible for taking care of their grandchildren at home. In the meanwhile, they engaged in agricultural production which was mainly in the form of subsistence farming. The varieties most planted in local areas included corn, wheat and vegetables. They also raised livestock including chicken, duck, etc. Since the main purpose of production was for self-consumption, local market participation was low.

Our analysis draws upon a specific intervention activity under a preschool free lunch program piloted by the WFP between September 2018 and September 2021. The free lunch program was piloted in two then nationally designated poverty counties, i.e. Longshan County and Yongshun County in Xiangxi. The sample included twenty-six preschools, which were sampled from fifteen townships across the two sampled counties. Of the twenty-five preschools, treated ones were preselected by local project management offices, while the comparison preschools were matched according to a vector of characteristics of the preselected ones. Treated preschools received four types of intervention activities: (1) nutrient-rich free meals to preschoolers; (2) kitchen facilities and dining environment upgrading; (3) nutrition education through various activities and awareness campaigns, targeting at children, caregivers, preschool teachers, administrators and kitchen staff; and (4) procurement of agricultural products from local poor farmers to supply school meal (the focus of this study).

5.2 Methods

- *Quantitative strand*

The quantitative part of the data was collected through questionnaires. In the baseline survey, we collected detailed information on their household characteristics, agricultural production and marketing channels, household income and assets, dietary data and nutrition knowledge. In addition to these modules, in the endline survey questionnaire, we added a separate module dedicated to contract enforcement.

In 2018, we conducted the baseline survey, during which 146 smallholder households were interviewed. 72 out of the 146 households signed a procurement agreement and thus formed the treatment group. The remaining 74 households comprised the comparison group. They were chosen after a propensity score matching procedure to ensure household characteristics in the treatment and comparison groups were reasonably balanced.

In May 2021, we conducted endline survey and interviewed 106 smallholder households. Of them, 58 signed the procurement contract and thus are beneficiaries of the HGSF program. The remainder belongs to the comparison groups. We obtained a full list of contracted smallholders from local project office who are currently supplying school meals. These contracted households were mainly interviewed in the preschool for which they are providing produces. Those in the comparison groups were interviewed in the village committee centre. In the survey, we collected detailed information on household characteristics, agricultural production, marketing channels, income, nutrition knowledge as well as dietary recall data.

It is worth mentioning that the targeted beneficiaries of the smallholders varied in endline survey from the baseline survey. The criteria for being chosen as a beneficiary (see an elaboration of these criteria in Section 6.2) imply that the treatment group smallholders in the baseline survey have to withdraw from the programme when their children or grandchildren graduated from preschools. This leads to high turnover rates of the beneficiaries. As a result, we are only able to construct a small panel for programme evaluation in which the number of treatment and comparison households are 14 and 27, respectively. The composition of the endline samples is presented in Table 2.

■ *Qualitative strand*

For the qualitative phase of this study, ten focus group discussions were organized following a semi-structured interview guide which was designed before the commencement of the qualitative data collection. To build a conceptual basis for the development of the guide and to collect insightful data, we relied on relevant literature as well as the stated intervention objectives prior to the implementation of intervention. Following Lioutas and Charatsari (2020), we left spaces for personal expression by adding 'why-questions', such as 'why do you think this is the case' or 'why do you think of this'. This approach is to ensure new concepts that we do not predict before the interview are captured. When new concepts and interesting themes emerged during preliminary analysis, new questions will be developed and introduced to the interview guide. That said, we follow a process of reflexive iteration in order to facilitate continuous sensing-making and data validation (Srivastava and Hopwood, 2009).

To better understand the impact of the project on farmer households as well as underlying mechanisms, we organized a number of multi-stakeholder's participatory focus group discussions in selected treated preschools. Three focus group discussions at Longshan county and seven at Yongshun county were organized. Participants of these discussions include county program officers, kindergarten principals, and representative contract farmer households.

Table 2. Composition of sample smallholders in the endline survey (n).

