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Abbreviations and acronyms

CA	conservation agriculture
CASU	conservation agriculture scale-up
FAO	Food and Agriculture Organization of the United Nations
FISP	Farmers Input Support Programme
FRA	Food Reserve Agency
FSP	Food Security Pack
GCMF	Global Commodity Management Facility
GRZ	Government of the Republic of Zambia
Ha	hectares
HGSF	home-grown school feeding
Hh	Household
IAPRI	Indaba Agricultural Policy Research Institute
LCMS	Living Conditions Monitoring Survey
MOA	Ministry of Agriculture
MOCDSS	Ministry of Community Development and Social Services
P4P	Purchase for Progress
RALS	Rural Agriculture Livelihoods Survey
SCT	Social Cash Transfer
USD	United States dollar
WFP	World Food Programme
ZMW	Zambian Kwacha

Executive summary

The aim of this study is to explore the distributional impacts of the Zambian home-grown school feeding (HGSF) programme jointly with the conservation agriculture Scale-Up (CASU) project, by making use of both a data set collected for evaluation purposes from a limited number of districts and two nationally representative data sets. The evaluation data, and similar surveys in general, allow us to estimate the average impact of the programme on the beneficiaries, but they are usually not nationally representative and do not provide a full picture of the incidence and distributional consequences of interventions. Neither do they, due to their highly limited coverage, allow for exploring the implications of a scale-up of the intervention. This study aims to explore such effects by combining microsimulation with impact evaluation methods.

School feeding, or provision of free meals for schoolchildren, is one of the most widespread social protection interventions. In the World Food Programme (WFP)'s HGSF modality, school feeding is complemented with procurement of food used for the meals from local smallholders. The objective of school meals is simultaneous improvement in school attendance and schoolchildren's nutrition, and the local purchase scheme aims to provide market access for smallholders, hence improving income stability and incentives to invest, ultimately increasing their productivity. Conservation agriculture (CA) consists of production methods that reduce farmers' vulnerability to climate risks and improve productivity.

School feeding, institutional procurement and CA are likely to benefit different groups of the population. Therefore, their impacts on poverty and income inequality are not known *a priori*; they depend on both selection into the programmes and the impact the programmes may have on beneficiaries. The magnitude of impact at the population level also depends on the scale of the programmes. The aim of this study is to disentangle the aggregate distributional impacts of these programmes by using microsimulation, a methodology used for estimating the outcomes on selected variables of interest, resulting from a projected or hypothetical change in key parameters of a policy or programme intervention for each agent separately (individuals or households, for example). Microsimulation also allows for generating multiple "what if" scenarios, where the aim is to compare the real outcomes to those that would have occurred under different conditions.

For CASU and market access, the method involves first estimating a model of selection into the programmes and their impact on household gross income from the evaluation data. The model of programme participation is then applied to a nationally representative household survey, the Rural Agricultural Livelihoods Survey (RALS), capping the number of participants by districts to the number of beneficiaries set by the programmes. (IAPRI, 2016). The estimated impacts are then added to the simulated beneficiary households' gross income, and the subsequent distributional impacts are explored.

The results show that before the intervention, programme participants are generally less poor than those not participating in programmes, but the levels of poverty and extreme poverty are still significant among the participants. CASU decreases poverty and extreme poverty and slightly reduces income inequality, even though it did not target farmers with the lowest income and landholdings. As shown by the impact evaluation study (Prifti and Grinspun, 2019) the market access scheme has a slightly negative impact on gross household income, but the impact on overall poverty is small due to its small scale. The joint impact of both programmes is poverty-reducing.

Microsimulation of the school meals component of school feeding is based on the 2010 and 2015 Living Conditions Monitoring Surveys. (CSO, 2016). The analysis consists of first estimating a model of school attendance as a function of household demographic and economic characteristics and then generating scenarios with different coverage of school feeding. The analysis is limited to the rural strata; school attendance in urban areas is already high and the impacts found were relatively mild.

The simulation results show that, if school feeding were scaled up to reach universal coverage, it would increase school attendance rates by 4.7 percentage points, on average, compared to a scenario with no school feeding. Compared with the current situation, universal school feeding would increase attendance by 1.8 percentage points. The difference between the no feeding and universal feeding scenarios is larger for females, though not significantly, and larger for the medium, large and non-agricultural households than for small farm households. The value of the food transfer and subsequently the direct effects on poverty are relatively small. However, for the children in the bottom consumption percentiles, the transfer represents a relatively large share of their estimated food consumption, especially if the food is completely allocated to the child.

1. Introduction

The aim of this study is to explore the distributional impacts on poverty and income of two programmes in Zambia, the home-grown school feeding (HGSF) programme and the conservation agriculture scale-up (CASU) project, complementing the impact evaluation findings by Prifti and Grinspun (2019). These programmes target different parts of the population but are partly overlapping; they aim to influence poverty and food security through different channels. In the World Food Programme (WFP)'s HGSF modality, school feeding or provision of free meals for schoolchildren is complemented with procurement of food used for the meals from local smallholders. The purchase scheme aims to provide market access for smallholders, hence improving income stability and incentives to invest, ultimately increasing their productivity and reducing poverty. The objectives of school meals alone are improvement in schoolchildren's nutrition as well as improvement in school attendance and hence human capital accumulation. Conservation agriculture (CA) consists of production methods that reduce farmers' vulnerability to climate risks and improve productivity. The CASU programme promoted the use of such methods among smallholders through training and demonstration and provision of inputs, aiming for adoption of more sustainable farming which increases farm productivity in the long run.

The evaluation data for CASU and HGSF, and similar surveys in general, allow estimation of the average impact of the intervention on the beneficiaries, but they are often not nationally representative and do not provide a full picture of the incidence and distributional consequences of interventions. For example, the implications of the programmes for national poverty rates or income distribution are typically of as much interest as the average impacts on their direct beneficiaries. The total effects at a national scale also provide information for further analysis, such as for cost-benefit or cost-effectiveness calculations. Thus, this study is intended to complement the impact evaluation.

The HGSF programme consists of two interventions combined into a single programme, which this paper will treat separately for analytical purposes: free school meals provided to primary school pupils and institutional procurement of the food supplied at the schools from local smallholder farmers. School feeding programmes are one of the most widespread social protection instruments in developing countries (World Bank, 2018). In the best-case scenario, if efficiently implemented, they could attain several goals simultaneously, generating both short- and long-term benefits at individual and household level. Local procurement of food can also trigger community level impacts through increased purchasing power of local households. As an in-kind transfer, the meals provided at school serve to immediately improve food security and nutrition of school-going children, with possible ripple effects to other family members. They may also reduce poverty and income inequality. They are primarily intended to increase school attendance, cognition and learning outcomes, and ultimately education levels, in particular among the poorest, hence helping to break the intergenerational cycle of poverty and undernutrition (WFP, 2013). Ultimately, the strength of these effects depends on the incidence of school feeding – which households are eligible for receiving school meals and how different households respond to school feeding. The food consumption impact occurs in all households that have children attending school but it is notable that school feeding only induces higher attendance rates in some of the households, whereas in others children attend school even in the absence of a meal or fail to attend despite school feeding.

In the HGSF programme, the products used for preparing school meals are procured locally (WFP, 2013). In developing countries such purchases can be used as a vehicle for providing market access to smallholders. This is the approach of the WFP Purchase for Progress (P4P) programme, which involves crop purchases from smallholders for school feeding and other local and regional programmes. However, the distributional impacts of a programme providing market access are not obvious. The barriers to markets or access to inputs even in the presence of a programme may be higher for the poorest of smallholders than for less poor farmers, although the need for access to a secure marketing channel and hence the willingness to enter the programme may be higher for the most vulnerable farmers. Ultimately the selection of suppliers for the school meals and other uses depends on the prevailing conditions and modalities of the programme as well as the characteristics of the population.

In addition to market access, adoption of agricultural technologies is essential for long-term growth of agricultural productivity. Improved production methods are important for smallholders to intensify the use of inputs, increase their income and allow further commercialization of agriculture. Changes brought about by climate change further highlight the importance of adopting sustainable production methods that prevent soil degradation and vulnerability to weather shocks, allowing better risk management, increasing resilience and reducing the need for negative coping strategies. conservation agriculture is a set of practices promoted by FAO that aims to intensify the use of sustainable agricultural production methods, enhance biodiversity and maintain natural biological processes above and below the ground surface. In Zambia, initiatives such as CASU aim to encourage and support the use of such technologies and practices among smallholders. Adoption of high productivity technologies is lagging, especially in Africa (IFAD, 2016) and typically the first adopters are the better educated and better resourced farmers (Dercon and Christiaensen, 2011; Knight, Weir and Woldehanna, 2003). Similar concerns are relevant for initiatives like CASU; despite the potential for productivity increases, the distributional impacts of programmes like this depend on the accessibility of technologies and the barriers that individual households face.

The impact of these types of interventions is usually evaluated by using the standard impact evaluation methodologies. In general, evaluations based on randomized controlled trials or quasi-experimental analyses of limited data sets aim to establish the average impact of an intervention on its direct beneficiaries. However, the distribution of impacts is typically less of a focus in such studies, although poverty analysis of the target group may be included.

It is likely that the three different interventions – school feeding, institutional procurement and CA – benefit different groups of the population. Selection into the programmes, either intentionally by policymakers, by self-selection of participants or unintentionally by the design features of the interventions, also defines who is able to gain from the programmes. For example, certain minimum conditions need to be met to be able to enrol in CASU. Procurement of crops is operated through aggregators, which may also have implications for programme participation. In turn, although Zambia’s school feeding programme is, in principle, available to all pre-primary and primary school children in the districts where it operates, households may respond differently to this incentive.

Geographical targeting such as the selection of the districts covered by the programmes also sets the initial conditions for the potential of these programmes to reduce poverty, improve food security, increase agricultural production or equalize incomes. The direct impacts may be poverty-reducing and food security-enhancing for programme beneficiaries but, depending on who benefits, they can also accentuate income inequalities in some parts of the rural population. The size of the overall impact will also depend on the scale of the programmes. Analysing such distributional impacts provides critical information for future policy design, cost-effectiveness comparisons and redesign of existing programmes.

The structure of this report is as follows: Section 2 discusses the pathways of impact and possible distributional impacts of the HGSF and CASU programmes; Section 3 provides an overview of microsimulation as a methodology; Section 4 describes the data sets used; and Section 5 details the methodology of this study. Section 6 describes the results and Section 7 concludes and provides policy recommendations.

2. Theory of change and distributional effects of home-grown school feeding and conservation agriculture

The HGSF programme procures from local farmers for the provision of school meals, among other uses. HGSF is based on the idea that purchasing the food locally can contribute to smallholder development. Institutional procurement seeks to provide small-scale farmers with reliable demand, stable prices and less cumbersome procurement mechanisms.

Programmes that provide market access aim to help smallholders to overcome market imperfections that typically limit smallholder agriculture in developing countries (de Janvry, Fafchamps and Sadoulet, 1991). Such limitations raise transport costs (effectively lowering the price received for the produce) and increase uncertainty regarding selling prices or even ability to sell the produce at the end of the harvest season. Other obstacles to market integration can result from unbalanced market relations between producers and intermediaries, lack of market information and producers' poor organization (de Miranda, Diop and Klug, 2017). Another reason for suboptimal production decisions is risk aversion; lack of knowledge regarding future prices and the existence of marketing channels can curb production, even if expected profits would favour cultivation (Fafchamps, 1992). These impacts may be accentuated by fixed investment costs involved in starting cultivation of new crops and entering the market. The lack of credit markets in rural areas diminishes the opportunities to overcome such barriers.

Institutional procurement can be used to fix market imperfections, encourage profitable production decisions and increase incomes and income security of farming households. Hypothetically, the lack of cultivation of cash crops can be due to lack of markets, low take- home price of the produce (due to excessive transport costs), price volatility or information gaps. In this case, creating markets allows a new optimal production decision and subsequent increase in farm profits. Reducing transaction costs, providing market access, increasing aggregation capacity and developing stronger marketing skills, commercialization and farmers' bargaining power – either directly or through farmers' organizations – can trigger changes in production choices and improve price margins. These changes can then improve poverty and food security outcomes for those supplying to the institutional procurement scheme. Ultimately this should allow smallholders to gain independent access to regular markets (Kelly and Swensson, 2017).

In the long run, market access through institutional procurement could also lead to the expansion and intensification of agricultural activities, a permanent increase in incomes and a transition into more modern production and marketing methods. In addition to the direct effects there can be spillover impacts on other farmers, generated by increased local demand, income and market knowledge. In the case of Zambia, the procurement of crops from local farmers specifically aims at creating markets for beans and cowpeas, which are purchased locally for the school meals provided by the HGSF programme.

Distributional impacts of a programme providing market access like the HGSF may or may not improve the livelihoods of the poorest of smallholders. Competitive tendering is often not accessible for smallholders, but public procurement schemes may have preferential treatment of smallholders or special targeting towards those most in need of assisted market access. There are different modalities of local procurement as explained in Miranda (2018). However, this does not guarantee that they are accessible to all; ultimately, the selection of suppliers depends on the prevailing conditions and modalities of the programme. For example, P4P operates partly through farmer organizations and small-scale traders, rather than large-scale traders, to reach smallholders. Despite reaching more smallholders than untargeted procurement, such modalities may cut off the most vulnerable farmers who are not members of organizations. Distributional impacts of such schemes are therefore of major interest, so quantitative exploration is needed to establish whether the programmes actually reach the intended groups.

Although institutional procurement relieves the problems arising from lack of market access, it is also possible that the suppliers are self-selected based on their individual need for guaranteed price and low risk. In this case, the suppliers represent farmers with low capacities who may be unable to generate significant improvements in profitability. In the presence of such selection these schemes can still increase household welfare through price stability but have limited impact on poverty and commercialization of agriculture. It is also notable that several purchasing programmes may be operating simultaneously. For example, Zambia's Food Reserve Agency (FRA) purchases maize at a set price nationwide, particularly from disadvantaged areas. Private outgrower schemes are widespread and provide similar price guarantees, in addition to inputs of credit or other types of support. The ultimate changes in outcomes from a given programme could be minor if the implicit target groups are essentially similar and switch from one programme to another. Establishing the actual effects requires quantitative analysis; to our knowledge, there are neither rigorous impact evaluations nor microsimulation analyses of the distributional impacts of institutional procurement in developing countries, even though these programmes have gained popularity over recent years.

