Community participation and the links between agriculture, nutrition and education: design of a randomised field experiment of “home-grown” school feeding in Mali

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Abstract

**Background:** Providing food through schools has well documented effects in terms of the education, health and nutrition of school children. However, there is limited evidence in terms of the benefits of providing a reliable market for small-holder farmers through “home-grown” school feeding approaches. This study aims to evaluate the impact of school feeding programmes sourced from small-holder farmers on small-holder food security, as well as on school children’s education, health and nutrition in Mali. In addition, this study will examine the links between social accountability and programme performance.

**Design:** A field experiment around the scale-up of the national school feeding programme, involving 116 primary schools in 58 communities in food insecure areas of Mali. The randomly assigned interventions are 1) “home-grown” school feeding programme group, including schools and villages where the standard Government programme is implemented; 2) “home-grown” school feeding and social accountability group, including schools and villages where the programme is implemented in addition to training of community based organisations and local government; and 3) control group, including schools and household from villages where the intervention will be delayed by at least two years, preferably without informing schools and households. Primary outcomes include small-holder farmer income, school participation and learning, and community involvement in the programme. Other outcomes include nutritional status and diet-diversity. The evaluation will follow mixed method approach, including household, school and village level surveys as well as focus group discussions with small-holder farmers, school children, parents and community members. The impact evaluation will be incorporated within the national M&E system strengthening activities that are currently underway in Mali. Baselines surveys are planned for January 2012. Monthly process monitoring visits, spot checks and quarterly reporting will be undertaken as part of the regular programme monitoring activities. Evaluation surveys are planned for 2014.

**Discussion:** National Governments in sub-Saharan Africa have demonstrated strong leadership in the response to the recent food and financial crises by scaling-up school feeding programmes. “Home-grown” school feeding programmes have the potential to link the increased demand for school feeding goods and services to community based stakeholders, including small-holder farmers and women groups. Alongside assessing the more traditional benefits to school children, this evaluation will be the first to examine the impact of linking school food service provision on small-holder farmer income, as well as the link between community level engagement and programme performance.
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1 Introduction

Child development requires a life-cycle approach to intervention. School health and nutrition programmes are a key part of this continuum, providing the foundation for physical, cognitive and educational development that will allow children to reach their full and equal potential. The recent food, fuel and financial crises have highlighted the importance of school feeding programmes, both as a social safety net for children living in poverty and food insecurity, and as part of national educational policies and plans. Today, every country for which we have information is seeking to provide food, in some way and at some scale, to its schoolchildren. However, where the need is greatest, in terms of hunger, poverty and poor social indicators, the programmes tend to be the smallest.

Past experience shows that countries do not seek to exit from providing food to their schoolchildren, but rather to transition from externally supported projects to nationally owned programmes. Countries that have made a successful transition have often explored linking school feeding programmes to agriculture development—an approach also known as “Home Grown School Feeding” (HGSF). Strategic leadership from the New Partnership for Africa’s Development (NEPAD) guided Governments in Sub-Saharan Africa to include HGSF as a key intervention within the food security pillar of the Comprehensive Africa Agriculture Development Programme (CAADP) framework. Several countries, including Cote d’Ivoire, Ghana, Kenya, Mali and Nigeria are already implementing national programmes. From this perspective HGSF provides an integrated framework with multiple impacts across agriculture, health, nutrition and education. Since early 2008, the World Bank Group, WFP and PCD have been working together to help governments develop and implement cost effective, sustainable national school feeding programs.

How best can the potential of school feeding be maximised to support multi-sectoral integrated frameworks linking agriculture, health, nutrition and education? How can the impact of HGSF be maximised to benefit the nutrition status of the school age child and the community? How can HGSF be a win-win for agriculture, education and health? There is a need to answer these questions operationally and build the evidence base to help policy makers manage the trade-offs across the multiple school feeding objectives. This paper develops the design of a field experiment of the HGSF programme in Mali, with baselines planned for late 2011.

Mali country context

Mali is, according to the FAO definition, a Low-Income Food Deficit Country (LIFDC) with a population of 14 million people, over half of whom are under 15 years of age. According to UNDP, Mali is ranked 178th in the Human Development Index table, with an average life expectancy at birth of 48 years, adult literacy rate of 26 percent and a GDP per capita (PPP) of $1083 USD. At country level, Mali has seen remarkable progress in terms of access to school (net enrolment ratios increased from 20 percent in 1990 to 66 percent in 2007) but the levels of enrolment are still well below the average for Sub-Saharan Africa and completion rates are very poor (see table 1 and figure 1). A large proportion of children and girls in particular, are excluded from the schooling system. There are also large disparities within Mali, in the regions of Koulikoro and Mopti for example, girls’ enrolment was estimated at 44 percent.

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3 Ibid.
Agricultural productivity in Mali is among the lowest in the world (2009). In Mali, the majority of farmers are involved in the production of food crops, with the main cereals being millet and sorghum. Production is carried out using a low level of technology: fertiliser use is minimal and access to credit is limited. Crop yields are not only low but also highly variable due to the fact that most farmers depend on rainfed farming while rainfall fluctuates considerably from year to year and season to season (USDA 2009) Figure 2 maps the main seasonal agricultural and educational cycles in Mali.

According to the 2005 WFP food security and vulnerability analysis, an estimated 4 million people, or 40 percent of the population live in food insecurity or are highly vulnerable to food insecurity. According to this assessment, the regions most at risk are Kayes, Koulikoro, Mopti,
Tombouctou, Gao and Kidal. Households affected by acute food insecurity and vulnerability are concentrated in the following regions: Kayes and Koulikoro, northern Ségou, the Dogon plateau, the area from Douentza and Djenné to Mopti and the river area around Tombouctou. The food security assessment also showed that food access is a primary constraint: food is available at market when harvests are good but that populations face constraints in food access and utilisation.

**Figure 3: Mali, livelihood zones, (Source: FEWS/USAID).**

In children under five years of age, 38 percent of children are chronically malnourished or stunted in their growth (low height for age), 15 percent are acutely malnourished or wasted (low weight for height), and 27 percent are underweight (low weight for age) which is a composite measure of stunting and wasting\(^6\). The majority (81 percent) of children 6-59 months are anaemic\(^9\), caused mainly by iron deficiency, malaria and helminth infections. Anaemia prevalence in school-age children is lower but still unacceptably high with 56 percent of school children affected\(^10\). While it is not know if there are national surveys on stunting and wasting in school children, 37 percent of five year olds, when they will soon be entering primary school, are stunted in their growth and 8 percent are wasted.

### 2 The intervention

The intervention is a school feeding programme implemented by the Government of Mali. The national programme was launched in 2009 and currently targets 651 schools located mainly in the 166 most vulnerable communes (official data report that currently 10% of the 9,400 primary school in the country have a school canteen run by the state or by partners including WFP and

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\(^6\) Mali Demographic and Health Survey, 2006.
In line with the National Decentralisation Policy and the 2009 School Feeding Policy, programme implementation is decentralised to the community level, involving the Communes and School Management Committees (CGS). The central government allocated nearly 5 million USD (2.6 billion CFA) in 2010 and 5.8 million USD in 2011 (3.1 billion CFA) from the national budget for food, cooking equipment and infrastructure rehabilitation and construction. Funds are channelled directly through the Ministry of Finance to its Regional Offices which in turn send to the Communes. Food commodities are procured on local markets by the Communes or by the CGS. To date, there is no fixed food basket nor fixed ration specification. The budget allocated for food procurement is based on student enrolment figures obtained by the Ministry of Education and price estimates for staples at the beginning of the school year. The budget covers staples, including cereals and pulses and oil. Fresh vegetables to complement the school feeding ration are contributed by parents and the community through cash or in-kind contributions. Cooks are generally organised on a voluntary basis (also considered as the contribution to the program from the community) through the CGS.