Participated in baseline or not?	Treatment group	Comparison group	Sub-total
Yes	14	27	41
No	44	21	65
Sub-total	58	48	106

6. Results

6.1 Enabling institutional environment

HGSF was implemented as an integral part of a comprehensive package of social protection program, i.e. free preschool lunch program. The free lunch program was designed at a time when there is growing attention on poverty reduction, child nutrition, and child development in China. Food related policy intervention and food assistance program provide an enabling environment for the smooth implementation of the structured demand. Incorporating HGSF as part of social protection program helps facilitate the comprehensive and complementary design and implementation of the program. In 2018, free lunch program was launched in two selected Counties of Hunan, China. The program was conducted in two counties of Xiangxi Tujia and Miao Autonomous Prefecture, Hunan province of China, namely Longshan county and Yongshun county. Both of them were then national-level poverty counties. The main intervention was to provide nutrient-rich free meals to children in 25 preschools which were not covered by any national nutrition improvement program.

Piloting is often used to test different implementation models, to identify problems, opportunities and challenges, and to learn from experience. The design and implementation of government-led HGSF explores models for linking HGSF to local agriculture and ways of ensuring that programs are delivered in a nutrition-sensitive manner. Given the pilot nature of the intervention, a stronger emphasis is expected on the learning objective, which provides an enabling environment for the implementation of HGSF program in Xiangxi. In the baseline report of the Xiangxi free nutritious lunch program, it mentioned that the evaluation serves accountability and learning purposes.

6.2 Role structure: home-grown school feeding–short food supply chain

Among all the potential structures and models presented in Figure 1, the role structure adopted by Xiangxi is HGSF-SFSC in its full term (upper-right in Figure 1). Figure 3 shows how HGSF can be combined with SFSC using Xiangxi as an example. This operating model guarantees smallholder's access to school feeding markets via a structured demand. Smallholders sell to preschools immediately after harvest. The products involved are mainly local fresh produce such as seasonal vegetables and fruits, poultry and eggs.

To establish the short food supply chain under HGSF (Figure 3), how to choose the targeted producers are the key. In Xiangxi's case, the criteria of selecting targeted groups were set by the local project office. Once the criteria were set out, the selection was implemented at preschool level. The principal of each treated preschool disseminated information on the HGSF demand through class WeChat group and collected information on the willingness of participation. They chose the contract famers based on four criteria. First,

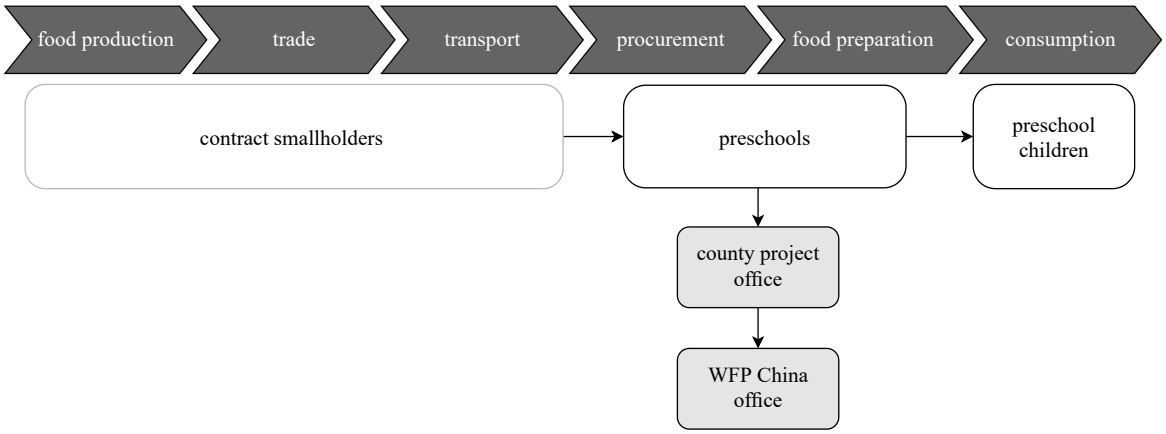

Figure 3. Example of home-grown school feeding (HGSF) and short food supply chain (SFSC) in Xiangxi.

they should be then registered poor households. Second, they should have agricultural production capacity. Third, they should have at least one child studying at that particular preschool. Fourth, the agreement should be signed voluntarily. In addition, HGSF targeted specific groups of smallholder farmers: including those meet certain poverty standards, those have certain capacity to supply the school feeding market and those women farmers. The goal of such demand is to increase the welfare for specified target groups rather than simply increasing the aggregate level of economic activity.