Conservation agriculture, on the other hand, is focused on improving the sustainability of farming and long-term yields by preventing soil degradation and erosion. In Zambia, the CASU programme ran from 2013 to 2017, providing training on CA, extension support and farm inputs to increase productivity and production of crops for food security and income generation. The scheme operated by providing subsidized inputs to lead farmers and it sought to help them overcome the initial costs of adopting these practices. As crop rotation and use of nitrogen-fixing crops are essential elements of CA, institutional procurement of pulses has significant synergies with CA.

A large number of empirical studies have shown that the adoption of CA is often hampered by local factors other than lack of profitability or income effects (Knowler, 2015; Knowler and Bradshaw, 2007). This is also the case in Zambia; Zulu-Mbata, Chapoto and Hichaambwa (2016) show that factors such as social, cultural and traditional beliefs are of importance in determining adoption of CA. These results suggest that there is scope for expanding CA adoption. There are also studies arising from both agricultural science and economics traditions, studying the impacts on yields; according to one survey (Brouder and Gomez-Macpherson, 2014) the details of the methods applied and the duration of the use of CA practices have implications for the impacts on yields. For Zambia, Abdulai (2016) shows that CA has a significant positive impact on farm income and a negative impact on poverty. However, due to the uneven incidence of adoption and the heterogeneity of these impacts, the actual impact of CA may vary across the income distribution. A specific analysis is therefore required to establish the distributional outcomes. From the policy perspective, these types of interventions – institutional procurement and promotion of CA – present the possibility of reaping synergies. In the case of HGSF and CASU, this could mean providing production support, market access and an education subsidy (the school meal) to maximize the impact on income and prevent the possible negative implications for school attendance from the increased need for child labour due to agricultural intensification.

School feeding programmes seek to improve educational attainment through higher attendance rates, while simultaneously reducing hunger and increasing children's nutritional status. School feeding can also improve learning outcomes by exerting an impact on cognitive skills, behaviour and concentration during the school day and reducing drop-out rates. Furthermore, they can act as a safety net (Bundy *et al*., 2009).

School feeding has elements of in-kind benefits and conditional cash transfers. The households that send their children to school enjoy an in-kind transfer in the form of the food provided. The transfer is only available to those households that comply with the implicit conditionality of attending school. The introduction of school feeding increases the potential consumption of the household when the child does not work, decreasing the relative cost of attending school. The choice to attend school also depends on the opportunity cost or the possible earnings of the child and is likely to vary by household.

It is likely that some households value schooling more than gains from the child working, for example due to the long-term benefits of education. In some instances when households are not faced by liquidity or credit constraints, they send the child to school, but where such constraints exist they may be forced to take the child out of school as a coping strategy. School feeding can also alleviate such constraints by providing immediate benefits from schooling.

School feeding provides the household additional food, either to the child or in some instances to the household through take home rations. School feeding potentially increases household food consumption but the household may also reallocate their resources and purchase less food and increase other consumption. Food from other sources may also be redistributed within the household as a result of school feeding. This implies that the impact on the child's food consumption is not known with certainty.

There are several evaluations of the impacts of school feeding – for a review, see Gordon, Ross and Lister (2012). They show that school feeding often, though not always, has positive impacts on school attendance and enrolment as well as some impacts on nutrition. However, these impacts are likely to vary by household; the decision to attend will depend on the opportunity cost of schooling and the consumption patterns and food demand across the households (Jacoby, 1997). Ultimately, the overall reduction in food insecurity and poverty will depend on the distribution of the underlying determinants of impacts in the population.

3. Microsimulation

To complement the impact evaluation of CA, institutional procurement and school feeding (Prifti and Grinspun, 2019), we carry out microsimulation analysis, looking at:

1. The nationwide distributional consequences of the CASU and HGSF programmes, given the participation decisions and the impacts on income estimated from the evaluation data;
2. The nationwide impact of school feeding and the scale of potential to increase school attendance rates in rural areas under different scenarios of school feeding coverage;
3. The possible distributional impact of the transfer of income in the form of school feeding.

Microsimulation is a methodology used for generating and assessing the outcomes resulting from a projected or hypothetical change such as a policy intervention based on microdata. The outcomes of interest are simulated for each agent separately; such agents can be, for example, individuals, households, firms or farms. Usually such simulations are done to assess the impact of a change of interest before it has actually occurred, or *ex ante*. Conversely, they can be used to simulate how things would have been in the absence of the change or to create data on a current situation when up-to-date data are not available. Thus, microsimulation is in some sense comparable to a "lab experiment". Microsimulation is generally quicker and cheaper to carry out than a real experiment and the evaluation thereof, and allows generation of multiple scenarios to compare the real outcomes to those that would have occurred under different conditions. In this paper, microsimulation is used to create both the existing situation and further scenarios, in data that otherwise describe the population in a representative manner, but do not contain information on the situation after implementation or scale-up of the programmes.

Unlike simple aggregate projections or evaluation of impacts based on a typical or representative agent, microsimulation provides detailed information on the distributional impact and heterogeneous effects on individuals, units or certain parts of the population of interest. As the response of agents to the changes of interest can also be heterogeneous and dependent on their characteristics, microsimulation allows detection of otherwise unforeseen and unexpected consequences of policies following from the heterogeneity of the agents (Bourguignon and Spadaro, 2006). Microsimulation also naturally enables calculating the aggregate or mean impact based on the impact on individual agents and is also helpful in, for example, estimating the total costs and revenues arising from redistributive policies.

There are different methodological approaches to microsimulation, which can involve different levels of complexity of the base population, behavioural responses and policies included in the model. At its simplest, microsimulation involves simple arithmetical calculations such as impacts of taxes and benefits on disposable income across the population. In this study, the income impacts of CASU and the institutional procurement scheme are drawn from an impact evaluation study and their incidence in the population is estimated by using a selection model. In the case of school feeding, household behavioural responses are also a focus of interest, i.e., decisions made as a response to the interventions and subsequent changes in incomes, school attendance and food consumption.

In behavioural microsimulation the response parameters must be estimated first, before proceeding to simulating the desired outcomes. This effectively requires that the impacts of interest can somehow be identified from the data at hand. For this purpose, this study uses the evaluation data for CASU and the market access component of HGSF. In the case of school feeding, the same data used for simulation are used for estimating the behavioural response.

Though microsimulation is essentially a partial equilibrium approach and the outcomes are calculated for each agent individually, they can also be matched with aggregate values obtained from other sources – as was the case in this study. As a partial equilibrium approach, microsimulation alone does not consider changes in prices and wages, which need to be taken into account when interpreting the results or providing policy recommendations.

4. Data

The simulation uses data both from the impact evaluation and from two nationwide data sets, the Rural Agricultural Livelihoods Survey (RALS) and the Living Conditions Monitoring Survey (LCMS). (IAPRI, 2016). (CSO, 2016). The methodology for estimating the poverty impacts of CASU and HGSF, which is described in detail in the next section, involves using the impact evaluation data to identify the likely beneficiaries, estimating the parameters for the impact on gross household income and applying these estimated impacts to the identified beneficiaries in the RALS data. The analysis of school feeding uses the LCMS.

The impact evaluation data consist of a survey of a sample of households collected from several selected districts, some of which were covered by HGSF and CA schemes. The sample[1] includes households from four different types of treatment group:

1. Households who have access to HGSF institutional procurement in districts where CASU is not present (Kawambwa and Luwingu districts).
2. Households who participate in the CASU programme but live in districts where there is no access to institutional procurement through HGSF (Chibombo and Chongwe districts).
3. Households from areas where both programmes are available[2] (Katete district).
4. Households who live in districts where neither programme is available (Kafue, Kasempa and Mporokoso districts).

The total sample size is 3 639 households. The data include information on agricultural activities and the revenues from them, as well as purchases of inputs and information on household consumption, income from non-farm sources, household assets and financial literacy.

The RALS is a nationally representative panel survey of rural farm households in Zambia. The second wave was conducted in 2015 and included 7 934 households, representing about 1.5 million rural agricultural households. The survey derived its sampling frame from the 2010 Zambia Population and Housing Census, stratified by farmer type, and it is statistically representative at the provincial level in all the provinces in Zambia when sampling weights are used. The data include a large amount of information on household characteristics and agricultural activities, including geographical variables such as distances to services and markets, sources of inputs and cultivation methods used.

The LCMS is a cross-sectional representative survey of households, carried out in Zambia at regular intervals. Both LCMS 2010 and 2015 data sets were used in this study for estimating the parameters of school attendance, whereas only the data from 2015 were used to simulate the outcomes.

In both 2010 and 2015 the survey was administered to a representative sample of households drawn using the 2000 Zambia Population and Housing Census as the sampling frame. The 2015 survey covered a representative sample of 12 260 non-institutionalized private households residing in both

[1] The sampling is described in detail in Prifti and Grinspun, 2019.
[2] This may not coincide with the whole district, as the programmes are only available in certain blocks.

rural and urban parts of the country and generated reliable estimates at national, provincial and rural/urban levels, whereas the 2010 survey covered 19 398 households. The 2015 data represent a total population of 15.5 million, with 58.2 percent, or 9 million, residing in rural areas.

The data include information on general living conditions and household characteristics, including household incomes and expenditures, food production, food security and coping strategies. The data on household members also include indicators of school attendance, which is the main outcome in the analysis. The LCMS is also used for generating poverty estimates for Zambia, with household expenditure per adult equivalent serving as the measure of welfare.

Unlike more established tax benefit microsimulation models such as MicroZammod (Nakamba-Kabaso *et al*., 2017), the data from both RALS and LCMS have not been updated to the current population, income or price levels. Hence the simulation results describe outcomes *given the 2015 values of background variables and population characteristics*. Monetary constants, such as the value of school meals or income changes as a result of the programmes, were all converted to 2015 values for the analysis. The main interest lies in the difference in outcomes that results from the policies, rather than in aiming to predict the actual outcomes for 2018 or future years. It needs to be noted, therefore, that the main focus is on the differences observed between the scenarios, rather than the absolute values observed. By using the same methodology, it would also be possible to change other background variables or reweight the data to match a different population projection, and scenarios could hypothetically be created, for example, for different populations.

5. Methodology

The microsimulation approach involves simulating outcomes resulting from policy choices. For CA and market access, the policies consist of the presence of the CASU programme and provision of market access through HGSF institutional procurement. Simulation of their distributional impacts requires determining the impact of the programmes on household income as well as estimating the decision to participate.

5.1. Simulation of CASU and market access through HGSF

The likely participants in the programmes are selected from RALS data using a model estimated from the impact evaluation data. Impacts on income per adult equivalent, also estimated from the impact evaluation data, are added to the gross income per adult equivalent.

The participation decision is modelled through a logit model (Annex 1) for all interviewed households that are eligible for that programme. In the case of market access, eligibility is through HGSF cooperative membership and in the case of CASU, eligibility requires access to at least 0.5 ha of land[3]. The decision to participate in CASU is assumed to occur first, and inclusion in CASU is also an explanatory variable in the HGSF participation model. The model is then used to predict the probability of participating in each programme for all households in the RALS data. The probabilities are then combined with the information on district level aggregate numbers of programme households to find the likely participants.

Because the evaluation data are retrospective and not nationally representative, but rather elected on the basis of the observed outcome (a choice-based sample), the predicted probabilities as such do not correctly reflect the actual population-level probabilities of participation (Hsieh, Manski and McFadden, 1985). There are several ways of using such models in simulations to match known aggregates, as discussed by Li and O'Donoghue (2014). In this study we adopt the method of ordering the observations by participation probabilities within each district and including the observations as simulated participants until their population weighted frequency reaches the district aggregate obtained from programme documents and information received from the implementing organizations. For those districts where the programmes were not implemented, no households are selected. For CASU, the actual number of participating farming households is known from the programme registry, whereas for HGSF market access, P4P only records the total amount of beans and peas purchased from farmers through aggregators.

The total number of participants was estimated by using the total amount of beans and peas purchased and calculating an approximate amount sold by each farmer.[4] As in the impact evaluation

[3] In practice only those observations that had no missing values in the explanatory variables were included.
[4] This is also the median amount of beans sold to the WFP according to the impact evaluation survey. It is also broadly in line with the potential WFP scale-up plan where 40 200 smallholder farmers directly benefit from supplying 7.6 tonnes of pulses, in total.

(Prifti and Grinspun, 2019), purchases made specifically for the HGSF and for other purposes are not treated separately, and similarly in this study, the total amount purchased by WFP is used in the simulations. The amount purchased for different purposes varies, but in 2017 the majority of pulses were used for school feeding. In essence, however, the selection of farmers to supply to the programme and its impact on their income can be assumed to be similar irrespective of the purpose for which the purchases were made.

Table 1 details the assumptions used for translating the aggregate coverage of the HGSF market access and CASU programmes in different scenarios to simulate the participants thereof in the nationwide data sets. The districts supplying to the HGSF procurement programme vary and there is no information regarding which districts the potential scale-up might extend to. Therefore, all districts that had supplied in 2016 and 2017 were used and the total amount purchased was divided between them in proportion to the average amounts supplied over the two years. The amount purchased for purposes other than HGSF was assumed to stay the same as in 2017.

The assumption (and, simultaneously, a limitation) of the approach is that the characteristics of the treatment and comparison groups in the evaluation data somewhat correctly reflect the differences of such groups in the targeted districts. The control group is representative of eligible households, but because the evaluation data were collected from selected districts and the treatment arms perfectly coincide with districts, it is possible that some differences in characteristics between the treatment groups reflect the differences between district populations (or sub-populations) rather than those of households typically selected into the treatments compared with those who are not.

The model uses basic household characteristics and access to land as explanatory variables. In addition, proxies for household capital, access to information and access to other programmes – i.e. the Social Cash Transfer scheme (SCT), the Food Security Pack (FSP), the Farmers Input Support Programme (FISP) and the FRA – are used, as well as distance to the nearest *boma* (district centre). There is a possibility that such variables have been affected by participation in the two programmes, in addition to the issue with district differences in access to programmes, as households make decisions to participate in different programmes simultaneously.