Figure 4 below illustrates the institutional framework of the intervention (adapted from Johnson and Janoch, 2011). The project is under the oversight of the Ministry of Education. There is one coordinator working in the Direction Nationale de l’Education de Base (DNBE) who manages, coordinates and monitors the programme over the entire country. At the regional level there is one person responsible for the coordination and monitoring of the programme for each of the 17 Academies d’Enseignement (AE). At the district level there is a ‘canteen advisor’ for each of the 70 Centres d’Animation Pedagogique (CAP) who has a role of monitoring and support of the activities of the CGS. The CGSs operate at the village level and have the role of day to day management of the programme. They are normally subdivided in subcommittees including a stock manager, a representative of the cooks and a treasurer.

This structure faces several different challenges. Firstly, it is clearly understaffed, particularly the national coordination which is left to just one person. Secondly, the monitoring of the intervention is not built in the structure and the MoE does not have up-to-date information on programme performance. Thirdly, the management of the canteen is delegated to the CGS at the village level. However, the CGSs often do not know their role or the role of other actors involved. The CGSs do communicate with the canteen advisor at the CAP (commune) level, but cannot access higher level positions. Finally, member of CGSs have difficult access to other actors because transport is poor, few cell phones are available and most people are illiterate.

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11 School feeding in Mali situation analysis, WFP/PCD/WB 2011.
Figure 5 shows the financial structure of the programme. Funds are released by the Ministry of Finance once or more times a year. They are distributed to mayors of the intervention communes through the regional offices of the ministry of finance. The mayor generally purchases food from local traders who then deliver it to each CGS.

**Figure 5: Flow of funds of the programme**

Food provision consists of a school lunch meal served at noon (school is from 8am to 12am and then again from 3pm to 5pm). The food mainly consists of staples (rice, millet or sorghum) enriched with condiments, vegetables, vitamins and minerals depending on the source of provision. Figure 6 captures the key activities in the food procurement process currently in use in the national programme. Enrolment figures are collected by the CAP through the CGS and passed on to the mayors to estimate the food requirements for school feeding. Mayors, who receive budget from the Ministry of Finance on the basis of the enrolment/food requirements, then issue tenders, on the basis of a credit advance, to certified service providers (traders) to procure the food. The service providers (traders) then purchase the food from the market or from small holders, and deliver it to the relevant schools.

**Figure 6: Stylised food procurement process in the national programme**

The purchase of food by mayors has a number of problems (Johnson and Janoch 2011):
• Food is mostly purchased from traders rather than from small holder farmers
• Food purchased by mayors is often unrelated to food habits of the beneficiary communities, it does not follow any specific nutritional advice, and its quality is uncertain
• Food is delivered to communities with delays and CGS are uncertain about deliveries
• Food can be easily in excess or deficit of needs because purchased based on rough estimates of enrolment (with low enrolment rates the margin of error can be large and the programme has the effect of increasing enrolment which is not accounted for in the allocation)\(^\text{12}\)

The targets of the school feeding intervention are public primary schools of rural villages and children attending school. Compulsory basic education in Mali is composed of 6 years of primary and 3 years of lower secondary. The schooling age for primary is 7 to 12 and it is 13 to 15 for lower secondary. Considering the high repetition rate (15-20%), early and delayed entrants, and uncertainties and misreporting of age, the target group of intervention consists of children aged 5-17 and their families.

3 Programme theory of the intervention
HGSF interventions can have multiple goals in the following areas\(^\text{13}\):

• **Food security**: supporting incomes of recipient households (those consuming food) and farmer households (those providing the food)
• **Education**: increasing school enrolment, attendance and reducing drop-out, and improving cognition and learning achievement
• **Health**: improving nutritional status of school age children

The impact of the intervention in each of the above areas occurs through a number of complex pathways. This section describes the pathways through which the programme is expected to operate. Though the evaluation of all potential effects of the intervention is beyond the scope of this study, a subset of outcome indicators for the evaluation will be selected based on: a) knowledge gap specific to school feeding in Mali; b) knowledge gaps in the school feeding literature in general; c) feedback from peer reviewers and technical partners; and d) budget constraints.

Figure 7 illustrates in very broad terms the impact theory of school feeding on food security, education, and health. School feeding affects educational outcomes directly by increasing enrolment, attendance and completion (line ‘a’ in the figure). It affects health directly by improving nutritional status (line ‘b’), this in turn has an indirect impact on education, as improving nutrition status has a positive impact on learning outcomes (line ‘d’). The intervention

\(^{12}\) Notice that there is a potential nutritional downside on nutrition following from this. If parents believe a child is fed in school when he/she is not, then the child is worse off after the intervention, though possibly just for one or few days.

\(^{13}\) See (Sumberg and Sabates-Wheeler, 2010) for an analysis exploring the links between school feeding and agricultural development that are at the heart of HGSF. See (Rashid, 2010) for an analysis on the costs, benefits and trade-offs associated with some of the different HGSF procurement models. See (Gelli, 2010) for programme theory for the school feeding side of the supply chain based on the current evidence of programme impact. See (Galloway 2010) for guidance on developing rations for HGSF, and see (Devereux, Sabates-Wheeler and Pascual Martinez, 2010) for the theory of change motivating the relationship between ‘home-grown school feeding’ and social protection outcomes/objectives.
can also affect income directly by increasing households’ food security (line ‘c’). Finally, there are effects running through increased income and health and nutrition and vice versa, as richer families are investing more in human capital and more educated and healthier adults are more economically productive. However, these latter effects only occur in the long term and certainly not before children have left school, therefore we will not discuss them in the following design.

**Figure 7: Overall programme theory of school feeding interventions**

![Diagram]

It must be emphasised that the ability of the school feeding intervention to deliver the effects depicted in Figure 7 critically depends on the appropriate implementation of the programme. The management and implementation of the intervention involves several actors, and scoping visits and a preliminary study undertaken by PCD (Johnson and Janoch 2011) have shown that in Mali there are several problems of communication, supervision and monitoring between these different stakeholders. Programme success will also depend on the ability of communities to actively engage in the programme and in the strengthening of the public institutions involved. The issues of social accountability, ‘good governance’ and the links between accountability and programme effectiveness are important areas that this impact evaluation will explore in more detail.

### 3.1 Impact on food security and small-holder agriculture

The project is designed to stimulate the economy at community level by purchasing food from small-holder farmers. Food for the school feeding programme is currently purchased from traders by mayors of the communes of intervention. Traders in turn purchase food from small-holder producers though these do not need to be resident of the villages targeted by the project. The capacity building, or HGSF+ component supported by PCD is intended to confer community-based organisation more decisional power and will increase their ability to purchase from individual farmers or farmers’ associations residing in the project villages. On the small-holder farmer production side the programme can have three main effects that are summarised in Table 2 and schematically in Figure 8: including output effects, distributional effects and stabilisation effects. In addition to these effects the programme can also have some wider effects on the local economy by generating employment.
Table 2: Programme impact on small farmers

<table>
<thead>
<tr>
<th>Effects</th>
<th>Impact on small farmers</th>
<th>Spill-over effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output effects</td>
<td>Increase in farm profits</td>
<td>Increase in consumer prices</td>
</tr>
<tr>
<td>Distributional effects</td>
<td>Increase in farm profits</td>
<td>Decrease in large farmers’ profits</td>
</tr>
<tr>
<td>Stabilisation effects</td>
<td>Risk reduction</td>
<td>none</td>
</tr>
</tbody>
</table>

Figure 8: Programme theory of school feeding and small-holder agriculture

The programme introduces additional demand on the market. In Mali, the school feeding programme purchases food for schools at the commune level, which includes several villages. Most communes have food markets. Mayors purchase from traders in the commune. Traders in turn purchase food from, among other sources, local farmers. The effect of the food purchases is a shift of the demand curve for food (say rice) to the right (movement from $D_0$ to $D_1$).