Compared to their counterparts, contract farmers and their households are likely to own more productive resources such as land. Household head from treatment group are more likely to be engaged in farming activities. Contract households show slightly higher market participation (Table 3). This implies that access to land, farm practices and market engagement may be preconditions for smallholders' HGSF program participation.

At the beginning of the program, a three-party agreement was signed between smallholders, selected preschools, and local program office. In contrast to conventional competitive tendering, direct contracting is a non-competitive procurement procedure that is more smallholder-friendly. It is more suitable when smallholders' production capacity is limited and when school solely needs to purchase a small proportion of local produce. For preschools in the treatment group, they were required to sign a tripartite agreement with local smallholder farmers who met the above criteria.

The three-party agreement demonstrates how the demand could be structured through procuring agricultural products from local poor farmers and connecting them with selected preschools. The preschools agreed to buy those foodstuffs produced by contract farmers at market price providing that food quality and safety standards were satisfied. The program office was responsible for providing technical trainings and production inputs such as seeds and fertilizer. Though not legally binding, the demand of each preschool was structured by the following items specified in the agreement: (1) the species of agricultural products to be supplied by the smallholders. In Xiangxi's case, as can be seen in Table 4, 95% of contract smallholders agreed to provide vegetables to preschools, followed by poultry and eggs; (2) the delivery method. In the case of Xiangxi, smallholders were required to deliver to preschool directly; (3) the quality of the produces; (4) the quantity. In Xiangxi, targeted preschools were required to purchase at least 30% of the food for school meals from local small-scale farmers;[1] and (5) payment and pricing mechanism. Table 4 shows that the majority of foodstuffs were sold at market price and were paid upfront.

Table 3. Land use, farming engagement and marketing channels by treatment status.[1]

	Treatment group (1)	**Comparison group (2)**	**Difference in means (3) = (1) − (2)**
Land use			
Area of paddy land (mu)	3.87	2.30	1.57*
Area of dry land (mu)	5.23	3.44	1.79**
Farming engagement of household head			
Household head engaged in farming activities	0.60	0.40	0.20**
Marketing channels			
Selling to individual consumers	0.13	0.05	0.08***
Selling to intermediaries	0.04	0.03	0.01

[1] This table is based on analysis from 106 endline households, with *** $P<0.01$,** $P<0.05$,* $P<0.1$.

[1] Establishing a target percentage of food that has to be purchased from smallholders is a common practice for HGSF, and this percentage could be gradually lifted as their capacity of supplying HGSF increases.

Table 4. Contract enforcement in Xiangxi.

	Contract farmers (n)	% of contract farmers
Contract species		
Vegetables	55	95%
Poultry	18	31%
Eggs	15	26%
Cereals, oils	10	17%
Fruits	3	5%
Livestock	1	2%
Price		
Higher than market price	3	5%
At market price	51	88%
Lower than market price	3	5%
Payment schedule		
Paid on site	55	95%
Paid at an agreed date	3	5%

6.3 Role enactment

■ *Smallholder's enactment*

Under HGSF-SFSC model, smallholders' enactment generally included selling their produces to preschools at the agreed quality and quantity as agreed by the contract. For farm to school transaction, one of the most important aspects is food quality control. In Xiangxi's case, this is done through principal's spot inspection when the transaction is made. Another institutional guarantee of the food quality control is achieved by linking preschooler's school meal to their family's production. The contract farmers interviewed stated that 'since my own children will also eat food that I provide, we will definitely not provide poor quality food. I will not use pesticide for the same reason'.

■ *Local project office's enactment*

Local project offices take supply-side interventions into account to complement demand-side support. Synergies with supply-side programs can stimulate smallholders to better participate in school feeding market. For example, in Xiangxi's case, one supply-side intervention is to upgrade the kitchen facilities in preschool to facilitate bulk purchases. Additionally, input subsidies and materials to targeted beneficiaries help boost production. For example, in 2020, local project offices distributed 9 types of seeds and 13 packs of organic fertilizers free of charge to each signed smallholder. Taking a holistic approach of combining HGSF with complementary interventions can help maximize the benefits of the HGSF programs. These synergies would help increase the willingness or capacity of small-scale farmers to provide the food that meet the quantity and quality standard of the contract through the improved access to information, technology, training, inputs, etc.