Table 1: Simulated scenarios for HGSF market access and CASU

Home-Grown School Feeding market access (including purchases for the Global Commodity Management Facility or GCMF)	**Assumptions** Participation determined by the model estimated from the evaluation data Each participating household supplies 200 kg; the number of households per district: total purchases/200 Impact on monthly gross income per adult equivalent: ZMW -40 (ZMW 32 in 2015 prices)
Scenarios	**Number of households/districts covered**
No market access	0
2015 coverage	Purchases from 10 districts, total approximately 4 900 households, 0.3 percent of smallholder households
2017 coverage	Purchases (including GCMF purchases) from 17 districts, total approximately 18 200 households, 1.2 percent of smallholder households
Expanded coverage	Total amount of purchases to feed and the same amount of GCMF purchases as in 2017 Total amount of purchases divided among 2016–2017 districts (25) in proportion to average purchases per district, total approximately 45 600 households, 3 percent of smallholder households
Conservation agriculture	**Assumptions** Participation determined by the model estimated from the evaluation data Impact on monthly gross income per adult equivalent: ZMW +55 (ZMW 44 in 2015 prices)
Scenarios	**Number of households/districts covered**
No CASU	0
2017 coverage	21 districts, 228 000 households, 15 percent of smallholder households
Combinations of programmes	**Assumptions** Participation in programmes determined by the models. Decision to participate in CASU made first, then HGSF subject to participation in CASU Impact on monthly gross income per adult equivalent: ZMW +60 (ZMW 48 in 2015 prices)
Scenarios	**Number of households/districts covered**
CASU and 2017 coverage of market access	As above, 40 percent of HGSF market access beneficiaries also benefit from CASU
CASU and expanded coverage of market access	As above, 48 percent of HGSF market access beneficiaries also benefit from CASU

All these programmes (SCT, FSP, FISP and FRA) had nationwide coverage at the end of 2017, but in 2015 there may still have been regional diversity in the ease of access to, for example, SCT or FRA, which is more often used as a sales channel in certain districts (IAPRI, 2016). Self-selection into the market access and CASU programmes may depend on access to inputs that is facilitated by FSP or FISP, although additional income from HGSF and CASU may also have an impact on ability to obtain subsidized inputs. Available marketing channels, in particular FRA, have essentially similar roles to the HGSF market access scheme in stabilizing household income. A sensitivity check was carried out by estimating a minimum model with only basic demographics and landholdings as explanatory variables.[5] This model is presented in Annex 1 along with the main model. The main difference in the results is that the households included in HGSF by using the simpler model have a higher level of poverty, with the exception of the small number of simulated participants in 2015, whereas the increase in poverty rates as a result of the programme is lower.

One caveat of the evaluation data is that the sampling protocol assumed that HGSF market access is only available for cooperative members and so the data are only available for them. In fact, other aggregators are also used occasionally, and in principle even non-members can supply through the cooperatives. However, it is not known how frequently non-members currently supply to the programme. Cooperative membership among Zambian rural farming households is relatively common, at 43.6 percent (IAPRI, 2016), due, for example, to channelling of farming subsidies through cooperatives. Constraining the choice to supply to the programme only to cooperative members can be taken as a reasonable assumption.

5.2.Impact estimates and scenarios of CASU and market access through HGSF

The impact estimates are calculated on the standard impact evaluation methodology used in Prifti and Grinspun (2019) and are consistent with results on the impact on household income.[6] Out of the programme impacts, CASU has a positive impact as expected, although the negative impact of the market access scheme is puzzling. However, as explained by Prifti and Grinspun (2019), it may be related to a reallocation of resources within the farm economy. The certain demand and price for pulses incentivizes farmers to grow pulses and move resources from livestock and the production of maize to the production of beans. This may indicate a preference for certainty of income over potentially higher income or may be a result of the yields ultimately attained not being conducive to increased farm income. Compared with FRA, which serves a similar purpose for maize, supplying to HGSF institutional procurement has the advantage of the price being announced at the beginning of the agricultural season, whereas the FRA prices are only known after the harvest, which may explain seemingly irrational choices.

The scenarios simulated (Table 1) are based on the known implementation of the programmes and the projected potential scale-up scenario of the HGSF market access scheme, provided by WFP (WFP, 2017). Table 1 summarizes the scenarios that are simulated for the HGSF market access scheme and for CASU. It is notable that the coverage of HGSF market access is very low even in the expanded scheme (3 percent), which limits the impact on overall poverty or income distribution, whereas CASU coverage is high, at 15 percent of smallholder households. The RALS 2015 sales data concern the produce of the cropping season, which was a “gap year” in terms of CA programmes,

[5] In fact, landholdings and household composition can also be endogenous and may have variation among districts.

[6] Prifti and Grinspun (2019) report impacts on total gross income, whereas in this study impact on total gross income per adult equivalent is used. The methodology is the same.

and the 2015 RALS data do not indicate any impact of the programme. The HGSF institutional procurement scheme was already operating in 2015 but at a very small scale. The scenario of “no programme” was generated by removing the impact of HGSF for this small number of probable participants in 2015.

Although the actual CASU programme has now ended, in the scenarios combining the two programmes a combined scenario of CASU and potential future scale-up of HGSF was also created. The reasoning behind this is that the participating households will likely continue using conservation farming techniques, which will continue to have potential synergies with market access. It is possible that other similar initiatives will be launched in the future, as the importance of CA is not declining.

Expanding the HGSF may not seem sensible if it actually reduces income, but it should be noted that the main goal of the scheme is not to reduce poverty but to increase the production of beans and diversify production. Improving income security can be considered as a positive outcome even if there is no positive impact on total income. Expanding the school feeding scheme also requires more pulses that must be purchased somewhere. The purpose of the scenario is also to illustrate how the impact of expanding the market access scheme changes at different levels of scale.

5.3.Outcomes for CASU and market access through HGSF

The main outcomes that are studied for CA and market access through HGSF include rates of poverty and extreme poverty, Gini coefficients and percentile ratios as the measures of income inequality. Poverty is typically defined against consumption, which is found to be a more reliable measure of standard of living than income in developing countries, and this is the variable used in the LCMS to define household poverty. The RALS does not have extensive information on consumption, but gross income[7] has been used as a measure of poverty in these data and generally produces results comparable with the poverty rates calculated by using consumption (IAPRI, 2016).

Poverty rate in this study is defined with the methodology used in the most recent LCMS (CSO, 2016). The poverty line is defined as ZMW 214 per month per adult equivalent and the extreme poverty or food poverty line as ZMW 152 per month per adult equivalent. Adult equivalents in households are calculated by using the Central Statistical Office (CSO) conversion factors for members of different ages.

Poverty provides an important indicator of success of income generation or social protection programmes, especially in countries such as Zambia where a majority of the population are poor[8]; however, the high level of poverty allows limited insights into the distributional impacts of these programmes. Reductions in poverty rates indicate that among the beneficiaries there are households near enough to the poverty line(s) for the transfer or income effect to move them above the line. It is, however, also important to use other measures of equality that also consider the

[7] Gross income in RALS is a sum of farm income or the gross value of crop production, fruits and vegetables and livestock income from sales of animals and products, and off-farm income or all cash or goods earned from working outside one's own farm.
[8] Rural poverty stands at 76% and urban poverty at 54%.

distribution of income among poor and non-poor. For this, we calculate the Gini coefficient and the ratio of 90th and 10th percentile.[9] Descriptive analysis is also carried out to investigate income changes across income distribution.

The changes in poverty rates and distributional indicators are dependent on which households are included in the survey. To assess their statistical significance, a “bootstrapping” procedure is carried out. After calculating the probabilities of participating in the programmes in each scenario, a sample of the size of the original data is resampled with replacement and the selection of participants and the calculation of new incomes are repeated for each sample. Resampling is carried out with the same stratification as that of the original survey, or by stratifying the sample by province and farmer category. Differences in poverty and extreme poverty rates resulting from the programmes, as well as changes in the measures of income inequality, are calculated for each sample. The process is repeated 1 000 times and empirical confidence intervals for the differences are obtained from the data of parameters generated by the bootstrapping procedure (see Efron, 1979, 1981).

This procedure does not consider randomness in impact estimates or the selection model estimated from the evaluation data, but only repeats the process of the survey sample and the selection of participants based on their probabilities of participation. Hence, the impact on poverty is always greater than or equal to zero.

5.4.Simulation of school feeding

Simulation of the impacts of school feeding involved: 1) simulation of how overall school attendance changes at different levels of coverage; and 2) calculation of how the transfer changes consumption for the households as a result of changes in attendance.

The evaluation data include information on school attendance by children in the households, so school attendance decisions could be estimated from the evaluation data. However, as the data only cover a limited sub-population, there is a risk that some heterogeneity among households and school attendance decisions may be lost. Rather than using the evaluation data, therefore, the estimation was done using the LCMS data and information on the scale of the school feeding programme in 2010 and 2015. A dummy indicating the presence of school feeding in districts was used to estimate the impact of school feeding.

The decision to send a child to school was estimated by a logit model for the probability of school attendance for each child (Annex 2). In practice, the estimation is based on the child-level data of primary school-aged children. The explanatory variables include the siblings’ ages, sex and birth order, in addition to household socio-economic characteristics and other factors influencing the costs and gains of schooling (such as the distance to school), as well as the availability of school feeding in the district. Once this relationship and the parameters have been established, the overall

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[9] There are a number of measures of inequality; see, for example, Haughton and Khandker, 2009. Despite their shortcomings, the Gini coefficient is perhaps the most well-known measure of inequality and percentile ratio allows for a very simple interpretation.

impact of school feeding can be simulated, by comparing the simulated situation where there is no school feeding (i.e. the school feeding dummy is replaced with zero for all districts) with the different degrees of coverage of the school feeding scheme (varying the value of the dummy accordingly) to assess the impact on overall income distribution, poverty and food security measured by food consumption.

There is a large variation in district-level school attendance rates nationally and the district coverage of the HGSF programme is not random. In the 2015 LCMS data, primary school-aged children's school attendance by district varies from almost 100 percent to less than 50 percent. Generally, the programme has been moving towards districts where attendance rates are low and away from those where high attendance rates have already been reached. For example, major urban regions of Lusaka and Livingstone were initially covered by school feeding, but by 2015 the scheme had been removed from these districts.

The logit models were estimated separately for the smallholder household stratum, the other rural strata (Annex 2) and urban strata that are not presented in the Table. Dummies were used to indicate the presence of school feeding at present and (for 2015 observation) in 2010, as the results showed that the impact on attendance appeared with some persistence – i.e. having school feeding in the past had a positive impact – and that short- and long-term effects differed across strata. This is also reflected by the coverage of the programme; exploration of attendance rates also shows that the feeding scheme was introduced specifically to districts having very low attendance rates and withdrawn from those where the rate reached a relatively high level of attendance.

School feeding seems to generate somewhat asymmetric impacts; in some but not all districts the attendance rate fell again after the withdrawal of the programme, and it was reintroduced after 2015. The school feeding programme started in 2003 with a very limited coverage in selected urban areas and has been expanding significantly since 2010, with an increasing emphasis on rural areas as opposed to urban districts. Given that districts suffering from low attendance and/or stagnant trends are more likely to be selected to the programme, the estimates, if anything, are likely biased downwards, as indicated by the negative but not significant coefficient of current school feeding in the smallholder stratum. The overall impact, reflected by the simulated outcomes, consists of both immediate and long-term effects or the coefficients of current and past school feeding.

In the urban strata the impact of school feeding was particularly persistent and due to removal of school feeding from major urban areas, reliable estimation of the impact proved difficult. A slightly positive coefficient for urban children was found when the estimation included only districts without school feeding and those districts where school feeding was introduced in 2015. Simulation, however, showed minimal impacts of school feeding. Most likely, with attendance rates over 90 percent, school feeding alone no longer has a major impact, but those who do not attend school face barriers to attendance that need to be tackled with other measures. Hence, in the presentation of results the focus is on rural areas.

The data only cover two periods. Although district-specific differences and the general trend are controlled for, district-specific trends in school attendance that may be due to, for example, construction of new schools, improved service delivery, changing impact on agriculture or changes in attitudes towards school attendance, cannot be taken into account. This is because there is no information on counterfactual trends in the absence of school feeding for the districts where school feeding was in place. The attendance rate in each scenario was simulated by predicting the attendance probability for each primary school-aged child by setting the school feeding variables to match the values for that scenario. Both school feeding dummies (school feeding and previous school feeding) were set to one in the districts where school feeding is present in that scenario. A random value from the interval [0,1] was drawn for each primary school-aged child, and the child was considered to be attending school if the predicted probability was higher than the random number. These new dummies were then used to describe school attendance in different scenarios and the overall attendance rate was calculated as the average of the simulated dummy variable.

In 2015, five percent of rural primary school-aged children attended private schools that are not covered by school feeding. This is not explicitly taken into account in the estimation; attendance in general is treated as a single binary variable. In a context where the policy of interest has implications for the choice between private and public school attendance, the decision to attend different types of schools needs to be modelled jointly (Glick and Sahn, 2006). However, in the case of school feeding, it is likely that the marginal impact on attendance occurs in those households where the choice of private schooling is not financially feasible. The choice between public and private schooling is not likely to be affected by school feeding, whereas attendance in private schooling is also dependent on a supply of such alternatives in the region, reducing public school attendance at the upper margin. In the absence of such exogenous explanatory variables, separating attendance of private vs public schools could, if anything, blur the impact of school feeding on overall school attendance.

5.5.Impacts of school feeding on food consumption

Once the school attendance status had been simulated, the possible implications for household consumption were calculated by adding the value of school feeding to the consumption of those households where a child or children are attending school. As is known from the theory of in-kind benefits (Faminow, 1995), the value of the benefit can be assessed in different ways. The simplest approach, which is also used here, is to use the market value or the cost of the benefit package for the government. The value of school feeding amounts to ZMW 88.07 (in 2015) per annum per child, or ZMW 7.33 per month per each child attending primary school.

However, it needs to be noted that, as the use of the package is constrained to food and education, the value of the package does not necessarily equal its market value for the recipients. For example, in Figure 1, for the households that move from C to D the value of the package is less than a similar increase in income because, despite the increase in utility, it forces them to consume more food. Furthermore, if the in-kind benefit produces societal value above the valuation by the recipient, the actual value should be taken into account in the calculations. Estimating the societal value is difficult and the estimation of the recipient value requires calculation of shadow prices of the goods and calculation of income levels that would produce the same level of welfare as the in-kind package (Tagliati, 2017).

Furthermore, changes in income do not necessarily translate into higher food consumption. As is known from consumer theory, the share of income spent on food tends to decrease with increased income, and the pattern of food groups consumed also changes. Getting precise estimates of changes in food consumption would require estimating a full system of demand for different groups of goods and their relationship to income (Banks, Blundell and Lewbel, 1997) or estimation of elasticities of calorie consumption with respect to income, such as in Harttgen *et al.* (2016). It is possible, however, that consumption of food purchased out of the additional income from school feeding is different from marginal consumption due to increases of other income. This can be justified by the fact that, contrary to the traditional consumer theory, studies on social protection instruments show that the sources of income have a direct impact on how the money is spent (Angelucci and Attanasio, 2013).