Figure 9: Impact of HGSF on commune food demand
The size of the shift depends on the extent of substitution effects and on the size of the market considered. Substitution occurs when households reduce the domestic consumption of food because children are fed in school. At one extreme there is full substitution: families do not provide any additional food to children fed in school or any other household member in excess of the school food ration. Food provided in school entirely substitutes for food normally consumed in the home. The result is an increase in household’s savings and consumption of non-food items. In this case there is no shift of the demand function ($D_0$) and HGSF does not have price or output effects. There is still a distributional effect of the intervention if food is purchased from small rather than large farmers. Profits of large farmers will in this case decrease whilst profits of small farmers increase. Full substitution however is unlikely to occur. The largest substitution is likely to occur when households interpret the school food ration as a cash transfer. In this, theoretical, case the income equivalent of the ration is spent following income elasticities. Considering that the areas of intervention are very poor, assuming an income elasticity of food of 0.6-0.8 and a food share of 0.8, we obtain that only about half of the HGSF transfer would eventually be spent on food and the food demand function shifts to $D^*$. However, studies show that rarely people interpret food transfers as cash transfers and that people tend to attach some preference to the food received and thus consuming food beyond what the income elasticities would suggest. Therefore the final shift in the demand curve is likely to happen somewhere between the curves $D^*$ and $D_1$.

The size of the demand shift also depends on the size of the market considered. If we are considering the national rice market, the shift is extremely small and the price and output effects are likely to be negligible (see Ahmed and Sharma, 2008). The effect is larger at the commune level if food is procured locally. However, some of the food may be purchased outside the commune and therefore the shift of the demand function at the commune level would be smaller than the one depicted in Figure 9.

The impact of HGSF on output and prices at the commune level will depend on the slopes of the demand and supply functions. Welfare effects on producers and consumers can be calculated using changes in consumer and producer surpluses. We do not know the values of the supply and demand elasticities of food items, which need to be estimated econometrically. For convenience, we consider constant elasticities around the equilibrium point (a logarithmic form provides this type of elasticity $ln(q) = a + bln(p) + cln(y)$).

Figure 10 Commune food demand market HGSF

![Diagram](attachment:Commune_food_demand_market_HGSF.png)
Consumer surplus is the area between the market equilibrium price line \((P^e)\) and the demand curve \((D_0)\). Producer surplus is the area between the market equilibrium price line \((P^e)\) and the supply curve \((S)\). Producers and consumers surpluses can be calculated provided we know the initial equilibrium price level \((P^e)\), the quantities of food produced and consumed at this price, and the own price elasticity of food demand (the shape of the demand and supply curves).

Two extreme cases of small and large supply elasticities are shown in Figure 11. The size of supply elasticity will depend on three main factors such as yield risk, market failures and rigidity of fixed factors. High income risk and missing markets are likely to be present in the communes of intervention, thus reducing the size of supply elasticity. Farmers are not likely to respond promptly to price changes. In addition, while farmers may be able to vary the amount of variable inputs used (labour and fertiliser for example), they might not be able to change the amount of fixed input in the short run (like equipment, land and livestock).

The two supply curves in Figure 11 can be seen as short and long term supply curves or elastic and inelastic with respect to risk and market factors. In any case, they illustrate the differential impact of HGSF on prices and output.

- If farmers are not able to provide the additional food demanded by HGSF (small supply elasticity – curve \(S_s\)), then most of the effect of HGSF goes into prices and little impact on output. From a welfare perspective, producer surplus increases (farmers win), while consumer surplus may decrease (consumers may lose).
- If farmers provide any additional food demanded by using current input more intensively and by quickly changing use of fixed inputs (large supply elasticity – curve \(S_l\)), then HGSF would have a large impact on output and negligible on prices. From a welfare perspective producer surplus increases (farmers win) and consumer surplus increases as well (consumers win). For the benefit of both producers and consumers therefore a high supply elasticity is needed.

**Figure 11 Impact of HGSF with small and large supply elasticities**

In general we should expect the supply elasticity to be between the two extreme depicted and therefore the programme to have an impact on both prices and output. The impact on prices depends on the level of spatial market integration. In principle, if markets are efficient, prices for the same food items should be the same everywhere after an adjustment for transport costs.
However, the literature on market integration suggests that transfer costs may create a wedge between prices at different locations, which allow prices in the two locations to vary in an uncorrelated way within a band (Baulch et al., 2008). In other words, if transport costs for an isolated commune are very high, food prices may increase up to a point when trade between the two locations takes place and prices are equalised. There is therefore a real possibility that food prices increase at the commune level and that this price effects are transmitted to consumers.

Based on this theoretical model, the programme will have a positive impact on farmers income via an increase in prices and food quantities produced. The impact on consumers is less obvious. Depending on the size of the increase in prices, some households may have they welfare reduced as a result of the intervention. This observation suggests that the evaluation in addition to assess impact on farmers income should also monitor price levels and model, by simulations, if not observe, their impact on consumers. Note also that the intervention will have other minor positive effects at the village level by creating additional employment (cooks, treasurers and stock keepers) and demand. This suggests that a micro-simulation at the village level should be conducted in order to assess the potential impact through general equilibrium effects.

The programme also has a distributional impact as it shifts demand from large to small farmers. As described in earlier sections, even if households are fully substituting the school meal, the programme generates a demand shift from large to small farmers. While small local farmers see an increase in their income, larger farmers suffer a reduction. This effect can be observed to the extent that the evaluation will be able to collect income data from a large number of farmers, with and without the programme, large and small.

Finally: the programme potentially reduces household risk. The programme can stabilise small farmers’ incomes by offering a stable demand and price. A number of positive effects follow from risk reduction including: an increase in expected utility, a reduction in the use of inefficient mitigating and coping strategy (such as lower yielding crops and precautionary savings), and an increase in productive investments. This impact can be observed indirectly by observing farmers’ risk mitigating and risk coping behaviours. However, it is quite possible that yield risk dominates price risk. In addition, whatever the price effects these may take a long time before having an impact on farmers’ expectations. The programme impact on risk behaviour therefore is unlikely to be large.

It is less obvious that a stabilisation of income variability at the aggregate level is needed or is an obstacle to the implementation of the programme. According to an USDA report (USDA, 2009) the success of HGSF initiatives in Mali is potentially compromised by the insufficiency and instability of food production in the aggregate, by the inability of vulnerable regions and areas to produce food in the desired quantity, and at the desired time, and by the inability of farmers to respond to the incentives provided by the project. Our analysis of FAO data on aggregate cereal production in Mali over the period 1961-2007 suggests that, at current growth rates, by year 2017 agricultural production in the country will be sufficient to bring malnutrition below 5% of total population (see Figures 12 and 13). It is also clear that cereal production has not only dramatically increased from the mid-80s but has also become more stable, accompanied with reduction in undernutrition rates during the same period.
The sufficiency and stability of food supply in the aggregate may hide seasonal stress, regional differences and the presence of chronically poor groups. However, in each village the pool of farmers from which the project will purchase food is rather small and the ultimate sellers will be traditionally surplus farmers who in the absence of the programme would sell to traders. Two other factors may facilitate a stable supply of food at the community level. First, the involvement of community based organisation in the management of the intervention will help the identification of farmers able to provide food at the desired time and in desired amounts. Second, following a model adopted by the Purchase for Progress programme of WFP, purchases may be organised through contracts with farmers’ associations rather than with individual farmers thus increasing the likelihood of providing a stable supply.