■ *Preschool's enactment*

Preschools are mainly responsible for designing menus and organizing nutrition trainings. For HGSF, school menus provide a critical interface to strengthen linkages among local agricultural production and dietary diversity (Singh and Fernandes, 2018). The HGSF-SFSC model can help create a menu that is suitable to local tastes and preferences and are indigenous to their culture. In Xiangxi's case menu is designed under the guidance of professionals with a focus on nutritional requirements of preschoolers, availability, affordability, current or potential foods produced by smallholders, incorporating locally available foods, dietary diversity,

local preference, local taste and seasonal differences, etc. Dietary diversity should be prioritized when designing a school menu. That said, a wide range of food groups should be incorporated into the school menu. Menus are often context specific. It is of great relevance to HGSF as it allows for locally available foods to be included to the menu. The regular food basket is complemented with fresh local food, such as fresh vegetables and eggs provided by the local smallholders.

6.4 Role functionality: benefits and good practices

As mentioned above, HGSF-SFSC has the potential to achieve multiple wins. This section presents some suggestive evidence on the benefits of HGSF-SFSC. Xiangxi's HGSF program was initially designed to deliver three main benefits. They are: (1) boost local smallholders' income; (2) contributing to diversified agricultural production; and (3) enhancing dietary diversity. In our survey, we asked the 58 contract smallholders the main benefits that this program may bring using a multiple choices question. Among them, 77% chose increased income, which is followed by improving the stable market engagement of own agricultural production (69%), enhancing the nutrition of own children/grandchildren (29%), improving the diet quality of their own households (17%) and enhancing the food safety of preschools (13%).

- *Income generation*

Compared with selling on local markets, selling products through SFSCs appears as a way for smallholders to secure more stable and better prices. In addition, they do not need to wait for potential buyers which is often the case if selling on local fairs. Another benefit of HGSF-SFSC program is the reduction of post-harvest losses.

Table 5 presents a difference-in-difference of the gross income per capita (nominal) for the households that were included both in the baseline and endline survey. We use gross income per capita as our survey did not contain information on expenditure. As can be seen, relative to comparison households, the gross income per capita tend to increase by RMB689.65 (approximately 10.5%) of the endline income for treated household. Note that the results presented in Table 5 are based on a rather small panel sample and thus the results are underpowered.

- *Production diversity and dietary diversity*

As mentioned above, one objective of the HGSF program in Xiangxi is to increase production diversity of contract smallholders. To achieve this goal, one complementary activity is the supply-side interventions, i.e. providing free agricultural inputs such as diversified seeds and organic fertilizer to contract smallholders. Results from our endline survey (Table 6) show that households in the treatment group planted more crop varieties than those in the comparison group during the sample period. Similarly, Table 6 also shows that the number of livestock varieties raised by the treatment group is significantly higher than that of the comparison group.

Table 5. Comparison of income between treatment and control group and between baseline and endline survey.

Gross income per capita (nominal) (RMB)	Treatment group	Comparison group	T − C
Baseline	3,632.88	8,034.64	-4,401.75
Endline	6,570.02	10,282.12	-3,712.10
E−B	2,937.14	2,247.48	689.65

Table 6. Agricultural production diversity and dietary diversity by treatment status (endline comparison).[1]

	Endline sample	Treatment group (1)	Comparison group (2)	Difference in means (3) = (1) − (2)
Crops production diversity score				
No. of varieties planted	7.217	9.052	5.000	4.052***
Livestock production diversity score				
No. of varieties raised	1.491	1.897	1.000	0.897***
Dietary diversity score				
No. of food groups consumed	5.36	5.59	5.08	0.50*

[1] Based on analysis from 106 endline households, with * $P<0.1$, *** $P<0.01$.

Table 6 also shows dietary diversity of our sample households. Note that this analysis is based on endline comparison only since we do not have dietary recall data in the baseline survey. Noticeably, households participated in the HGSF-SFSC regime have a higher dietary diversity than their counterparts. The difference is statistically significant at 10% significance level. Although the treatment and comparison group was not randomly assigned, it provides some suggestive evidence that the program may be leveraged in terms of enhancing dietary diversity of the targeted households.