The usual household data sets, as well as the data sets available for this study, do not record the food consumption of each individual within the household and individual consumption must be assessed on a per capita or per adult equivalent basis, calculated from the total household food consumption. However, it is possible that the distribution of food within a household significantly deviates from equitable distribution, due to different decision-making powers and bargaining power within the household. On the other hand, Jacoby (2002) reported an intrahousehold “flypaper effect”[10] in the context of school feeding – i.e. food consumption by the immediate beneficiary increased more than that of other members of the household. The different scenarios created by microsimulation can also be used to incorporate various assumptions about the distribution of food consumption within the household, such as equitable distribution or full flypaper effect.

As with the analysis of HGSF market access and CASU, the confidence intervals of the outcomes of interest need to be bootstrapped. In the case of school feeding the whole process, including the estimation of the model and simulation of outcomes, is repeated for each bootstrapping sample a thousand times. Confidence intervals for the differences of interest are generated from the resulting data.

[10] In public finance, “flypaper effect” refers to a situation where a government grant increases local consumption more than an increase in income of the equivalent size.

Table 2: Simulated school feeding scenarios

School feeding	**Assumptions**
	The impact of school feeding is estimated based on school attendance overall, not separately for attendance in public schools. School feeding has an impact on attendance in both the short- and longer-term. The value of the school meal= ZMW 88.07 per annum per child. All children attending school receive a meal. **Allocation of school meal value within household:** The value of the school meal fully contributes to household food consumption: 1. the value of the school meal is divided within household in proportion to adult equivalents; 2. the value of school meal is allocated to the child only.
Scenarios	**Number of districts covered**
No school feeding	0
School feeding 2015	22
School feeding 2017	38 (2017 district division), 26 (2015 district division)
Universal school feeding	All

6. Results

6.1.CASU and market access through HGSF

As explained above, logit models (Annex 1) were used to estimate the probability of participating in the programme. The model was used to select the most likely beneficiaries in the RALS data set. The beneficiary households are simulated for each district separately. This means the beneficiary households can display higher or lower poverty and extreme poverty rates because the districts from which they were selected have generally different poverty rates, given that the selection of beneficiaries favours poor or less poor households within districts, or through a combination of these two effects.

When looking at district-level poverty and extreme poverty rates (Table 3), the poverty rates for all households in the programme districts are generally slightly higher, but the difference is statistically significant only for the districts covered by the expanded HGSF market access scheme and those that are covered by both CASU and the expanded market access, and even these differences are not of meaningful magnitude.

Table 3: Poverty rates in HGSF and CASU districts

	All	HGSF 2015 districts	HGSF 2017 districts	Expanded HGSF districts	CASU districts	Districts with both programmes 2017	Districts with both programmes (CASU and expanded HGSF)
Poverty before programmes	0.644	0.666	0.658	0.681	0.652	0.634	0.670
p value for difference between programme districts and other districts		0.164	0.244	0.000	0.154	0.527	0.007
Extreme poverty before programmes	0.523	0.553	0.534	0.561	0.529	0.511	0.550
p value for difference between programme districts and other districts		0.072	0.367	0.000	0.367	0.433	0.009
N	7 934	1 261	1 952	3 152	4 770	1 558	2 638
Weighted N		254 630	434 271	664 462	888 741	343 650	546 202

CASU: conservation agriculture scale-up, HGSF: home-grown school feeding.

A closer inspection of the characteristics of simulated participants (Tables 8 and 9 in Annex 1) shows that there are some significant differences, although gross average income per adult equivalent does not differ significantly across participation groups. Market access participants have greater access to other schemes – namely FISP, extension services and FRA. There is also a higher proportion of SCT recipients, as in the evaluation data access to SCT was highest among market access beneficiaries, reflected by the coefficient in the participation model. In 2015, SCT did not yet have nationwide coverage; however, by the end of 2015 it was implemented in 50 districts,[11] and not all the districts included in 2017 or in the hypothetical expansion scheme were covered by SCT. For this reason, it does not affect selection of simulated participants in these districts.

CASU beneficiaries have the highest access to land; they also have higher mobile phone ownership as well as better access to agricultural assets, as demonstrated by plough ownership.[12] Compared with non-participants, CASU beneficiaries (similarly to the market access beneficiaries) have higher access to FISP and extension services, but unlike market access participants they do not sell to FRA more frequently than non-beneficiaries.

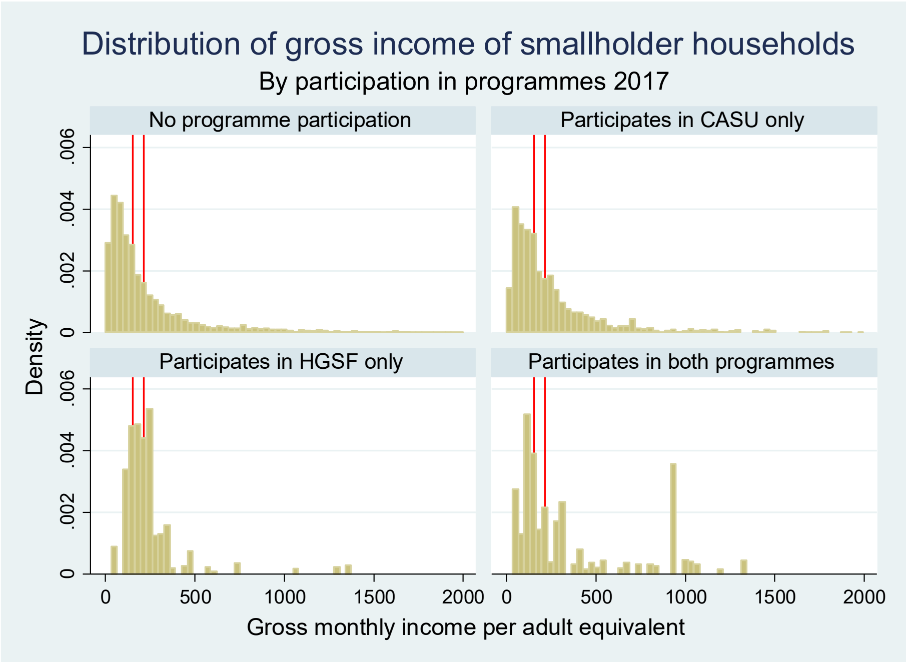
Figure 2 shows the distribution of income among the simulated participants in both programmes and their combinations. The vertical lines indicate the food poverty and total poverty lines. A visual inspection shows that the participants of CASU and HGSF market access are generally better off and there are fewer households at the lower end of income distribution, which is also confirmed by the poverty and extreme poverty rates shown in Tables 8 and 9 in Annex 1.

The average income before programmes is not significantly different across the groups formed by participation status in the programmes. Poverty and extreme poverty rates, however, vary significantly across the groups, suggesting that the main difference arises from variations in the distribution of income rather than simple differences in average income.

[11] Source: http://socialprotection.org/programme/social-cash-transfer-programme

[12] Plough ownership is used as a proxy as it was found to explain participation in the programmes in the evaluation data in a significant manner.

Figure 1: Distribution of income among participants of programmes



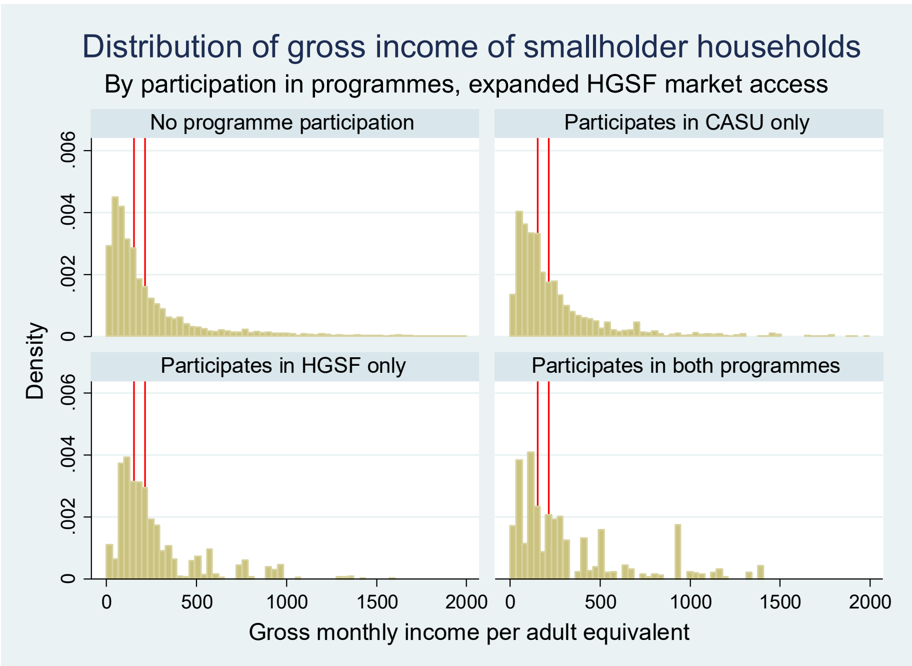
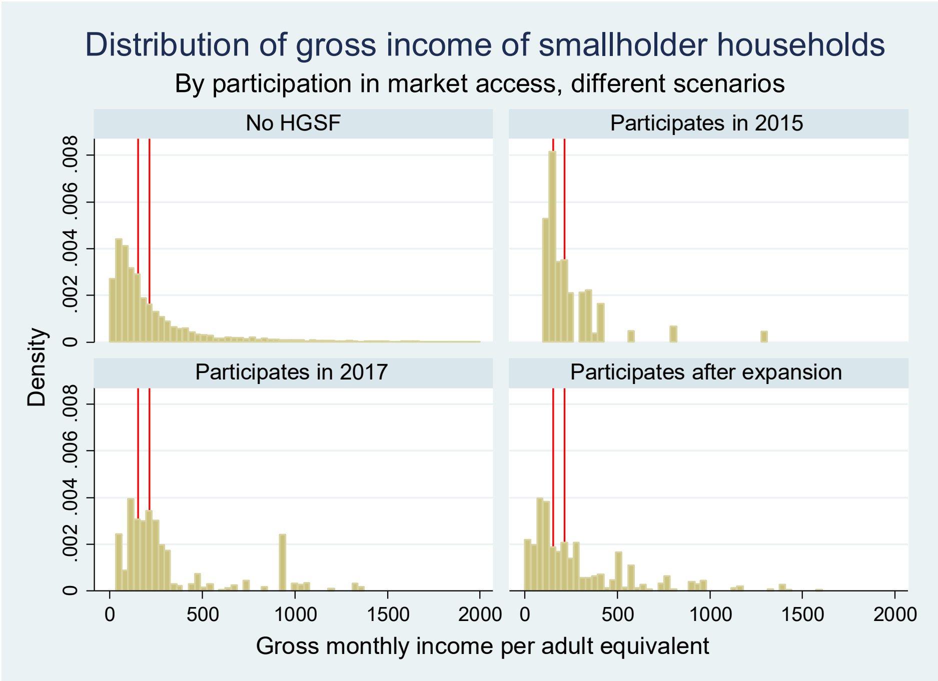


Figure 1: Distribution of income among participants of programmes *Cont*



Note: The vertical red lines represent the extreme poverty line (ZMW 152 per month per adult equivalent) and the poverty line (ZMW 214 per month per adult equivalent).

Those participating in CASU and in all different scenarios of HGSF market access coverage – except in 2015, when coverage was very low – and participants in both programmes in 2017 have significantly lower poverty rates than the overall population or those not participating in the programmes. For extreme poverty rates, the difference is also generally negative, but for the combined programmes the difference between participating and non-participating households is not statistically significant, at the five percent significance level (Figure 2, Table 4). Poverty rates are lowest among the households that, according to the simulation, participate in both programmes, although even among them the poverty rate is 50 percent in the 2017 scenario and 47.5 percent in the expanded scenario.

Table 4: Poverty rates among participants of programmes

	All	HGSF 2015 participants	HGSF 2017 participants	HGSF expanded participants	CASU participants	Participants in both, 2017	Participants in both expanded
Poverty before programmes	0.6435	0.576	0.530	0.529	0.590	0.502	0.475
95% confidence interval for difference between programme participants and non-participants		(-0.405, 0.07)	(-0.248, -0.007)	(-0.186, -0.018)	(-0.095, -0.015)	(-0.307, 0.021)	(-0.269, -0.020)
Extreme poverty before programmes	0.5228	0.357	0.313	0.391	0.455	0.380	0.402
95% confidence interval for difference between programme participants and non-participants		(-0.436, -0.024)	(-0.320, -0.082)	(-0.201, -0.035)	(-0.119, -0.033)	(-0.289, 0.038)	(-0.234, 0.018)
N	7 934	26	115	257	1 496	62	110
Weighted N	1 512 335	4 132	16 733	43 532	221 206	8 423	17 404

The confidence intervals for the changes in poverty rates following the programmes are reported in Table 5. As the simulation involves adding or subtracting income to the original level according to the estimated impacts on gross income per adult equivalent, the direction of the change in poverty and extreme poverty is determined by the estimated impact. The 95 percent confidence intervals for the change in poverty and extreme poverty rates are based on bootstrapping the survey sample and subsequent participants in the programmes.

The largest drop in poverty is generated by CASU, among the simulated CASU participants. In addition, CASU reduces poverty among those participating in HGSF, as some of them are also CASU participants. As the impact of HGSF market access on income is negative, it increases poverty and extreme poverty rates among the participants. It is notable, however, that as indicated by Table 1, the coverage of HGSF is very low, and subsequent changes in overall poverty rates, nationwide or at district level, are negligible, although for the actual participants the poverty effects are of relevant magnitude. For example, for those participating in HGSF market access in 2017 and in the expanded scheme, poverty increases by about 7 percentage points. For extreme poverty rates the reductions are similarly of meaningful magnitude for the actual participants; for example, both programmes in their 2017 coverage reduce extreme poverty among the actual participants by 25 percentage points, but overall changes are small, in particular for the market access impacts. For CASU and the combined programmes the confidence interval for overall reduction in extreme poverty is between 1.6 (1.5 for expanded programmes) and 2.4 percentage points.