3.2 Impact on education

We formulate hypotheses regarding the impact of school feeding on child schooling and learning starting from an economic model of parental educational choices in developing countries adapted from Glewwe (2002). Figure 14 below illustrates the determinants of schooling and learning. Schooling produces learning which in turn has welfare effects. Schooling can be thought of as enrolment, attendance, drop-out or school completion. Learning is the acquiring of basic skills such as language and mathematics. These skills are valued in the markets and educated children are expected to generate higher income and wages. In addition, more educated individuals may conduct healthier lives.
The main determinants of schooling and learning are child characteristics, schooling costs, households' characteristics and school quality. Cognitive ability and motivation facilitate learning and encourage families to send children to school. School costs, such as transport to school, meals while in school, and uniforms, have a direct effect on schooling but should not affect learning. Household characteristics like income and preferences (including attitudes towards education, and time discounting) affect schooling directly, while other characteristics may affect learning directly (for example more educated parents may improve learning by helping children with their homework). School quality affects learning directly through the quality of the teaching, the teaching environment (supplies and facilities) and schooling by affecting households schooling decisions.

The household schooling decision model can be framed in the following way. Setting the following simplifying assumptions:

- Parents make decisions for their only child
- There are only two time periods: 1. Child attends school, works or both, 2. Child is an adult and works
- There is no borrowing or savings

The parents’ utility function is:

$$U = C_1 + \delta C_2 + \sigma L$$

(1)
Where $C_1$ and $C_2$ are consumption levels in the first and second period respectively, $\delta$ is a discount factor for future consumption and $L$ is learning. $\sigma$ are parental preferences for education to represent the fact that parents value children education in its own and not only because it increases their consumption levels.

Learning is produced by the following function:

$$L = \alpha f(S)g(Q) \quad (2)$$

Where $\alpha$ represents cognitive ability of the child; $S$ is schooling (as a fraction of total child time and learning is an increasing function of schooling; $Q$ is school quality and learning is an increasing function of school quality.

Parents’ consumption in periods 1 and 2 are:

$$C_1 = Y_1 - pS + (1 - S)kY_c \quad (3)$$
$$C_2 = Y_2 + kY_c \quad (4)$$

Where $Y_1$ is parents income produced at time 1, $p$ is the cost of schooling (including meals consumed by the child while in school), $Y_c$ is the income earned by the child if working, and $k$ is the fraction of income earned by the child given to the parents. $C_1$ is therefore the sum of income earned by the parents and the fraction of income earned by the child and given to the parents, minus the cost of schooling. No borrowing or savings are made and in each period all income, and all income only, is consumed. Consumption at time two is the sum of the income made by the parents and the income made by the adult child and given to the parents.

Income earned by the child if working is:

$$Y_c = \pi L \quad (5)$$

Where $\pi$ is a parameter that transforms learning into income. It is assumed that income is an increasing function of acquired skills.

It can be shown that substitution of (2) in (5), (5) in (3) and (4), and (2), (3) and (4) in (1) gives the following parents utility function:

$$U = Y_1 - pS + \delta Y_2 + ((1 - S + \delta)k\pi + \sigma)\alpha f(S)g(Q) \quad (6)$$

After differentiating (6) with respect to $S$, setting to zero and taking total differentials we obtain:

$$dS = \pm d\kappa \pi + d\alpha - dp + d\sigma + dQ + d\delta \quad (7)$$

Showing that schooling is an increasing function of child cognitive abilities ($\alpha$), parents preferences for schooling ($\sigma$), time discounting (higher value $\delta$, more weight given to future consumption compared to current consumption or less ‘impatience’), and school quality ($Q$). It is a decreasing function of schooling costs. The effect of the fraction of income children give to parents ($\kappa$) and of the market valuation of learning ($\pi$) is ambiguous, though it is likely to be positive (but high valuation of learning and fraction of income provided to parents may make time out of schooling very valuable, hence the negative sign).
In summary, parents make schooling decisions based on: child characteristics (e.g. cognitive ability of the child and motivation); school costs (e.g. meals, uniform, stationery, fees, transport etc.); household characteristics (income, preferences, education); and school quality (teacher quality and supplies). Learning increases as a result of schooling. In addition, the same factors affecting parents decisions also affect learning directly. In this model school feeding affects schooling and learning in two ways:

- School meals reduce financial and opportunity costs of schooling and therefore increase schooling directly which in turn affects learning positively
- School meals increase cognitive ability. This in turn increases child learning in school and affects parents schooling decisions (learning increases expected income and therefore parents’ interest in schooling)

Note that the reduction in school costs can be partially outweighed by additional programme costs. In particular, the programme may require community participation in two ways (PCD, World Bank, and WFP 2011). First, communities are sometimes required to provide fire-wood for cooking and other items like fresh fruit, vegetables and other condiments (Galloway et al., 2009). In addition, they are expected to provide cooks and storekeepers (though participants in these activities often receive compensation in the form of a daily meal). Second, school management committees (CGS) may collect contributions from parents either in monetary form or in-kind. All these contributions increase the costs of schooling.

There may also be feedbacks from increased schooling and learning to school quality. Firstly, learning in school may increase because the average cognitive ability of pupils has increased (peer effect) or because teachers become more motivated to teach. Secondly, cost reduction may bring to school children of poorer background thus reducing average cognitive ability and reducing overall performance via the same peer effects. Thirdly, schools may become overcrowded because of increased attendance, though the effects of crowded classrooms on learning are still unclear (Ahmed and Arends-Kuenning, 2003).

### 3.3 Impact on nutrition

School feeding interventions can potentially have an impact on nutritional status of school children and their younger siblings, as summarised in Figure 15.

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14 Note that we assumed that the schooling choice was made entirely by the parents ignoring the emotional effect of school feeding on children. School fed children may become more motivated and this could lead to higher attendance directly or indirectly (via parents’ decisions). This suggests that the model should include the utility function of children, not just the parents (see Dreze and Kingdon, 2001).
a) The nutritional impact is mediated by the extent of food substitution effects within the household, and the use of the energy intake by the child and her siblings.

b) The reduction in malnutrition via diet diversification and the absorption of micronutrients in the body can have direct effects on cognition.

c) Better nourished children may be best positioned to learn while in class and outside class.

These three issues will now be discussed in turn:

a. Substitution effects

Building on Beaton and Ghassemi (1982) and Svedberg (2000) we provide a simplified programme theory of the nutritional impact of school feeding. The school meal can be shared by children with other household members or can substitute (at least partly) for food normally consumed in the home. This is obvious in the case of take-home-rations, whereby children take home a quantity of food on a regular basis, but also applies to any school feeding programme, because households may in principle use the school meal as a substitute for food normally consumed and spend the monetary equivalent otherwise. Evaluations of fortified biscuits programmes in Bangladesh and Indonesia found that gains in nutritional intake were not limited to the children actually receiving the biscuits at school. The two studies found significant evidence that school children shared the biscuits with their younger sister or brother at home. A recent RCTs in Burkina Faso also found that take-home-ration programmes led to an improved of the nutritional status of younger siblings in beneficiary households. In Uganda, an RCT also found significant improvements for pre-schooler siblings of children receiving school feeding. This provides emerging evidence of a spill-over effect and a window of opportunity to also affect
children during a critical developmental stage when nutritional interventions can have the strongest impact.

Ingested foods contribute to three outcomes, of which physical growth is only one:

- **Physical growth.** Food can help physical growth in terms of height and weight. It is normally believed that catching-up by stunted children after the age of five is limited. However, food intake should increase storage of fat and therefore weight.
- **Physical Activity Level (PAL).** Energy intake is spent in work after school or in more activity and play.
- **Basal Metabolic Rate (BMR).** Energy is required to maintain the healthy functioning of the body while at rest.