6.5 HGSF-SFSC: challenges and constraints

Although the project office stipulates that each preschool's purchases from contracted farmers should be no less than 30%, we found that to reach this goal, several challenges remain.

■ *Seasonality and unstable supply*

For HGSF linked with short food supply chain, unstable supply from smallholders is a key constraint. First, the production and supply of farmers are seasonal and unstable. There is often an oversupply of a few types of agricultural products in the peak season as a result of the homogenous local production. On the other hand, insufficient supply will occur in lean season. This has caused strong supply instability and seasonality. The principal of X preschool in Luota Township mentioned that 'the supply of farmers can reach one third during the peak season, but this goal cannot be achieved during the lean season'.

Second, the majority of local farmers are subsistence farmers and the scale of production is rather limited. This leads to a low frequency of supply and a limited capacity of targeted households to respond to the HGSF structured demand. Smallholder farmers will only supply preschools when there is surplus after self-consumption. Therefore, their supply to HGSF is still relatively limited.

Third, the vast majority of contract farmers are left-behind elderly whose children are migrate workers. The elderly is in charge of taking care of their grandchildren at home. Due to physical and age constraints, these left-behind elderly have limited production capacity and thus are constrained in terms of engaging in large-scale production.

Fourth, force majeure also affects local agricultural output. For example, local crops such as corn and vegetables were damaged due to excessive rain prior to the interview, resulting in a sharp decline in output or no harvest at all. In addition, the destruction of farmland and aquaculture by wild animals is also common in local area. Such factors affect the quantity and stability of farmers' supply.

■ *Supply-side intervention is yet to be strengthened*

The complementary supply-side intervention can help strengthen smallholders' capacity to produce diverse foods of adequate quality and quantity to supply HGSF (FAO and WFP, 2018). Dorward and Kydd (2004) define economic coordination risk as 'the risk of failure of one player's investments by other players in different stages in the supply chain'. In order to further incentivize contract farmer's production, in the fall semester of 2020, WFP China office distributed 9 kinds of seeds and 13 packs of organic fertilizer to contract smallholders conditional on their supply of harvesting agricultural products to the contract preschools. That said, it is designed in the idea of conditional transfer payments. The preschool and the project office will supervise the planting of seeds and the use of fertilizer. However, because these seeds have just been planted, we have not yet been able to examine the effects of the intervention. What is certain, however, is that farmers have a positive attitude towards material assistance. During the interview, the contract smallholders mentioned that all the seeds that can be planted have been planted. Unfortunately, due to the unfavourable weather conditions, most of the plant were flooded by rain. It seems a foregone conclusion that there will be a reduction in production or no production at all, which poses challenges for the evaluation of effects of these free inputs.

In addition, we also discovered two problems regarding supply-side interventions during the key informant interview. First, for farmers of relative large scale, supply-side intervention are still far from enough. The distribution of seeds will help small farmers increase the variety and scale, but for large-scale farmers, the subsidy needs to be increased. Interviewed contracted farmers stated that the distribution of seeds and fertilizers cannot meet their needs. Second, the effect of this one-time subsidy incentive may be temporary. Thus, local governments and project offices need to optimize mechanism design in order to provide continuous incentive to encourage smallholders' investment in stable agricultural production.

■ *Transportation remains a constraint*

The distance from the farmer's home to the preschool is an important factor affecting farmer's food supply. We found that, for short food supply chain model, farmers who live nearby tend to supply more frequently. On the contrary, farmers who are farther away only supply on a monthly basis. It is often that they will supply produces when the school bus came pick up their children. This is convenient for contract farmers but posed potential hazard since the pathway of the school bus may be blocked by the products. In some cases, some farmers living father away would rather leave their vegetables in the field instead of spending a lot of time and transportation costs to send them to preschools. This leads to food loss at some extent.