Table 5: Changes in poverty and extreme poverty rates among participants of programmes

Changes in poverty, proportion							
	All	*HGSF 2015 participants*	*HGSF 2017 participants*	*HGSF expanded participants*	*CASU participants*	*Participants in both, 2017*	*Participants in both expanded*
Poverty before programmes	*0.644*	*0.576*	*0.530*	*0.529*	*0.590*	*0.502*	*0.475*
Poverty after 2015 HGSF	*0.644*	*0.682*	*0.556*	*0.539*	*0.591*	*0.516*	*0.481*
Confidence interval for difference	*(0, 0.001)*	*(0.018, 0.251)*					
Poverty after 2017 HGSF	*0.644*	*0.682*	*0.599*	*0.555*	*0.592*	*0.555*	*0.500*
Confidence interval for difference	*(0.001, 0)*		*(0.029, 0.139)*				
Poverty after expanded HGSF	*0.646*	*0.682*	*0.599*	*0.599*	*0.596*	*0.555*	*0.550*
Confidence interval for difference	*(0.001, 0.003)*			*(0.037, 0.108)*			
Poverty after CASU	*0.632*	*0.576*	*0.502*	*0.514*	*0.510*	*0.448*	*0.437*
Confidence interval for difference	*(-0.016, -0.009)*				*(-0.106, -0.063)*		
Poverty after 2017 programmes	*0.632*	*0.654*	*0.544*	*0.530*	*0.510*	*0.448*	*0.437*
Confidence interval for difference	*(-0.015, -0.009)*					*(-0.128, -0.01)*	
Poverty after expanded HGSF and CASU	*0.633*	*0.654*	*0.544*	*0.553*	*0.509*	*0.448*	*0.435*
Confidence interval for difference	*(-0.014, -0.008)*						*(-0.092, -0.013)*
N	*7 934*	*26*	*115*	*257*	*1 496*	*62*	*110*
Weighted N	*1 512 335*	*4 132*	*16 733*	*43 532*	*221 206*	*8 423*	*17 404*

Table 5: Changes in poverty and extreme poverty rates among participants of programmes *Cont.*

Changes in extreme poverty							
	All	*HGSF 2015 participants*	*HGSF 2017 participants*	*HGSF expanded participants*	*CASU participants*	*Participants in both, 2017*	*Participants in both expanded*
Extreme poverty before programmes	*0.523*	*0.357*	*0.313*	*0.391*	*0.455*	*0.380*	*0.402*
Extreme poverty after 2015 HGSF	*0.523*	*0.438*	*0.333*	*0.399*	*0.455*	*0.380*	*0.402*
Confidence interval for difference	*(0, 0.001)*	*(0, 0.218)*					
Extreme poverty after 2017 HGSF	*0.524*	*0.438*	*0.408*	*0.427*	*0.458*	*0.459*	*0.440*
Confidence interval for difference	*(0, 0.002)*		*(0.032, 0.182)*				
Extreme poverty after expanded HGSF	*0.525*	*0.438*	*0.408*	*0.451*	*0.459*	*0.555*	*0.550*
Confidence interval for difference	*(0.001, 0.003)*			*(0.029, 0.102)*			
Extreme poverty after CASU	*0.502*	*0.155*	*0.212*	*0.330*	*0.316*	*0.181*	*0.250*
Confidence interval for difference	*(-0.024, -0.016)*				*(-0.165, -0.108)*		
Extreme poverty after 2017 programmes	*0.503*	*0.236*	*0.242*	*0.342*	*0.314*	*0.133*	*0.227*
Confidence interval for difference	*(-0.024, -0.015)*					*(-0.388, -0.096)*	
Extreme poverty after exp. HGSF and CASU	*0.503*	*0.236*	*0.242*	*0.361*	*0.314*	*0.133*	*0.218*
Confidence interval for difference	*(-0.023, -0.015)*						*(-0.285, -0.092)*
N	*7 934*	*26*	*115*	*257*	*1 496*	*62*	*110*
Weighted N	*1 512 335*	*4 132*	*16 733*	*43 532*	*221 206*	*8 423*	*17 404*

As the results concerning poverty hinge on the estimated impacts of the programmes, a further check was carried out to ascertain the potential for poverty reduction of HGSF by calculating the share of households within an interval of 50 ZMW below the poverty and extreme poverty line among the participants in HGSF market access. Out of those participating in 2017, 16.6 percent are less than 50 ZMW below the poverty line and 23.1 percent are less than 50 ZMW below extreme poverty line. The same figures for the expanded scheme are 11.3 percent and 19.6 percent, respectively. Thus the market access scheme could also have the potential to reduce poverty, if the impact were positive and of similar size to the observed effect of CASU.

Change in poverty rate is a common measure of effectiveness of programmes in countries where poverty rates are high, but income inequality as a broader concept also depends on how income is distributed within the poor and non-poor population. For example, very high incomes at the high end of income distribution, often measured by top income share, increase inequality but do not necessarily have an impact on absolute poverty rate. Similarly, distribution of income among the poor can be more or less equal; “poor” can be very near the poverty line or well below it. In this study we measure the impact on income distribution by calculating changes in both Gini coefficients and the ratio of 90^{th} and 10^{th} percentiles of the per-adult equivalent income.

Table 6 presents measures of income distribution for incomes after different coverage of programmes and the bootstrapped confidence intervals for the change in the Gini coefficient and the ratio. The impact of HGSF market access on the Gini coefficient is positive (i.e. inequality increases) but minimal in absolute and relative terms, whereas CASU and the combined programmes have a slightly equalizing impact on income distribution. In relative terms the overall reduction in the Gini coefficient due to CASU or 2017 programmes is 1.5 percent and that of the expanded programmes jointly 1.4 percent.

Table 6: Measures of inequality before and after programmes

	Before programmes	After HGSF 2015	After HGSF 2017	After HGSF expanded	After CASU	After both programmes 2017	After both programmes, expanded HGSF
Gini coefficient	0.626	0.626	0.627	0.627	0.617	0.617	0.618
Confidence interval of change in Gini		(0.0001, 0.0002)	(0.0004, 0.0006)	(0.001, 0.002)	(-0.011, -0.009)	(-0.012, -0.009)	(-0.010, -0.009)
90th percentile/10th percentile	18.421	18.421	18.619	18.688	17.603	17.604	17.543
Confidence interval of change in percentile ratio		(-0.08, 0.000)	(-0.09, 0.175)	(-0.034, 0.398)	(-1.44, -0.708)	(-1.45, -0.691)	(-1.313, -0.505)

A relative strength of microsimulation is that it allows exploration of the magnitude of changes across a distribution. Figure 5 illustrates the change in average gross monthly income per adult equivalent for each of the income percentiles that are formed based on original income before any of the programmes. The height of each line indicates the contribution of each programme or combination thereof to the average income per adult equivalent in the respective income percentile. The locations of the poverty line and the extreme poverty line are indicated by the vertical lines.

As seen from the Figure, the absolute gains and losses due to the programmes are relatively similar across the income distribution, although they tend to be larger in the upper half of the income distribution, with the exception of the highest percentiles. This is also shown by a positive correlation between percentile and the change in average income, which is smaller in the lowest percentiles of the income distribution. Compared with the average income in higher percentiles (indicated by the bars and the right-hand y-axis) the average additional income is low in relative terms, as in the top two percent of the income distribution the average income is almost 500 times the average per adult equivalent monthly income in the lowest percentile (ZMW 8 vs ZMW 3 796). Panel 3 shows how much more significant the effects can be when considered in relative terms; in the lowest percentiles very modest changes in average income, due to a small number of participants in the programmes, translates into a large relative increase in average income.

The difference between the 2017 schemes and the expanded scheme is small. Due to the negative impact of HGSF, the income effect of the programmes is actually reduced overall when the programme is expanded. CASU clearly increases incomes throughout the distribution.

Figure 2: Changes in income due to programmes across income distribution

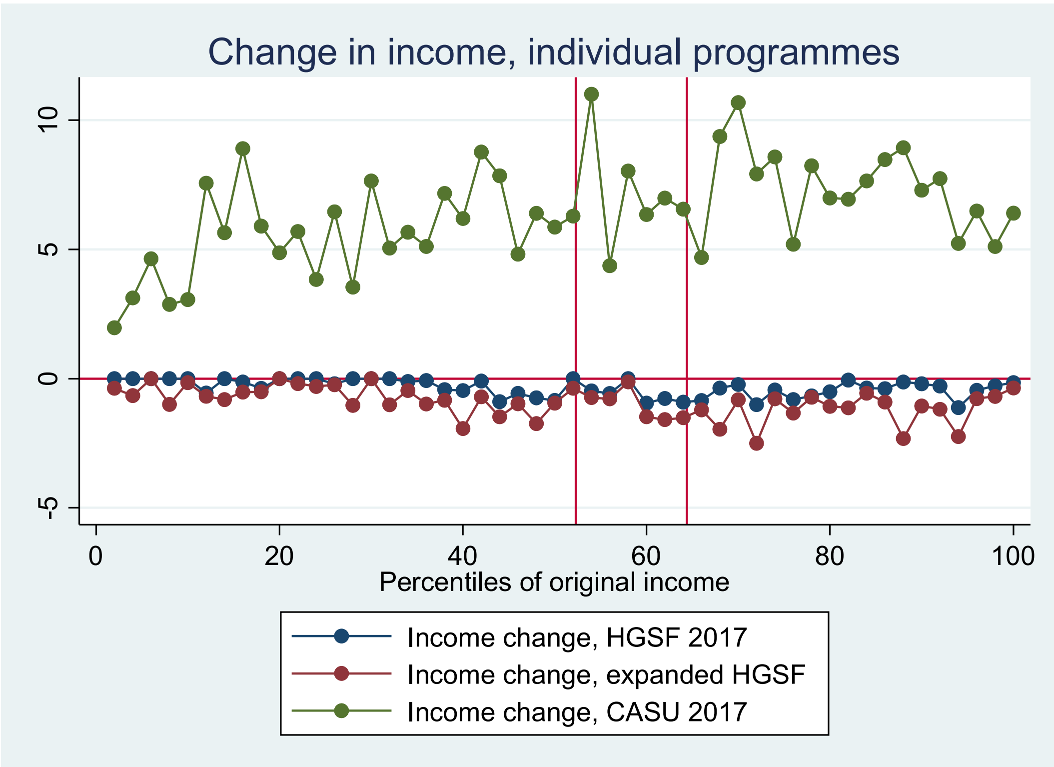
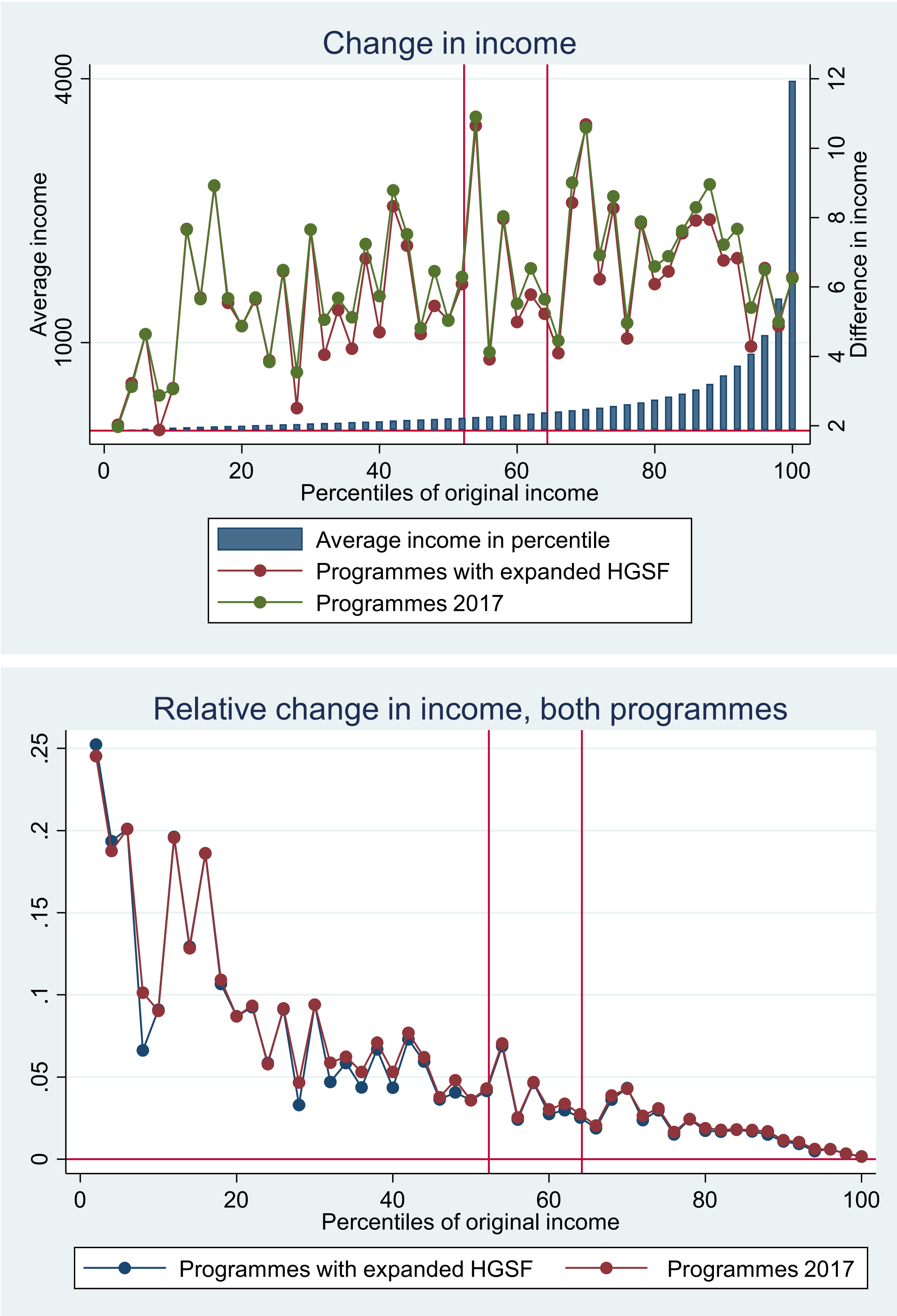


Figure 2: Changes in income due to programmes across income distribution *Cont.*



Note: The vertical red lines represent the extreme poverty line (ZMW 152 per month per adult equivalent) and the poverty line (ZMW 214 per month per adult equivalent).

The results show that the programmes have less absolute impact on the very poor households, but they are also not significantly biased towards the highest income deciles. The farmers with the smallest landholdings are probably not able to participate in the programmes due to land, labour and possibly credit constraints; nevertheless, the self-selected target groups include a considerable number of poor households. The largest average effects, both positive due to CASU and negative due to HGSF, occur at the higher end of income distribution, although in relative terms the programmes are also highly significant for the poorest. In terms of income increase, the improvements in income are generally under five percent in the non-poor percentiles.

6.2 School feeding

The logit models of primary school attendance that were estimated by using the LCMS data are presented in Annex 2. As explained in the methodology, the simulated attendance is then predicted for each individual primary school-aged child by taking a random draw from a uniform distribution and simulating a binary variable of school attendance by comparing the random number with the predicted probability. School attendance rates for the population and population subgroups were then calculated by using the simulated attendance figures. Subsequent implications for consumption were calculated by using the simulated attendance, assuming that all children attending school receive a meal or a transfer of income of the market value of annual school meals.