Catch-up growth in children and adolescent may be possible though the process is slower than catch-up in weight and it is not certain up to what age it takes place (probably up to the end of the adolescent growth spurt) (FAO/WHO 1985). All malnutrition indicators could change after the intervention (stunting, wasting and underweight) though the impact will depend on the extent of substitution effects and on whether children are increasing the use of energy for PAL and BMR. A child may have normal height and weight and still be undernourished because he does not expend enough energy in activity and play to maintain health and develop his cognitive abilities. Assessment of malnutrition should also measure PAL, particularly in adolescents who engage in considerable work and play. Unfortunately there is no accepted theory, nor evidence, on whether children adapt to nutritional stress by reducing weight or PAL. There is also uncertainty on the definition of a minimum acceptable level of PAL (an arbitrary factor of 1.5 of BMR is often used for example by FAO). Finally, there is no standardised way to measure PAL. Observation of behaviour in class and questionnaires for parents and teachers could be used to measure PAL.

Finally, highly deprived children may use additional energy intake from school meals simply to restore the original BMR. In addition, higher weight requires more energy, therefore BMR is a function of body weight and the BMR requirement increases as weight increases.

Because of the complex pathways described in this section, we should not expect a strong impact of the programme on nutritional status of children. However, we might expect an improvement in children activity and play and an improvement in nutritional status of siblings (if substitution effects are strong).

**b. Diet diversification, micronutrients and cognition**

Micronutrients may have a direct impact on cognitive abilities. It is not well understood how iron affects brain functioning and the central nervous system, but there is ample evidence that reduction in iron deficiency improves mental functions across all age groups (Grantham-McGregor and Ani 2001; Pollitt 1993). Iron interventions were found to have a positive impact on infant development scales, IQ tests and school achievements.

**c. Indirect effects of better nutrition on cognition**

Restoration of micronutrient requirements and energy intake can also have an impact on attention and motivation. Energy intake (Pollitt, Gersowitz, and Gargiulo 1978) and iron intake (Grantham-McGregor and Ani 2001) can have an impact on hyperactivity, withdrawal, nervousness, hostile behaviour and happiness. The emotional status of children affects the
attention span and has other spill-over effects. The quality of teaching in class is likely to be affected as teacher may become more motivated and as the quality of students performance in class improves (think of the different impact on learning of improving attention of 10%, 50% or 100% of students in class).

3.4 Role of social accountability

The effectiveness of the programme could be considerably improved by improving the communication mechanisms between the actors involved, by strengthening the monitoring system, and by introducing elements of social accountability. On the institutional side, the introduction of a monitoring system and the creation of communication mechanisms between the different actors would likely have the effect of improving the programme performance (see Figure 16). Similar effects could be expected from a stronger engagement of the CGSs. The delegation of certain responsibilities to the CGSs could increase motivation and awareness of the programme among beneficiaries while at the same time ensuring a better implementation of activities (such as monitoring of public officers performance and food procurement from small holders in the community). These effects would have a positive impact on all the intermediate and final outcomes of the intervention.

Figure 16: Impact of institutional and community strengthening on programme performance

Institutional strength

Community engagement and skills

Programme performance

- Monitoring
- Communication and feed-back

- Social accountability
- Motivation and awareness

With the support of PCD, a capacity building component will be integrated alongside the national school feeding programme and will constitute one of the treatment arms of the experiment (see Figure 14). A working group composed of in-country stakeholders including SNV, CRS, WFP (SF and P4P teams) is currently working on the details of the package of “software” interventions to improve overall programme performance. This package will include:

- Training of mayors and CAPS. At the beginning of each school year a number of training events will be organised for commune level stakeholders including mayors and CAP. The purpose of the training events is to improve service delivery on several accounts:
  - The establishment of a monitoring system of programme activities
  - The identification of formulas for the allocation of food to schools (currently the allocation is based on rough enrolment estimates, but enrolment is endogenous as it is driven by food provision, hence a flexible system of funds and food allocation based on ‘predicted’ enrolment needs to be put in place)
The illustration of methodologies for purchasing from small farmers rather than from traders (formulation of bids, contracts, contingency plans etc.)

Nutrition education and the importance of adequate nutrition for school children and smallholder farmers e.g. how to use the foods they grow or purchase to improve the nutritional status of all family members, including diet diversification, availability of staple and nutrient rich foods by season, food storage and safety, food processing and preparation.

- **Training of CGS.** Training events for CGS at the village level will be held periodically, on a monthly or quarterly basis, in every intervention village:
  - Members of CGS will be given the instruments to efficiently implement the programme including basic accountancy skills, information on their rights and entitlements, and information on methods to raise complaints
  - Participatory monitoring events will be periodically held at the village level. Members of CGS, PTAs, and parents will be involved in participatory events where the programme performance will be monitored in close detail, suggestions for improvement will be proposed and complaints brought to the attention of project staff and CAPs.
  - Nutrition education and the importance of adequate nutrition for school children and smallholder farmers e.g. how to use the foods they grow or purchase to improve the nutritional status of all family members, including diet diversification, availability of staple and nutrient rich foods by season, food storage and safety, food processing and preparation.

**Figure 17: Stylised food procurement process in the HGSF+ programme**

One of the most difficult aspects of the intervention is the package of measures to increase food purchases from small farmers. PCD intends to promote purchases from small farmers through training, monitoring and communication activities between the actors involved. Mayors and CAPs will be instructed, and encouraged, to involve small farmers in the transactions. Currently,
mayors purchase food from one or more traders following government guidelines regarding contracts and bidding process. Under the project, and in coordination with the Ministry of Agriculture, mayors and traders will be requested to enforce the purchase of food from local producers at least in a minimum percentage. On the other hand, the CGSs will be assigned the task of identifying local suppliers, possibly at the village level, and of establishing contacts between these suppliers and the traders.

3.5 Main hypotheses and outcome indicators

We summarise here the expected impact of the intervention on education, nutrition and social protection discussed in Section 4.

- The intervention will have an impact on a small number of farmers in the intervention villages. Other persons in the village may benefit either directly or indirectly via an increase in income.
- The intervention will have a positive impact on enrolment, attendance and drop-out rates.
- The intervention will have an impact on cognitive abilities and class behaviour including attention.
- The impact on learning (test scores) will be moderate as school quality is unlikely to change in the short term.
- The intervention will have a limited impact on physical growth of children because of the increase in PAL, substitution effects and the age range (6 to 17 years) of the targeted population. An impact on siblings of school-going children is possible if substitution effects are strong.
- The intervention will have a moderate impact on the diet because food purchases by communities and mayors do not follow nutritional guidelines and nutrition education is absent.
- The intervention will have no impact on micronutrient status as the food provision is not fortified and only small effects on diet diversity are expected.
- The overall impact of the programme will increase through the introduction of social accountability mechanisms and the strengthening of the monitoring and communication system.

Table 3 includes a list of the main outcome indicators of the study. Section 5 will describe how data will be collected using different survey instruments. All outcomes, including school attendance and test scores, will be obtained at the household level.

### Table 3: Main outcome indicators of the intervention

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>Farm profits</td>
</tr>
<tr>
<td>Distributional effects</td>
<td>Small farmers participating in the programme</td>
</tr>
<tr>
<td>Schooling</td>
<td>Enrolment, attendance, and completion</td>
</tr>
<tr>
<td>Attention</td>
<td>Digit span or other test</td>
</tr>
<tr>
<td>Learning achievements</td>
<td>Scores on language and maths tests</td>
</tr>
<tr>
<td>Physical growth</td>
<td>Anthropometric measures of height and weight</td>
</tr>
<tr>
<td>Diet diversity</td>
<td>Household consumption</td>
</tr>
<tr>
<td>Social accountability</td>
<td>Parental monitoring and motivation</td>
</tr>
</tbody>
</table>
Note that in addition to outcome indicators we will also observe the programme impact on intermediate indicators, particularly for those outcomes that are more difficult to observe directly: income and social accountability. In the case of income, we will look at intermediate outcome such as input use (labour, land, seeds and fertiliser), investments (farm capital like tools and machinery), and market access (marketed surplus, prices and markets). In the case of social accountability, we will observe the impact of the programme on knowledge and practices of mayors and CGSs members as they result from the training activities. The quantity, quality, and timely preparation and delivery of food in school will also be considered.