Sifeng is a contract farmer we interviewed at Y Preschool in Luota Township, Longshan County, Xiangxi Prefecture. Her family signed a tripartite agreement with the preschool and the local project office in 2018. Her family was also among the first since the free nutritious lunch program kicked start in Xiangxi in 2018. At that time, his grandson was attending the preschool. By the time we interviewed her, his grandson had already entered elementary school and thus she was no longer qualified as contract farmers. Therefore, when we interviewed her, her family had already withdrawn from the agreement. Although the agreement terminated, she still occasionally sold eggs to the preschool. Her home was far away from the school, and it costed her 8 yuan for the round ticket by bus. Although her family also grew potatoes and sweet potatoes, she seldom sold these ingredients to the preschool because they were heavy and bulky. Agricultural products, such as free-range eggs, were lighter and easier to carry and therefore were her main products supplying the school feeding market.

In contrast, Yuewei of the Z Preschool in Xiluo Town, Longshan County has benefited greatly from this HGSF program. He mentioned that he would sell food to the preschool more than 20 times per month. He lived nearby, and therefore it was convenient to transport. When asked if he would like to recommend the program to relatives and friends, he happily said 'not really' because in that case there would be more competitors in the HGSF market.

■ *Future demand is expected to decrease*

Whether such a model could be sustained and scaled up also relies on demand size from school side. The scale of preschools in rural areas has been declining over the years. The principal of one Preschool in Hongyanxi Town explained that the number of preschoolers was declining semester by semester. When it was first opened in 2017, 120 preschoolers enrolled. This figure has reduced sharply to 53 this semester. It was not uncommon for some children to be transferred to preschools in the city during a semester. The same situation was also happening in the elementary schools in the local township. In fact, the principal of A Preschool in Xiluo Town mentioned that behind her preschool used to be an elementary school. It has been closed due to the shortage of students. As a result, she mentioned that she was concerned about making further investment in her own preschool. Under such circumstances, not only preschools are facing the pressure of attracting enough students, sustaining the HGSF program in the local area is also challenging.

7. Conclusions

In this study, we aim to introduce new perspectives of SFSC in the formation and implementation of HGSF. Whilst the samples of empirical data and cases that this study draws upon is limited, it nonetheless provides interesting tracks for understanding how various stakeholders come into play in the realization of HGSF combined with SFSC. Meanwhile, this paper presents both good practices as well as challenges of the HGSF-SFSC (in its full term) model implemented in Xiangxi from South Central China, using both quantitative and qualitative material collected from field survey and focus group discussions. Understanding and analyzing how smallholders and other key stakeholders who engage in HGSF conceive HGSF-SFSC are pivotal for forecasting a potential combination of HGSF and SFSC.

Our study shows that HGSF is not monolithic, and it could be implemented in combination of both long and short food supply chain. The pilot HGSF discussed in this study was designed and implemented as an integral part of free nutritious lunch program in Xiangxi. Such food assistance program provided an enabling environment for HGSF implementation. We find that compared with smallholders in the comparison group, those in the treatment group show higher income, agricultural production diversity and dietary diversity. Another observation was one of the criteria of choosing the targeted beneficiaries, that is smallholders must have a child attending the preschool with which they were about to sign a HGSF contract. This is not only for the purpose of targeted poverty alleviation, it also helps ensure that the provided foodstuffs could meet food safety and quality standard. Food safety and quality are crucial for any school feeding program, including home-grown school feeding. To that end, Xiangxi's case offers important good practices to manage food safety risks, particularly for the presence of hazards which end consumers may not be able to detect.

Despite the multiple benefits the HGSF-SFSC may deliver, this study also identifies several constraints including unstable supply under the farm to school model, insufficient supply-side support to enable the participation, the transportation constraints and the expected decrease of demand from local preschools. Overcoming these constraints is important, especially in terms of sustaining or scaling up the current pilot.

It is worth noting a couple of limitations of this present study. First, due to data limitations, we did not seek to identify causal relationship; therefore we need to caution the reader against drawing any causal relationship from the quantitative findings. Second, since our study focuses exclusively on the experiences in Xiangxi, the work presented herein is limited in its external validity. Comparisons with other areas are needed to enrich our conclusions. China's Student Nutrition Improvement Program has been implemented in rural China since 2012. There is, however, little research on under what kind of supply chain model that the school meals were provided. Summarizing various models of the school feeding practices in China and comparing the pros and cons of each model remain an important area for our future research.