Given that the level of the transfer is less than five percent of the food poverty line, it is unlikely that significant impacts on poverty will be observed. However, the relative impacts on different parts of the income distribution may be more significant.

The consumption data do not include individual level measures or information on the food that children have had at school. Neither do the data explicitly include a question on whether the household benefited from school feeding. It is assumed that the consumption measures do not include school meals. However, there are different ways of calculating the new consumption and food consumption after the inclusion of the meals for those attending school.

The first method applied involves the assumption that the additional food is divided equally between household adult equivalents and so the total consumption per adult equivalent goes up by the total value of school meals per household/number of adult equivalents. The increase in food consumption is the same if consumption is not diverted away from food as a result of the food transfer. The actual consumption per child is not known. Describing consumption in terms of consumption per adult equivalent removes the impact of age variation on the patterns of consumption by using approximate ratios of children's relative consumption compared to adults. This allows, for example, the calculation of poverty figures, given that the definition of poverty is based on consumption per adult equivalent. As the division of consumption within the household is generally not known, consumption per adult equivalent (which is the same for all household members) provides the most feasible way of comparing living standards between households. For example, changes in the Gini coefficient are more logically calculated from the consumption per adult equivalent, as inequality measures should not depend on the ages of the individuals in question.

The second method involves allocating the total value of school feeding only to the child attending school. The value of school feeding is added to the consumption per adult equivalent in the household in question, but only for the children attending school. If the comparison is conducted for the whole population, the average change in consumption is the same for both methods; however, it will differ when only children are considered. As in the first method, the second approximation can also be applied to food consumption, subject to the assumption that the food transfer fully increases the amount of food consumed.

However, if individual children's actual food consumption levels are of interest, including the consumption differences due to age, each child's food consumption can also be corrected for by using the weight of each child in the calculation of adult equivalents to generate an estimate of actual consumption and adding the value of school feeding. All three methods are used in the calculations below.

Table 12 in Annex 2 shows simulated primary school attendance rates among primary school- aged children in two rural strata, by gender and stratum, by the gender of the head of household, and by disability and orphanhood in scenarios with different coverage of school feeding, together with 80, 90 and 95 percent confidence intervals for the differences, obtained by bootstrapping.

The difference between no school feeding and universal school feeding in rural areas leads to a 4.7 percentage point increase in the attendance rate, which is significant at the ten percent level. The increase in attendance from no feeding situation to 2017 coverage is 2.9 percentage points and the gain from expanding from the current coverage to universal coverage is 1.8 percentage points. These are both weakly significant at 20 percent significance and at the margin of 10 percent significance.

There is a difference among overall impacts of school feeding in different strata. The impact of universal school feeding compared with no school feeding is stronger in the second stratum, which includes the original strata of agricultural households with medium- and large- scale activities and non-agricultural rural households. According to the bootstrapped confidence intervals, this difference is also nearly significant at the 10 percent level and significant at the 20 percent level.

The difference between response strength in the different strata may be related to the agricultural activities; when the value of a school meal does not need to be weighed against the productivity of the child in agricultural work, the meal represents a larger gain. Similarly, the value of education may be perceived to be higher or the cost of going to school lower (due to lower travel distance or access to means of transport) in less poor households. This finding emphasizes the fact that, to reach the poorest of children, school feeding needs to be coordinated with agricultural or other social protection interventions in order to maximize its impact on the poorest households. For example, interventions that increase household income but, implicitly or through the new activities taken up, require more work effort, are likely to reduce incentives to attend school.

With universal school feeding the simulated attendance rate in the second stratum is well over 90 percent, similar to the rate in urban districts, whereas in the smallholder stratum the attendance rate with universal school feeding is slightly over 80 percent. It is conceivable that school feeding has a stronger impact in households where children have fewer work responsibilities on the farm, such as farms with higher revenues or households where the main source of livelihood is not agriculture.

There are some interesting patterns of gender difference in the impact of school feeding, although generally they fall short of statistical significance. Girls' school attendance is higher in all scenarios and in the actual observed attendance rates. Female children seem to respond to school feeding more than male children; the difference between attendance rates with no school feeding and universal school feeding scenarios is about one percent higher for girls. When the differences are calculated separately by rural strata, similarly to the overall data, female attendance rates are higher in all scenarios, except for the universal school feeding scenario.

The stronger response for girls compared to boys persists in the smallholder stratum (slightly over two percent). The difference, however, is only at the margin of significance of the 20 percent significance level. Interestingly, in the medium, large and non-agricultural household stratum, male children's attendance increases much more as a result of school feeding – by almost ten percent – although this stratum is much smaller and there is a lot of random variation, resulting in lack of significance. In this stratum the actual school attendance is also higher for female children, but the situation is reversed in the universal feeding scenario, although the difference between male and female children is very small.

Due to the lack of strong statistical significance, drawing strong conclusions is questionable. However, it seems that female children especially respond to school feeding in poorer households, which may be explained by girls' consumption at home and participation in household chores being weighed against the value of the school meal. Male children may be more engaged in agricultural work, which is more productive, and hence for them the difference between the value of a school meal and the forgone earnings from the child's labour is smaller. In the case of wealthier households who hire outside agricultural labour or those who are not engaged in agriculture, primary school-aged boys' work effort is not as valuable and the value of education (which adds to the value of the school meal) may be perceived to be higher for them.

There is no significant difference between the overall impact of school feeding in female- and male-headed households (**Table 12**, Annex 2). The impact of school feeding is higher for orphans and disabled children, but the bootstrapped distribution of the difference shows that the differences are not significant. This is likely due to the very small number of disabled children in the sample, although the observed difference of almost 30 percent in the attendance rates is statistically significant; disabled children attend school much more rarely than their non-disabled counterparts. The size of the differential effect of school feeding, however, suggests that, as with girls, disabled children may be sent to school when their consumption and relatively low productivity at home is weighed against the value of the school meal.

To illustrate the impact of school feeding on consumption levels, the impact on consumption and food consumption was applied. The changes in average consumption and food consumption among primary school children are shown in **Table 13** in Annex 2.

The average increases in food consumption are relatively low, representing only a 1.6 percent increase in consumption per adult equivalent in the case of equal division of the transfer and around 4 percent in the case where the transfer is allocated to the child alone. When compared with the estimated individual consumption of the child, the figures are somewhat more significant, with universal school feeding leading to, on average, a nearly 9 percent increase in food consumption when the additional food is allocated to the child.

If the main goal of school feeding is specifically to increase primary school children's food consumption it is essential that the transfer does not significantly shift the intrahousehold division of food away from the child receiving the school meal. In the case of equal division of food, the impact on each individual is very small, and as is known from the evaluations of cash transfers, the size of the transfer is significant for the impact (Bastagli *et al*., 2016). This is also reflected in the poverty impact of school feeding; universal school feeding only reduces poverty by 0.2 percent and extreme poverty by 0.3 percent, compared to no school feeding, when the transfer is equally distributed among the adult equivalents in the household.

Typical household surveys have little or no information on intrahousehold distribution of resources. In many cases, as in this study or other works using similar data, the data do not allow the exact individual effects of school feeding on food consumption to be pinpointed.

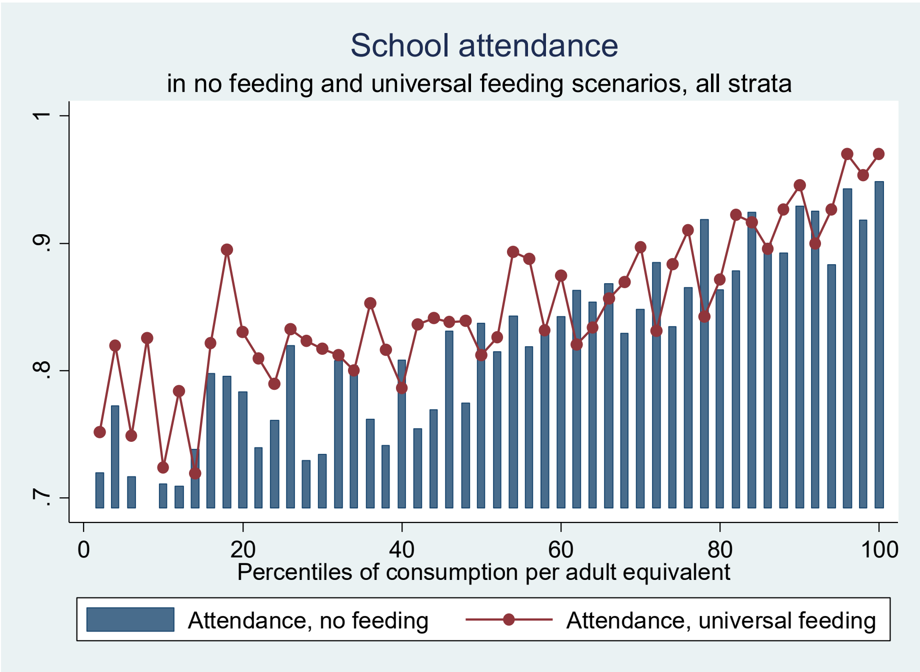
In addition to average measures, the distribution of the consumption effects is of interest. **Table 14** in Annex 2 shows basic measures of inequality or Gini coefficients and the ratio of 90th and 10th percentile of consumption among primary school-aged children. School feeding has a significant, albeit relatively small, effect, reducing inequality among primary school-aged children both where the transfer is divided equally among the household members and where it is allocated to the child alone. When all individuals are considered, the difference in Gini coefficients in the case of no school feeding is 0.562, with universal school feeding and equal division it is about 0.560 and with allocation to the child it is about 0.561 – i.e. the impact is very small.

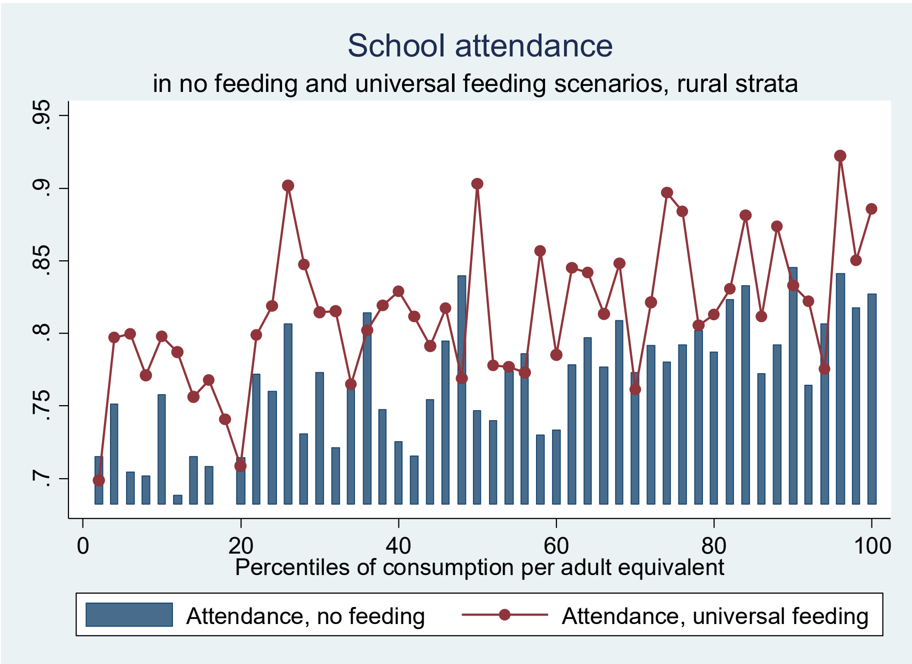
All children attending school are assumed to receive a meal even though those attending private schools at the higher end of income distribution do not. For this reason, it is credible that the estimates represent a lower limit of the impact on income inequality. Even universal school feeding as a redistribution mechanism has a small impact, although it does reduce inequality.

Figure 4 shows primary school attendance rates in the two extreme scenarios – no school feeding vs. universal school feeding – across the distribution of consumption per adult equivalent. Each bar represents two percent of children, ordered by the level of consumption per adult equivalent in the household. The upper panel concerns only rural households, as in most of the analysis, whereas the middle panel also includes urban households.

As seen from the Figure, there are some gains in attendance throughout the income distribution of rural households. The largest increases in attendance are seen in the lower part of the income distribution and this pattern becomes more prominent when urban households are included. However, even with universal feeding, attendance lags behind in the lowest percentiles compared with the highest percentiles, and this pattern also occurs when only rural households are included. The scope for increasing school attendance by expanding coverage, or the difference between the bars and the red line in Panel 3, indicates that the improvements are likely to occur at the lower half of the income distribution, although not clearly increasing with the level of poverty. Clearly, school feeding has an important role to play in increasing school attendance, but this alone is not adequate to attain equality of educational opportunities.

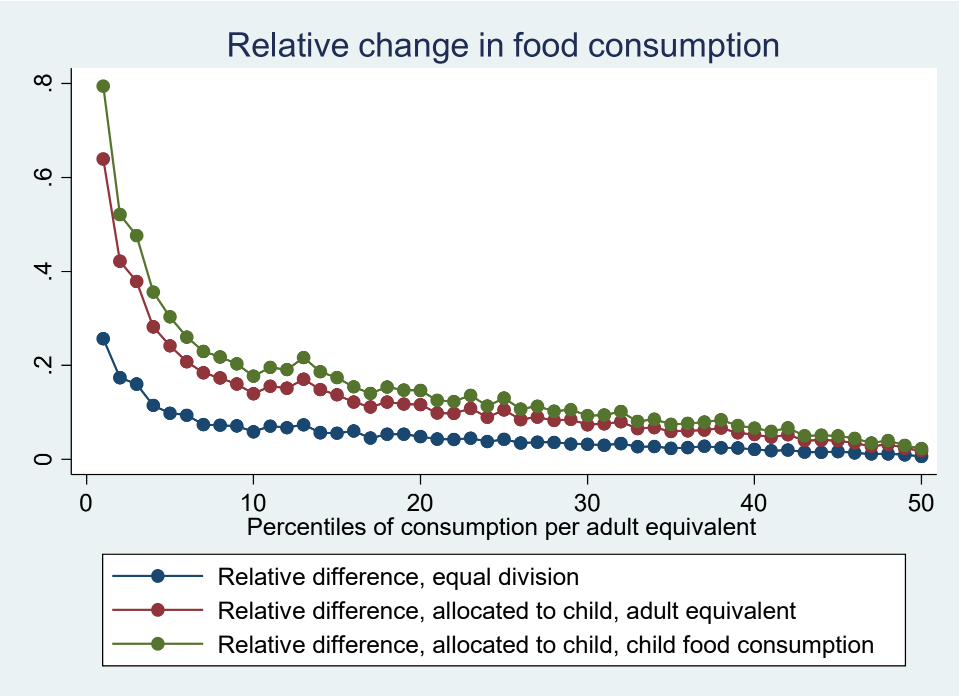
Figure 3: Impact of school feeding on school attendance across income distribution





Similar analysis is carried out for the value of the transfer in the scenarios, and with different assumptions about the division of the transfer within households (**Figure 5**). The three lines represent the relative impact of school feeding on food consumption, measured as the difference in food consumption between the scenarios of no school feeding and universal school feeding as relative to consumption without school feeding. The three methodologies used are as above, equal division of the additional food among all household members and allocated only to the child, compared with food consumption of adult equivalent consumption in the household. The highest line is the relative change compared with the estimated individual food consumption.