4 Evaluation design
The project will be expanded in each of the following regions: Mopti, Koulikoro and Kayes. The MoE (Ministere de l'Education 2009) has set clear criteria for the selection of the intervention areas. Priority is given to areas of food insecurity and vulnerability, poor enrolment rates (particularly of girls), poor presence of donors and of high community involvement. Similarly, criteria for the selection of schools include: schools with poor retention and completion rates (particularly of girls); schools with children from nomad and destitute families; schools with children with special needs; schools where one third of class has to travel at least 3km to reach the school; schools demanding canteens.

The impact evaluation will be an integral component of the monitoring and evaluation activities of the national school feeding programme. A baseline survey will be conducted in intervention and control sites in January 2012 and again in January 2014. By 2015 the control schools and community will be fully integrated in the intervention. We will consider the possibility of conducting further surveys in the following years building matched control groups in order to detect long term effects of the intervention on farmers’ productivity.

We discuss here two main elements of the evaluation approach: random assignment and manipulation of treatment; and threats to validity.

4.1 Random assignment and manipulation of treatments
The evaluation will measure outcomes at child, household and school level. Households and schools will be randomly assigned to the intervention. Three treatment arms are envisaged:

1) **Control group.** These are schools and household from villages were the intervention will not be implemented. The intervention will be delayed by at least two years in these villages, preferably without informing schools and households.

2) **School feeding programme group (HGSF).** These are schools and villages where the standard Government programme is implemented, with Mayors responsible for the food procurement.

3) **Home grown school feeding and social accountability group (HGSF+).** These are schools and villages were the programme is implemented in addition to a capacity building component including training of community based organisations and local government on food procurement, nutrition education, and feedback monitoring.

Note that the HGSF+ intervention is conducted at the commune level. Training and monitoring systems involve Mayors and exert their effects at the commune level, affecting outcomes in
schools where the HGSF+ programme is not implemented. On the other hand, the number of communes where the programme is implemented is rather small, which reduces the statistical power of the analysis, and the effect of the HGSF intervention against the control group are best observed at the school level.

Hence, we opted for a design that compares outcomes of HGSF and control group at the school level, and that compares outcomes of HGSF+ and HGSF at the commune level. The MOE will select 58 communes in which the programme will be implemented. In each of these communes Mayors will select two schools and each school will be randomly assigned to the treatment or to the intervention. A protocol will be designed in order to ensure that contamination between the two schools in each commune is avoided. This will allow comparison of outcomes of the intervention against the control group at the school level in 58 communes. The 58 schools assigned to the intervention will then be randomly assigned to HGSF and HGSF+. In this way the randomisation of the HGSF+ intervention will occur at the commune level.

The intervention will be implemented in the regions of Mopti, Koulikoro and Kayes. These areas are among the most vulnerable of the country and offer a diversity of agro-climatic conditions and cropping patterns. Areas that are inaccessible for most of the year or in which there are serious security concerns were excluded from the study.

Power calculations (see Appendix 1 for more details) and resource availability suggested the adoption of a sample of 25 household from the village areas of the 58 schools receiving the intervention and of 20 households in the village areas of the 58 control schools. Farmers will be oversampled in both areas in the following way: 10 out of the 25 households in the 58 intervention villages will be farmer households and 5 out of the 20 households in the 58 control villages will be farmer households. This distribution of the sample between farmers and non-farmer households and between project control groups allows the construction of comparable samples (see Table 4).

**Table 4: Summary of sample sizes**

<table>
<thead>
<tr>
<th></th>
<th>Communes</th>
<th>Schools</th>
<th>Households</th>
<th>Farmers</th>
<th>Children¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>58</td>
<td>58</td>
<td>870</td>
<td>290</td>
<td>2,700</td>
</tr>
<tr>
<td>HGSF</td>
<td>29</td>
<td>29</td>
<td>435</td>
<td>290</td>
<td>1,500</td>
</tr>
<tr>
<td>HGSF+</td>
<td>29</td>
<td>29</td>
<td>435</td>
<td>290</td>
<td>1,500</td>
</tr>
<tr>
<td>TOTAL</td>
<td>58</td>
<td>116</td>
<td>1,740</td>
<td>870</td>
<td>5,700</td>
</tr>
</tbody>
</table>

¹ The number of children in an estimate based on an average of 2.6 children per family in families with children and 1.5 children per family in farmer households

Households will be randomly selected in the catchment areas of the selected schools for the survey interviews.¹⁵ In practice, the sampling of households will not be conducted via a previous census as this was considered too costly in terms of time and resources. We opted for

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¹⁵ We suggest a random selection of households in the villages. This approach has also been successfully adopted, for example, by (Adelman et al. 2008; Adelman, Gilligan, and Lehrer 2008; Buttenheim, Alderman, and Friedman 2010). One additional advantage of this approach is that it allows the identification of the determinants of enrolment/attendance and provide estimates of the relative relevance of school cost reduction effects produced by the programme.
interviewing village chiefs and building a list of enlarged households in the villages covered by the sample school. The listing will also include an approximation of the size of the enlarged households. In addition, a number of farmer households will be oversampled in each village: Chiefs (and members of the CGSs) will also be asked to list which farmers they would contact if they were to purchase food within the village for the provision of school meals. This latter information will be used to single out the surplus farmers in the area (up to 10 in the project villages and up to 5 in the control villages that will be interviewed).

Enlarged households will be randomly selected (preferably with inclusion probability proportional to size) from the list provided by the village chiefs, and listings of the restricted households within each selected enlarged households will then be developed through interviews with household heads. A restricted household with children aged 5-15 will then be randomly selected within each selected enlarged non-farmer household, and we estimate that each household will have at least two children in this age group. A similar selection procedure will be used for farmer households when these exceed the numbers of 10 and 5 in the project and control villages respectively. In farmer households though, no age criteria will be used and the household will be identified around the main agricultural holding unit of the enlarged household. This consists of the family members involved in the main production unit (land and livestock) in the enlarged household.

### 4.2 Threats to validity

We list here the main potential threats to the internal validity of the study. In order to do so, we address contamination, spill-over effects and Hawthorn-like effects for each of the outcome indicators of section 3.

From the table below it seems that most threats could be avoided by:

i. assigning treatments to communes rather than to villages within communes in order to avoid contamination effects;

ii. avoid informing teachers and households of the control villages that the programme will be implemented after two years in order to avoid expectancy effects;

iii. adopt strategies in conducting cognitive and achievement tests that prevent teachers and children from over-performing.