Despite these limitations, this study has several policy implications. First, to further increase the impacts of the demand-assisted approach, the structured demand could be extended to the broader public procurement,

such as public demand from local government and primary schools, given the limited demand size of the preschools. Moreover, for further strengthening the effect of HGSF-SFSC, continuous supply-side interventions should be put in place in order to stimulate smallholder's market participation of the school feeding market and beyond. In addition, providing more preschool-related job vacancies such as preschool caterers and cooks may also be an avenue to sustain the income increase of local smallholders. Future study is still needed to compare different HGSF operating models, especially from the perspective of proximities, in order to deepen our understanding towards how HGSF can influence local food networks.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical standards disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Institutional Review Board of the International Food Policy Research Institute (DSG-18-0837). Written informed consent was obtained from all subjects.

References

Aggestam, V., E. Fleiβ and A. Posch. 2017. Scaling-up short food supply chains? A survey study on the drivers behind the intention of food producers. *Journal of Rural Studies* 51: 64-72. https://doi.org/10.1016/j.jrurstud.2017.02.003

Aubry, C. and L. Kebir. 2013. Shortening food supply chains: a means for maintaining agriculture close to urban areas? The case of the French metropolitan area of Paris. *Food Policy* 41: 85-93. https://doi.org/10.1016/j.foodpol.2013.04.006

Barrett, C.B. 2008. Smallholder market participation: concepts and evidence from eastern and southern Africa. *Food Policy* 33: 299-317. https://doi.org/10.1016/j.foodpol.2007.10.005

Bos, E. and L. Owen. 2016. Virtual reconnection: the online spaces of alternative food networks in England. *Journal of Rural Studies* 45: 1-14. https://doi.org/10.1016/j.jrurstud.2016.02.016

Charatsari, C., F. Kitsios and E. Lioutas. 2020. Short food supply chains: the link between participation and farmers' competencies. *Renewable Agriculture and Food Systems* 35: 643-652. https://doi.org/10.1017/S1742170519000309

Chiffoleau, Y., S. Millet-Amrani, A. Rossi, M.G. Rivera-Ferre and P.L. Merino. 2019. The participatory construction of new economic models in short food supply chains. *Journal of Rural Studies* 68: 182-190. https://doi.org/10.1016/j.jrurstud.2019.01.019

Dubois, A. 2018. Nurturing proximities in an emerging food landscape. *Journal of Rural Studies* 57: 1-12. https://doi.org/10.1016/j.jrurstud.2017.10.005

FAO and WFP. 2018. Home-grown school feeding. Resource framework. Technical document. Available at: https://www.wfp.org/publications/home-grown-school-feeding-resource-framework

Fernandes, M., R. Galloway, A. Gelli, D. Mumuni, S. Hamdani, J. Kiamba, K. Quarshie, R. Bhatia, E. Aurino, F. Peel and L. Drake. 2016. Enhancing linkages between healthy diets, local agriculture, and sustainable food systems: the school meals planner package in Ghana. *Food and Nutrition Bulletin* 37(4): 571-584. https://doi.org/10.1177/0379572116659156

Gelli, A., E. Masset, C. Adamba, H. Alderman, K. Arhinful, E. Aurino, G. Folson, I. Osei-Akoto and A. Asante. 2021. School meals as a market for smallholder agriculture: experimental evidence from Ghana. IFPRI discussion paper 2045. International Food Policy Research Institute (IFPRI). Washington, DC, USA. https://doi.org/10.2499/p15738coll2.134616

Giampietri, E., A. Finco and T. Del Giudice. 2016. Exploring consumers' behaviour towards short food supply chains. *British Food Journal* 118(3): 618-631. https://doi.org/10.1108/BFJ-04-2015-0168

Giampietri, E., F. Verneau, T. Del Giudice, V. Carfora and A. Finco. 2018. A theory of planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Quality and Preference* 64: 160-166. https://doi.org/10.1016/j.foodqual.2017.09.012

González-Azcárate, M., J.L. Cruz Maceín and I. Bardají. 2021. Why buying directly from producers is a valuable choice? Expanding the scope of short food supply chains in Spain. *Sustainable Production and Consumption* 26: 911-920. https://doi.org/10.1016/j.spc.2021.01.003

Kneafsey, M., L. Venn, U. Schmutz, B. Balázs, L. Trenchard, T. Eyden-Wood, E. Bos, G. Sutton and M. Blackett. 2013. Short food supply chains and local food systems in the EU. A state of play of their socio-economic characteristics. EUR 25911. Publications Office of the European Union, Luxembourg, Luxembourg. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC80420.