Figure 4: Relative change in food consumption as a result of school feeding



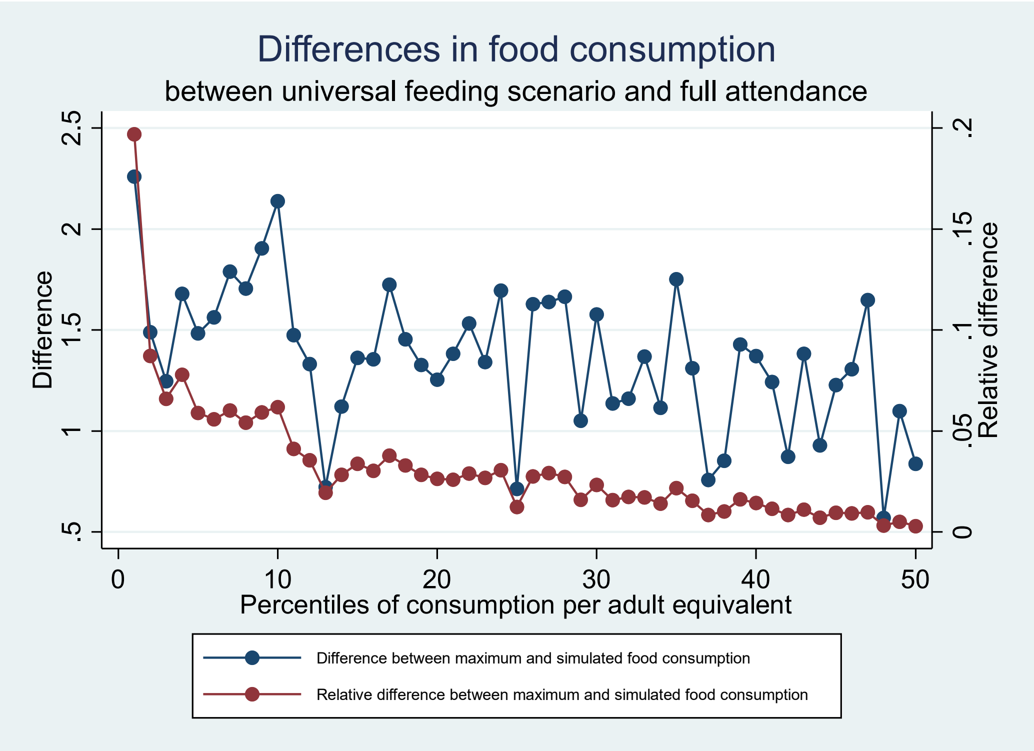
The uppermost line shows that if the food is completely allocated to the child, the increase in the food consumption in the lowest deciles is of significant magnitude, and in the lowest quintile of schoolchildren it is generally above 20 percent. When such impacts on consumption are measured as changes in consumption of adult equivalents (the second line), the impacts are of course smaller in relative terms (ranging from 64 percent to 14 percent), although they are still significant, especially in the lowest percentiles. The two measures paint a very similar picture, as their only difference is the average child factor in each percentile. The difference between the relative changes in food consumption when the food is allocated to the child or divided equally among the household members is much larger and increasing towards the poorer deciles. The difference between the relative impacts in these two scenarios varies between 38 and 8 percentage points.

This highlights the fact that intrahousehold division of resources and transfers has a large potential impact on how much the programme specifically improves child nutrition. Generally, in relative terms, the potential impact of universal coverage of the school feeding programme is much more significant for the poorest children. Further closing the gap in the attendance rates is also necessary to fully attain the objectives of the programme.

To explore more precisely the scope for improvement through school feeding beyond universal school feeding, we look at the difference between the maximum food consumption (where all children attend school and receive the meal) and the simulated outcome obtained from the universal scenario. Figure 6 represents the difference between consumption in the situation where all children attend school and that of universal school feeding (left y axis). The scope for improvement is generally higher in the lower percentiles and there is a downward trend.

When presented as a percentage of food consumption (the right y axis) it becomes obvious that the scope for significant further improvement in food consumption is significant in the poorest percentiles, mainly in the lowest quintile, and negligible in relative terms for the highest percentiles. This further highlights the need to target the poorest members of the population with interventions that increase school attendance, and to clearly align any social protection or productive interventions with the aim of improved schooling. This requires ensuring that agriculture or other income-generating activities do not prevent school attendance. The results obtained in the impact evaluation of HGSF (Prifti and Grinspun, 2019) show that there is potential for such a negative impact. A review of interactions between social protection and agricultural interventions shows that, although evidence is mixed, in some instances child labour can be increased (Veras Soares *et al.*, 2017).

Figure 5: Difference and relative difference between food consumption in universal school feeding scenario and full attendance scenario



7. Conclusions

The aim of this study is to complement the impact evaluation of two major agricultural and social protection programmes in Zambia, HGSF and CASU, by providing simulated estimates of their distributional consequences and the implications for expansions of the purchase programme and school feeding. The programmes have different goals but, due to complementarities between certain elements of the programmes, there is a possibility of reaping significant synergies. The CASU encouraged cultivation of legumes and provided inputs for the lead farmers and guidance and training for the follower farmers. On the other hand, in the districts where HGSF institutional procurement programme is operating it provides a marketing channel with a fixed price for beans and/or cowpeas, complementing production support with market access. However, whether such programmes act to reduce poverty or income inequality depends on who takes up the programmes and how much they actually change the outcomes, such impact perhaps depending on household characteristics.

School feeding itself is a relatively simple instrument that can simultaneously reduce food insecurity, improve nutrition and increase educational attainment among the poorest. The benefit of school feeding at the household level, however, is weighed against the potential return to child labour and the costs of schooling, which may result in weaker impacts in households where children are used for labour, or in those parts of the population where school attendance is already high.

This study used microsimulation to study such distributional consequences and the impact on the national scale of the CASU and HGSF programmes. Currently, the nationally representative data sets do not include information on participation in these programmes, nor do they allow estimation of the impacts across the population, as at the time of data collection they were either small-scale (HGSF) or non-existent (CASU) and the data do not include specific questions relating to these or related programmes. The impact evaluation data collected by FAO include a rich set of variables that allow estimation of a multitude of impacts. However, from a poverty and inequality reduction perspective they provide an incomplete picture; the limited number of districts and the sampling strategy that was designed to capture as many households as possible that were participating in the programmes did not allow examination of the distributional impacts across the population and provides a limited picture of how participants compare with non-participants on a national scale.

The results show that both CASU and the HGSF institutional procurement reach households that are less poor than the population overall but still have non-negligible poverty rates. Therefore, the programmes have the potential to reduce poverty, even though they are not strictly poverty-targeted. Due to its positive impact on household income and broad coverage, CASU also actually reduces poverty and extreme poverty at the national level.

Selection into programmes varies across the income distribution. Participation rates are low at the lowest end of income distribution and decline towards the highest percentiles. In terms of overall income distribution, the programmes have a slightly equalizing impact. The benefits (and losses due to the market access programme) are spread across the entire income distribution. This supports the observation that the programmes exclusively target neither the poor nor large-scale farmers, but concern smallholders generally. In effect, the poorest are to some extent excluded, likely due to their land constraints or inability to, for example, join a cooperative due to lack of resources.

Results on selection into the programmes also show that participation is correlated with participation in other programmes. Due to imperfect coverage of the evaluation data used to estimate selection into programmes, there is some uncertainty regarding this result. However, there is clearly a need to study in more detail how programmes are linked to each other – for example, whether additional programmes providing market access in general are substitutes for each other or whether they genuinely engage new households. Although the actual impacts of the programmes were estimated in a separate study (Prifti and Grinspun, 2019), they also suggest that some additional elements such as production support are needed to generate positive effects for the market access component.

The actual school feeding programme has been in place for a longer period of time and, due to its coverage being based on districts and changing over time, its impact on attendance rates is possible to estimate with the LCMS data from two different time periods, with the caveat that each district shows distinct and specific trends. As expected from the theory of change, the impact of school feeding on attendance is positive. In particular, there are also persistent effects whereas some impact evaluations of on-site feeding have found effects that largely disappear after the initial increase in school attendance (Bundy *et al*., 2009).

Differences between genders are also consistent with other studies. It seems that school feeding may have more impact in less poor and non-agricultural rural households, which is consistent with the higher relative cost of schooling impeding attendance or the higher value of children as labour in households that cannot hire labourers due to liquidity constraints. A closer inspection of changes in attendance rates across the distribution of households also shows that even after applying a universal school feeding scheme the poorer children are lagging behind those from more affluent households in terms of their school attendance. Hence for further development of the programme it is necessary to acknowledge that the poorest households may need further motivation to increase the children's school attendance to the levels of wealthier households.

The simulations of impact on food consumption show that intrahousehold division of resources and transfers has a large potential impact on how much the programme improves child food consumption specifically, in particular in the lowest income percentiles, where households are larger and the relative impact of school feeding on food consumption is much larger. The potential relative gain in food consumption from universal attendance compared with the attendance levels in the scenario of universal feeding is much larger for the poorest children.

Policy recommendations

Although the production support schemes have the potential to contribute to poverty reduction, this very much hinges on their ability to generate genuinely positive net impacts rather than replace a low-risk, low-profit livelihood strategy with another similar strategy, as well as the accessibility of the programmes for the poorest. These factors are particularly important in the case of these programmes.

If participation is based on self-selection, such as in the case of these programmes, and participation requires either assets or participation in farmers' organizations, it does not seem likely that the actual coverage can be heavily leaning towards the poor. This may be acceptable if the goal is to kick-start higher productivity agriculture or technology adoption rather than to reduce poverty or extreme poverty. However, in the long term, supporting the poorest to participate would require increasing their productive potential through other means of assistance. For initiatives such as CA, also engaging the poorest smallholders can be beneficial, but it can be provided, for example, as part of a cash or input transfer scheme that also alleviates their liquidity and credit constraints and reduces risk aversion to allow technology adoption.

Provision of market access has more impact if it actually allows higher value production, rather than simply lowering the risk of another livelihood strategy that does not provide essentially better income. As shown by the results, it can also potentially serve as a poverty reduction tool, although this requires positive impacts on income. Diversification or crop substitution may also be a desirable goal – for example, due to high dependence on a staple – but for individual households it may be a risk management strategy that does not increase overall income significantly. The provision of market access may need to be complemented with technical assistance, access to inputs or business skills, or in some instances with cash transfers to allow the households to make riskier but more profitable choices.

School feeding seems to reach its stated goals of increasing school attendance and food consumption for children, although it is not possible to provide a precise measure of this potential impact, given the lack of data on intrahousehold distribution of resources. More data are needed to establish whether the large potential gains for children's food consumption in the lowest deciles can be attained without further support. For the poorest, reducing the gap in school attendance compared with the wealthier households is nevertheless also important in terms of increasing children's food consumption.

Simulations such as those presented in this paper can be helpful in providing detailed information on the distributional impacts of policy options, such as the poverty impact of programmes. Combined with the cost information of the programmes, the scenarios generated can be used for calculating cost-effectiveness of different policy options.

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Annex 1

Table A1.1: Selection models for participation in programmes

	Market access	CASU	Market access, minimum model	CASU, minimum model
0.5–0.99 ha	0.269	0	0.332	0
	(0.356)		(0.299)	
1–1.99 ha	0.032	0.759***	0.293	0.888***
	(0.335)	(0.195)	(0.282)	(0.168)
2–2.99 ha	0.084	1.126***	0.279	1.440***
	(0.339)	(0.198)	(0.286)	(0.168)
3–3.99 ha	-0.296	1.151***	-0.058	1.438***
	(0.358)	(0.227)	(0.3)	(0.187)
4–4.99 ha	-0.279	1.391***	0.039	1.683***
	(0.367)	(0.239)	(0.307)	(0.195)
5–5.99 ha	-0.273	1.097***	0.093	1.547***
	(0.373)	(0.261)	(0.313)	(0.206)
over 6 ha	0.028	1.216***	0.254	1.768***
	(0.345)	(0.214)	(0.289)	(0.173)
Female head of household	0.063	0.669**	0.373	0.361*
	(0.229)	(0.23)	(0.191)	(0.183)
Single head of household	-0.637**	0.188	-0.792***	0.389*
	(0.233)	(0.23)	(0.194)	(0.184)
Age of head of household	-0.011**	0.022***	-0.010**	0.022***
	(0.004)	(0.004)	(0.003)	(0.003)
Unfit/fit household members	-0.039	0.065	-0.036	0.127***
	(0.038)	(0.039)	(0.032)	(0.032)
Schooling rate	-1.854***	-1.139***	-1.408***	-0.576**
	(0.251)	(0.252)	(0.201)	(0.192)
Members age 0-5	-0.095*	0.248***	-0.106***	0.304***
	(0.038)	(0.043)	(0.032)	(0.034)
Members age 6–14	-0.179***	0.074	-0.203***	0.176***
	(0.047)	(0.049)	(0.04)	(0.038)
Members age 15–65	0.090*	0.134**	0.049	0.250***
	(0.041)	(0.043)	(0.034)	(0.034)
Members over 65	-0.566**	-0.091	-0.307*	0.068
	(0.181)	(0.177)	(0.148)	(0.14)
Owns other motorized vehicle	-1.299**	-0.174		
	(0.462)	(0.369)		
Owns mobile phone	-0.913***	0.872***		
	(0.124)	(0.124)		

Table A1.1: Selection models for participation in programmes *Cont.*

Owns plough	0.443**	2.204***		
	(0.138)	(0.156)		
Receives SCT	3.190***	-1.048***		
	(0.32)	(0.239)		
Receives FSP	0.357	-0.054		
	(0.492)	(0.543)		
Receives FISP	-0.13	0.132		
	(0.112)	(0.122)		
Sells to FRA	1.303***	-2.199***		
	(0.137)	(0.161)		
Receives extension services	0.465***	0.214		
	(0.118)	(0.131)		
Distance to *boma* more/less than 1 hour	-0.454**	-2.084***		
	(0.147)	(0.155)		
Participates in CASU	0.879***		0.085	
	(0.139)		(0.093)	
Household coop member		1.112***		1.008***
		(0.151)		(0.113)
Constant	1.509***	-3.565***	1.341***	-4.677***
	(0.424)	(0.338)	(0.352)	(0.284)
N	2 180	2 821	2 449	3 176

Note: *,** and *** values are different at the 5,1 and 0.1 % significance levels, respectively. CASU: conservation agriculture scaling-up, FISP: Farmer Input Subsidy Programme; FRA: Food Reserve Agency; FSP: Food Security Pack; ha: hectares; SCT: Social Cash Transfer.