**Table 5: Threats to internal validity**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Metric</th>
<th>Spill-over and contamination</th>
<th>Hawthorn and placebo effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schooling</td>
<td>Enrolment, attendance, drop-out and completion</td>
<td>Children may attend school from neighbouring communities to have access to meals</td>
<td>Expectation of coming programme in control villages</td>
</tr>
<tr>
<td>Cognitive ability</td>
<td>Raven’s matrices or other test</td>
<td>Very unlikely</td>
<td>Teachers’ and children’s attempt to over-perform in both project and control villages</td>
</tr>
<tr>
<td>Attention</td>
<td>Digit span or other test</td>
<td>Very unlikely</td>
<td>Teachers’ and children’s attempt to over-perform in both project and control villages</td>
</tr>
<tr>
<td>Learning achievement</td>
<td>Scores on language and maths tests</td>
<td>Very unlikely</td>
<td>Teachers’ and children’s attempt to over-perform in both project and control villages</td>
</tr>
<tr>
<td>Physical growth</td>
<td>Anthropometric measures of</td>
<td>Children from other villages may</td>
<td>Very unlikely</td>
</tr>
</tbody>
</table>
Parents perceptions

<table>
<thead>
<tr>
<th></th>
<th>Very unlikely</th>
<th>Very unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet diversity</td>
<td>Household consumption</td>
<td>Very unlikely</td>
</tr>
<tr>
<td>Micronutrient intake</td>
<td>Iron status, anaemia</td>
<td>Children from other villages may access school meals</td>
</tr>
<tr>
<td>Income</td>
<td>Farm profits</td>
<td>Unlikely, if food purchases are made in control villages</td>
</tr>
<tr>
<td>Social accountability</td>
<td>Parental monitoring and motivation</td>
<td>None at household level, possible at local Government level</td>
</tr>
</tbody>
</table>

Given the panel structure of the data there is a potential risk of differential attrition. However, it is difficult to predict why households or farmers from the control groups should respond to the interviews in different ways. Refusal to take part in the interview by households not benefiting from the project seems to be main threat. However, as shown in the table above, the project has limited impact on households expectations in both project and control groups and therefore should have limited impact on response rates.

One issue with impact on cognitive development is that the observed impact can be the result of:

- Increased attention in school resulting from the energy meal (short term)
- Increased overall cognitive abilities resulting from protracted school feeding, school attendance, play time, social interactions etc. (long term effect)

Kristjánsson et al. (2007) have observed that most evaluations have not been able to distinguish the two effects. This could be achieved through careful design of the intervention as the one shown in Table 6. Half of the project children are not given the meal on the day of the test until after the test, while half of the control children are given the meal before the test. The differences across columns (a-c and b-d) should produce the long term effect, while the differences across rows (a-b and c-d) should produce the short term effect. This approach will possibly be tested as a case study in a sub-sample of schools.

**Table 6: Teasing out short-term and long-term impact on cognitive development**

<table>
<thead>
<tr>
<th></th>
<th>Meal</th>
<th>No meal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>Control</td>
<td>c</td>
<td>d</td>
</tr>
</tbody>
</table>

### 4.3 Survey instruments

The impact evaluation will include household, school, farmer, village and commune level data collection. As outlined in the preceding sections, the study will be integrated within the M&E of the national programme. The baseline survey for the study will be implemented alongside a wider school level programme monitoring baseline.

The study will employ the following survey instruments:

**Household questionnaire.** This will collect data at the household level and for each household member separately. The definition of ‘household’ in Mali is not straightforward as many families share the same living compound and polygamous families are common. A study by Beaman and Dillon (2009) found that adding descriptions to a restricted definition of household (a group of people who normally live in your household – adopted by the DHS) increases the number of adult male members reported during the interview. This however
does have a very limited impact on household characteristics such as per capita food consumption, assets and agricultural production. We recommend the use of the restricted definition adopted by the Rapid Household Survey 2006 which reflects the LSMS experience in collecting data in developing countries. According to this definition, a household is a group of people who normally live and eat together. Members spending less than three months with the household within a year should be excluded. Families living in the same compound should be considered as different households, though the consumption section of the questionnaire needs to be carefully designed in order to take into account the common use of food resources. Polygamous households should be treated as distinct households if wives live and cook in separate houses.

The household questionnaire will include the following modules:

- Household roster (main demographic characteristics, including of children residing elsewhere)
- Education (school attendance, education of all household members, time spent in class and working, distance and transport to school, meals while in school, parents’ aspirations, PTA membership and involvement)
- Household assets and farm assets (household facilities and durables including land and livestock holdings)
- Economic activities (simple income questionnaire on time spent working by household members in wage work, own business and own farm)
- Expenditure (monetary expenditure and own production of food, education, health, durables, and non-food expenditure)
- Anthropometry (height and weight of parents and children above 6 months of age – parents measurements are taken to assess the genetic potential)
- Cognitive and achievement tests (test scores on maths, language and digit span test),
- Farm income (agricultural production and revenues, input expenditure and depreciation of farm assets)
- Other income (a simplified income questionnaire for other income sources like microenterprises, transfers, remittances, gifts etc.)

School questionnaire. In each school a questionnaire will be administered to head teachers and teachers and will include the following modules:

- School facilities (school characteristics including boards, toilets, furniture, books and all school-feeding related characteristics – kitchen, storage room etc.)
- School participation (school-level data on enrolment, attendance and drop-out)
- School management and food procurement
- Teachers (qualifications, living conditions and aspirations)
- Training and monitoring activities

Mayors’ questionnaires. Mayors will be interviewed in each of the 58 communes at the baseline and at the endline. The purpose of the questionnaire is twofold. First, it will collect information at the village level that will be used in the multivariate analysis when analysing the project outcomes at the household level. Second, some project outcomes, like for example
the number of small farmers involved in the project, will be observed through this instrument. The tool will include the following modules:

- Funding of school canteens (instalments received and payments made)
- Food deliveries (quantities and characteristics of delivery to each school)
- Food procurement (details of all procurement over the calendar year)
- Monitoring and supervision (supervision of correct procurement and deliveries)
- Knowledge and practices (training and knowledge acquired)

### 4.4 Other relevant research

We propose conducting complementary qualitative research in three areas: tracking expenditure survey; parental perceptions of schooling; assessment of programme characteristics that cannot be observed through standard surveys.

**Public expenditure tracking.** As the national programme is relatively new and in the process of scaling-up, there might be inefficiencies or leakages in the flow of funds running from the Ministry of Finance down to the school management committees. We suggest conducting research following the flow of funds from its initial allocation at the central level, to the regional offices, the mayors, the CGSs and the traders or small farmers involved. The research will allow a careful examination of all the stages of the financial transactions involved, highlighting the characteristics of the procurement system and identifying entry points for improved efficiency.

**Focus groups with farmers, parents, children, teachers and local authority stakeholders.** These focus groups are designed to obtain insights on the challenges and opportunities in terms of engaging small holder farmers in the food procurement process, determinants of parents’ and children’s decisions to attend school, as well as related issues linked to hunger and seasonality. Teacher attitudes and motivation will also be assessed. The focus groups will be conducted in a small sub-sample of communes/schools at baseline, at mid-term and during the follow-up survey.

**Programme monitoring and process analysis.** Survey data collection will be integrated in the regular project monitoring activities also supported by PCD that include school level monthly and quarterly data collection. Periodic visits (in some cases unannounced) will also be made to the project communities in order to observe nutritional characteristics of the meal served in school; pupils’ behaviour in class after the meals; modalities of cooking and storage; other aspects of project implementation that cannot be observed through a quantitative survey.

### 5 Methods of analysis

The analysis will be conducted on the average treatment effect (ATE), the average treatment effect on the treated (ATT) and econometric and simulation analysis.

ATE will be calculated for all relevant final outcomes of the intervention, and particularly for schooling outcomes. Impact will be assessed for the two treatment arms using regression analysis. A set of control variables will be selected to improve efficiency of the estimates.

ATT will be calculated for outcomes such as cognitive ability and nutritional status. The reason for this is that enrolment rates in Mali are very low in rural areas (around 30%). The main problem in conducting this analysis is that school feeding may bring to school children of very
poor backgrounds with poor nutritional status and cognitive abilities to start with. This problem can be overcome econometrically by using matching techniques during the analysis of the data.

**Prices**

We are not aware of studies of market integration in Mali. The Observatoire du Marche Agricole (OMA) collects agricultural prices on a weekly basis from more than 50 locations around the countries. In principle, their data could be used to assess the extent of market integration, but not having access to the data we will assume in the following that markets are not fully integrated. If markets of staple foods (millet, sorghum, and rice) are not fully integrated, prices can vary from one location to the other and the additional demand introduced by the project may have a positive impact on prices.