Lioutas, E.D. and C. Charatsari. 2020. Smart farming and short food supply chains: are they compatible? *Land Use Policy* 94: 104541. https://doi.org/10.1016/j.landusepol.2020.104541

Meemken, E.-M. and M.F. Bellemare. 2020. Smallholder farmers and contract farming in developing countries. *Proceedings of the National Academy of Sciences* 117(1): 259-264. https://doi.org/10.1073/pnas.1909501116

Montalbano, P., R. Pietrelli and L. Salvatici. 2018. Participation in the market chain and food security: the case of the Ugandan maize farmers. *Food Policy* 76: 81-98. https://doi.org/10.1016/j.foodpol.2018.03.008

Paciarotti, C. and F. Torregiani. 2021. The logistics of the short food supply chain: a literature review. *Sustainable Production and Consumption* 26: 428-442. https://doi.org/10.1016/j.spc.2020.10.002

Sacchi, G., G. Stefani, D. Romano and G. Nocella. 2022. Consumer renaissance in alternative agri-food networks between collective action and co-production. *Sustainable Production and Consumption* 29: 311-327. https://doi.org/10.1016/j.spc.2021.10.018

Schneider, S., V.F. Thies, C. Grisa and W. Belik. 2016. Potential of public purchases as markets for family farming: an analysis of Brazilian school feeding program between 2011 and 2014. In: S. Barling (Ed.), *Advances in Food Security and Sustainability* 1. Academic Press, Cambridge, MA, UK, pp. 69-95. https://doi.org/10.1016/bs.af2s.2016.09.003

Sellitto, M.A., L.A.M. Vial and C.V. Viegas. 2018. Critical success factors in short food supply chains: case studies with milk and dairy producers from Italy and Brazil. *Journal of Cleaner Production* 170: 1361-1368. https://doi.org/10.1016/j.jclepro.2017.09.235

Shaw, A.T. and J.-P. Gilly. 2000. On the analytical dimension of proximity dynamics. *Regional Studies* 34(2): 169-180. https://doi.org/10.1080/00343400050006087

Shrestha, R.M., P. Schreinemachers, M.G. Nyangmi, M. Sah, J. Phuong, S. Manandhar and R.-Y. Yang. 2020. Home-grown school feeding: assessment of a pilot program in Nepal. *BMC Public Health* 20(28): 1-15. https://doi.org/10.1186/s12889-019-8143-9

Singh, S. and M. Fernandes. 2018. Home-grown school feeding: promoting local production systems diversification through nutrition sensitive agriculture. *Food Security* 10(1): 111-119. https://doi.org/10.1007/s12571-017-0760-5

Srivastava, P. and N. Hopwood. 2009. A practical iterative framework for qualitative data analysis. *International Journal of Qualitative Methods* 8(1): 76-84. https://doi.org/10.1177/160940690900800107

Sumberg, J. and R. Sabates-Wheeler. 2010. Linking agricultural development to school feeding. FAC Working Paper 12. Future Agricultures Consortium. Brighton, UK.

Sumberg, J. and R. Sabates-Wheeler. 2011. Linking agricultural development to school feeding in sub-Saharan Africa: theoretical perspectives. *Food Policy* 36(3): 341-349. https://doi.org/10.1016/j.foodpol.2011.03.001

Tan, S. 2019. How do grassroot NGOs become the policy entrepreneurs? Diachronic research in the waste management field. *Journal of Public Management* 16(2): 79-90. (in Chinese)

WFP. 2009. Home-grown school feeding: a framework to link school feeding with local agricultural production. Available at: http://documents.wfp.org/stellent/groups/public/documents/newsroom/wfp204291.pdf.

WFP. 2020. State of school feeding worldwide 2020. Available at: https://www.wfp.org/publications/stateschool-feeding-worldwide-2020.