Table A1.2: Characteristics of participants in HGSF

	No Market access	Market access 2015	Market Access 2017	Market access expanded	F test
Poverty rate	0.647	0.576	0.516	0.526	*
Extreme poverty rate	0.527	0.357	0.294	0.441	*
Gross annual income per adult equivalent	3698.694	2716.338	4153.201	3667.292	
Landholdings, ha	4.145	2.840	4.339	5.011	
Coop member	0.426	1.000	1.000	1.000	*
Female head of household	0.257	0.367	0.154	0.227	
Single head of household	0.302	0.340	0.061	0.211	*
Age of head of household	48.124	52.199	42.408	47.545	
Unfit/fit household members	2.220	2.534	1.479	1.434	*
Schooling rate	0.612	0.502	0.552	0.670	*
Members 0–5	0.861	0.571	1.299	0.714	*
Members 6–14	1.742	1.103	1.389	1.423	*
Members 15–65	3.022	3.255	3.688	3.550	*
Members over 65	0.238	0.255	0.130	0.128	*
Owns other motorized vehicle	0.032	0.000	0.009	0.017	*
Owns mobile phone	0.533	0.312	0.553	0.582	
Owns plough	0.204	0.287	0.685	0.393	*
Receives SCT	0.018	0.491	0.063	0.031	*
Receives FSP	0.010	0.022	0.018	0.010	
Receives FISP	0.378	1.000	0.725	0.868	*
Sells to FRA	0.203	0.721	0.634	0.629	*
Receives extension services	0.200	0.421	0.445	0.445	*
Distance to *boma* over 60 min	0.550	0.111	0.223	0.335	*
Population size	1 438 719	4 131	12 602	26 807	

Note: * values are different at the 5% significance level. CASU: conservation agriculture scaling-up, FISP: Farmer Input Subsidy Programme; FRA: Food Reserve Agency; FSP: Food Security Pack; ha: hectares; SCT: Social Cash Transfer.

Table A1.3: Characteristics of participants in HGSF and CASU 2017

	No programmes	CASU only	HGSF market access only, 2017	Both, 2017	F test
Poverty rate	0.653	0.594	0.555	0.502	*
Extreme poverty rate	0.536	0.458	0.242	0.380	*
Gross annual income per adult equivalent	3686.748	3764.243	3354.194	4253.279	
Landholdings, ha	3.764	6.497	3.649	4.295	*
Coop membership	0.389	0.712	1.000	1.000	*
Female head of household	0.255	0.264	0.128	0.272	
Single head of household	0.289	0.370	0.128	0.133	*
Age of head of household	47.589	51.205	43.746	45.819	*
Unfit/fit household members	2.221	2.118	1.285	2.183	*
Schooling rate	0.613	0.612	0.571	0.512	*
Members 0–5	0.842	0.954	1.043	1.195	*
Members 6–14	1.688	2.018	1.120	1.502	*
Members 15–65	2.949	3.515	3.184	3.976	*
Members over 65	0.229	0.280	0.216	0.109	*
Owns other motorized vehicle	0.027	0.057	0.006	0.008	*
Owns mobile phone	0.490	0.792	0.358	0.632	*
Owns plough	0.141	0.595	0.249	0.909	*
Receives SCT	0.020	0.007	0.247	0.094	*
Receives FSP	0.009	0.018	0.017	0.021	
Receives FISP	0.349	0.612	0.879	0.706	*
Sells to FRA	0.226	0.120	0.756	0.553	*
Receives extension services	0.195	0.259	0.618	0.258	*
Distance to *boma* over 60 min	0.605	0.198	0.387	0.011	*
Population size	1 252 858	212 779.00	8 198	8 423	

Note: * values are different at the 5% significance level. CASU: conservation agriculture scaling-up, FISP: Farmer Input Subsidy Programme; FRA: Food Reserve Agency; FSP: Food Security Pack; ha: hectares; HGSF: home-grown school Feeding; SCT: Social Cash Transfer.

Table A1.4: Characteristics of participants in CASU and expanded HGSF

	No programmes	CASU only	HGSF market access only, expanded	Both, expanded	F test
Poverty rate	0.654	0.600	0.565	0.475	*
Extreme poverty rate	0.537	0.460	0.384	0.402	*
Gross annual income per adult equivalent	3690.609	3748.582	3399.262	4184.272	
Landholdings, ha	3.758	6.489	3.994	5.536	*
Coop member	0.381	0.700	1.000	1.000	*
Female head of household	0.256	0.264	0.186	0.270	
Single head of household	0.290	0.375	0.168	0.199	*
Age of head of household	47.611	51.235	45.329	48.248	*
Unfit/fit household members	2.231	2.154	1.440	1.720	*
Schooling rate	0.612	0.610	0.643	0.584	
Members 0–5	0.842	0.976	0.902	0.821	*
Members 6–14	1.695	2.026	1.190	1.668	*
Members 15–65	2.944	3.491	3.260	4.013	*
Members over 65	0.230	0.289	0.169	0.097	*
Owns other motorized vehicle	0.028	0.058	0.004	0.028	*
Owns mobile phone	0.490	0.795	0.458	0.681	*
Owns plough	0.141	0.585	0.206	0.857	*
Receives SCT	0.020	0.007	0.109	0.046	*
Receives FSP	0.009	0.019	0.013	0.014	
Receives FISP	0.341	0.607	0.925	0.710	*
Sells to FRA	0.217	0.114	0.795	0.405	*
Receives extension services	0.192	0.248	0.480	0.385	*
Distance to *boma* over 60 min	0.608	0.200	0.415	0.083	*
Population size	1 234 987	203 796	26 069	17 406	

Note: * values are different at the 5% significance level. CASU: conservation agriculture scaling-up, FISP: Farmer Input Subsidy Programme; FRA: Food Reserve Agency; FSP: Food Security Pack; ha: hectares; HGSF: home-grown school Feeding; SCT: Social Cash Transfer.

Annex 2

Table A2.1: Models of school attendance

	Stratum 1	Strata 2, 3 and 4
2015	0.231***	0.367*
	-3.38	-2.17
School feeding	-0.128	0.896**
	(1.06)	(2.64)
School feeding previously	0.312*	0.627
	(2.3	-0.347
Female	0.164	0.227
	-0.087	-0.205
School feeding*Female	0.216*	0.145
	-0.109	-0.262
Disabled	-1.567***	-1.336
	-0.313	-0.688
School feeding*Disabled	0.713	0
	-0.622	(.)
Orphan	0.19	0.366
	-0.196	-0.424
School feeding*Orphan	0.223	-0.881
	-0.351	-0.602
Female household head	0.227**	0.347
	-0.082	-0.203
School feeding*Female household head	-0.072	0.028
	-0.135	-0.342
Number younger household members	0.844***	0.684***
	-0.046	-0.092
Female* number younger household members	-0.047	-0.028
	-0.043	-0.083
Household members 0–6 years	-0.790***	-0.625***
	-0.052	-0.101
Household members 7–13 years	-0.337***	-0.239***
	-0.028	-0.061
Household members 14–17 years	0.197***	0.02
	-0.034	-0.067
Household members 18–64 years	0.021	0.078
	-0.023	-0.042
Household members over 65	0.258**	0.071
	-0.079	-0.147

Table A2.1: Models of school attendance *Cont.*

Household head highest education, some primary	0.269***	0.588**
	-0.081	-0.186
Household head highest education, primary	0.708***	0.604**
	-0.09	-0.21
Household head highest education, grades 8–9 of secondary	0.883***	0.821***
	-0.094	-0.204
Household head highest education, grades 9–11	1.084***	1.074***
	-0.142	-0.318
Household head highest education, secondary	1.214***	1.126***
	-0.178	-0.334
Household head highest education, A level	1.172	-0.407
	-0.768	-0.845
Household head highest education, post-secondary	2.141***	1.763***
	-0.231	-0.309
Large agricultural		-0.234
		-0.36
Non-agricultural		-0.431*
		-0.168
School feeding*large agricultural		0.524
		-0.59
School feeding*non-agricultural		-0.073
		-0.307
Constant	0.686***	0.875
	-0.194	-0.461
N	14 315	4 579

Note: *,** and *** values are different at the 5,1 and 0.1 % significance level, respectively.

Table A2.2: Simulated attendance rates and confidence intervals of differences

		Simulated attendance rates			Differences		
	Actual outcome 2015	No feeding	2017	Universal school feeding	Universal vs. No feeding	No feeding vs. 2017	2017 vs. universal feeding
All	0.782	0.768	0.796	0.814	0.047	0.029	0.018
95% confidence interval					(-0.021, 0.118)	(-0.009, 0.062)	(-0.018, 0.06)
90% confidence interval					(-0.009, 0.108)	(-0.001, 0.056)	(-0.008, 0.055)
80% confidence interval					(0.009, 0.097)	(0.004, 0.05)	(0.002, 0.049)
Male	0.761	0.756	0.773	0.797	0.041	0.018	0.024
Female	0.802	0.779	0.819	0.831	0.052	0.040	0.013
Male-Female difference	-0.041	-0.024	-0.046	-0.034	-0.011	-0.022	0.011
95% confidence interval					(-0.06, 0.022)		
90% confidence interval					(-0.053, 0.01)		
80% confidence interval					(-0.046, 0.004)		
Stratum 1							
Male	0.755	0.758	0.766	0.783	0.025	0.008	0.017
Female	0.796	0.775	0.812	0.822	0.046	0.037	0.010
Male-Female difference	-0.041	-0.017	-0.046	-0.039	-0.022	-0.029	0.007
95% confidence interval					(-0.067, 0.022)		
90% confidence interval					(-0.059, 0.009)		
80% confidence interval					(-0.053, 0.002)		
Strata 2, 3, 4							
Male	0.820	0.729	0.843	0.935	0.205	0.114	0.091
Female	0.861	0.819	0.887	0.926	0.108	0.069	0.039
male-female difference	-0.041	-0.090	-0.044	0.008	0.098	0.045	0.052
95% confidence interval					(-0.068, 0.108)		
90% confidence interval					(-0.05, 0.09)		
80% confidence interval					(-0.036, 0.07)		

Table A2.2: Simulated attendance rates and confidence intervals of differences *Cont.*

		Simulated attendance rates			Differences		
	Actual outcome 2015	No feeding	2017	Universal school feeding	Universal vs. No feeding	No feeding vs. 2017	2017 vs. universal feeding
Strata 1	0.776	0.767	0.789	0.802	0.036	0.022	0.013
Strata 2, 3, 4	0.841	0.775	0.866	0.930	0.156	0.091	0.065
Difference	-0.065	-0.008	-0.076	-0.128	-0.120	-0.069	-0.051
95% confidence interval					(-0.254, 0.032)		
90% confidence interval					(-0.23, 0.004)		
80% confidence interval					(-0.207, -0.023)		
Male household head	0.788	0.767	0.798	0.813	0.046	0.031	0.015
Female household head	0.753	0.769	0.789	0.820	0.051	0.020	0.031
Difference	0.036	-0.001	0.009	-0.007	-0.005	0.011	-0.016
95% confidence interval					(-0.065, 0.048)		
90% confidence interval					(-0.055, 0.04)		
80% confidence interval					(-0.043, 0.03)		
Non- disabled	0.785	0.770	0.798	0.816	0.046	0.028	0.018
Disabled	0.429	0.473	0.576	0.594	0.121	0.103	0.018
Difference	0.356	0.298	0.223	0.222	-0.075	-0.075	0.000
95% confidence interval					(-0.447, 0.124)		
90% confidence interval					(-0.411, 0.084)		
80% confidence interval					(-0.368, 0.023)		
Not orphan	0.781	0.766	0.794	0.813	0.046	0.028	0.018
Orphan	0.800	0.815	0.878	0.878	0.063	0.064	0.000
Difference	-0.019	-0.049	-0.084	-0.066	-0.017	-0.036	0.019
95% confidence interval					(-0.137, 0.112)		
90% confidence interval					(-0.127, 0.081)		
80% confidence interval					(-0.102, 0.058)		

Table A2.3: Consumption in different scenarios and confidence intervals

Total consumption	**Equal division**		**Difference**	**Confidence interval**
	No feeding	147.244		
	2017 coverage	149.671	2.427	(2.333, 2.467)
	Universal feeding	149.711	2.467	(2.319, 2.616)
	Allocated to child			
	No feeding	147.244		
	2017 coverage	153.093	5.849	(5.675, 5.934)
	Universal feeding	153.224	5.980	(5.6, 6.298)
Food consumption, adult equivalent	Equal division			
	No feeding	84.444		
	2017 coverage	86.871	2.427	(2.333, 2.467)
	Universal feeding	86.911	2.467	(2.319, 2.613)
	Allocated to child			
	No feeding	84.444		
	2017 coverage	90.293	5.849	(5.6, 6.298)
	Universal feeding	90.424	5.980	(5.675, 5.934)
Food consumption, individual consumption	Equal division			
	No feeding	67.139		
	2017 coverage	69.566	0.036	(0.034, 0.037)
	Universal feeding	69.606	0.037	(0.034, 0.039)
	Allocated to child			
	No feeding	67.139		
	2017 coverage	72.988	0.087	(0.083, 0.09)
	Universal feeding	73.119	0.089	(0.083, 0.095)

Table A2.4: Measures of inequality

	Total consumption, children only		
		p90/p10	Gini coefficient
Equal division	No feeding, equal division	7.237	0.429
	Universal feeding	6.813	0.422
	Difference	0.424	0.007
	Confidence interval of the difference	(-0.484, -0.232)	(-0.008, -0.006)
Allocated to child	No feeding, equal division	7.237	0.429
	Universal feeding	6.428	0.414
		0.809	0.016
	Confidence interval of the difference	(-0.998, -0.578)	(-0.017, -0.014)

FAO, together with its partners, is generating evidence on the impacts of coordinated agricultural and social protection interventions and is using this to provide related policy, programming and capacity development support to governments and other actors.

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