There are several markets of producer and consumer prices along the supply chain of staple foods. These markets are linked by complex relations and involve several actors: producers, collectors, bulkers, traders, retailers and consumers. The markets where the programme may have an impact are the foire (village, or group of villages, level market), the bulker market and the retailer markets. Foire markets in particular are markets where foods are purchased from local farmers by collectors and where local consumers make their purchases. If the project has an impact on prices it is likely to occur at this level. In practice, the impact on prices can happen a maximum of 3 times per year when purchases by the mayors are made and only in the HGSF+ programme sites.

Impact on prices could in principle be observed through the household level questionnaires. The farm gate price could be observed at the household level by including in the questionnaire questions related to prices paid and time of sales. This however would complicate the income section of the farmer questionnaire. Consumer prices are more difficult to observe in a standard household survey because the recall time is seven or 30 days and there is only one survey per year.

As part of the programme monitoring activities, price data will be collected on a monthly basis for millet, sorghum and rice in the local foire next to each of the selected schools. The work could be assisted by the OMA through the provision of training given its long experience in the field. Collection of prices does not even require visits to markets if stable contacts can be established with collectors in each of the markets and prices could be communicated by phone.

**Other general equilibrium effects**

There is a possibility that some of the outcomes of the programme cannot be observed because of the type of the intervention and the sampling design. In particular, the programme is likely to benefit only few farmers in each of the project villages and the number of project villages for the study may not be sufficient to perform project-control comparisons that are statistically significant. If this is the case we will assess the programme impact on farmers using econometric analysis and simulations. Two exercises in particular can be conducted. The first is a micro-simulation of the farm-level impact of the intervention. Using household data we can estimate production and profit functions and then simulate the impact on farmers’ income, factoring in the additional demand and changes in food prices. Changes in prices can be simulated or observed directly through surveys. Similarly, the impact on consumption can be simulated after the estimation of a consumption function using household data. The second exercise consists of a
village level simulation using a computable general equilibrium model. In this case, data are collected in one or two villages in order to build a social accounting matrix (SAM) to be used to simulate the impact of the injection of liquidity in the village economy. The advantage of this approach is that it allows the simulation of the impact on the entire community via price and demand effects. This method could also be used to simulate the differential impact of the programme in a drought and in a surplus year.

6 Heterogeneity of impact
The programme is targeted to disadvantaged groups. Main beneficiaries are:

- Children aged 6-17 attending primary school
- Poor, rural districts of the country
- Small holder farmer households

The programme has a poverty inequality reduction impact at the national level. At the local level has a poverty reduction impact, but the inequality reduction impact will depend on whether:

- The project will increase enrolment. Children going to school are likely to be from richer background and more accessible areas
- The project will involve small farmers. The programme might rely on large farmers or traders for the provision of food.

Gender, age and geographic area are other relevant categories to analyse impact. The impacts of school feeding in different contexts are quite heterogeneous (Adelman et al., 2008) School feeding, for instance, has been associated with marked improvements school participation of girls in rural areas with large gender disparities in access to education (Gelli et al., 2007). Smallholder farmers targeted by the program will in large proportions be women. From the educational perspective, school feeding impact has also been found to vary with pupil age, as household schooling decisions are also affected by the opportunity costs of education, that tend to increase with age and gender (Dreze and Kingdon, 2001).

7 Cost effectiveness
Actual expenditures incurred during implementation of HGSF interventions will be collected, reviewed and analysed from project reports, and other sources. Cost data will be collected retrospectively at the different levels of HGSF implementation. Full financial and economic costs will be estimated. Cost data will be used to provide costs per achievement of one unit of outcome, such as per cent increase in enrolment or income. The figures obtained in this way will then be compared to figures calculated for other interventions.

Of particular interest is the cost-effectiveness of the community level/social accountability component of the intervention. The comparison between the HGSF+ and the HGSF component is roughly equivalent to the comparison between a home grown school feeding project and a standard school feeding project. Many would expect the home grown school feeding project to be cheaper and more cost effective because of lower transport costs. However, the alternative
procurement source, its distance and affordability is unknown, and hence the difference in costs between the two programmes is an empirical question.

8 Staff duties
The assessment team will be guided by a steering group including the Government of Mali’s coordination framework on school feeding. Key Government stakeholders will include, amongst others, Mamadou Doumbia (National School Feeding Programme Coordinator, Ministry of Education) and Makiyou Coulibaly (Technical Advisor, Ministry of Agriculture). The impact evaluation will be undertaken by a consortium of research partners including the Partnership for Child Development (PCD), the Institute of Development Studies (IDS) and Innovations for Poverty Action (IPA) working in close collaboration with key Government stakeholders. The technical team leading the evaluation includes Aulo Gelli (Research Fellow, PCD) Edoardo Masset (Research Fellow, IDS), with Loïc Watine (Country Director, IPA Mali) and Amadou Sekou Diallo (Mali Programme Manager, PCD) working at country level and ensuring strong policy level engagement. The design of the evaluation will be peer reviewed by members of the HGSF technical review group, including J-PAL, IFPRI, LSHTM, the World Bank and WFP.

9 Communication strategy
Key aims of the HGSF programme are to collect, share and disseminate HGSF knowledge and expertise and to promote networks from across the globe. The geographical spread of the programme coupled with the need to both communicate with and facilitate the collaboration of a wide range of HGSF stakeholders from government ministers to smallholder farmers necessitates an integrated communication strategy. As such the programme employs a number of communication tools, including amongst others, high level meetings and workshops, printed training materials and online knowledge and networking platforms, to inform, advocate and promote HGSF theory and good practice. The proposed impact evaluations will be integrated into the communication streams outlined below.

Table 7: Communication strategy.

<table>
<thead>
<tr>
<th>Stakeholder level</th>
<th>Audience</th>
<th>Communication Objective(s)</th>
<th>Format of Information</th>
<th>Means of Dissemination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Practitioners; Farmers; Teachers; Community Organisations;</td>
<td>To translate academic and policy focused findings into practical and applicable steps to improve the procurement and delivery of localised HGSF programmes.</td>
<td>Personal presentations; Workshops; Printed training and guidance materials; Radio broadcasts;</td>
<td>Development of HGSF networks and in-country HGSF champions to lead and co-ordinate workshops and presentation with local stakeholders; Use of local media e.g., AIR and Farmer Voice Radio;</td>
</tr>
<tr>
<td>District/Province</td>
<td>Regional policy makers; School commissioner/</td>
<td>To inform, advocate and promote HGSF to district level policy makers and practitioners; To advise on and development of HGSF online knowledge resource Use</td>
<td>Personal presentations; workshops; Printed training and guidance</td>
<td></td>
</tr>
</tbody>
</table>

16 Currently including, amongst others, the Ministry of Education, Ministry of Agriculture, Ministry of Health, WFP Mali, CRS, SNV…etc…
supervisors; Agricultural organisations; NGOs highlight HGSF best practice; To facilitate HGSF networks; materials; Radio broadcast; Online resources; of national and regional media e.g., AIR and Farmer Voice Radio Online country-specific information and contacts portal; Development of regional knowledge fairs.

National

- Government ministries of Health, Education and Agriculture;
- National policy makers;
- NGOs

Inform, advocate and promote HGSF theory; Provide the information, expertise and advice needed to implement/develop nationally owned HGSF programmes; Enable the development of multi-sector HGSF networks;

Personal presentations; Workshops and training; Printed materials; Online resources;

Targeted mailing of hard copy evaluation findings; Online country specific information portals; Online networking facility between stakeholders and HGSF experts; National level Knowledge fairs.

Global

- Regional networks e.g. AU, NEPAD, Donor agencies e.g. WB, WFP; Global NGO and multi-lateral organisations e.g. Save the Children, Action Aid, Oxfam UN agencies;
- Governmental development agencies e.g. USAID, JICA, DFID, CIDA.

To identify and advocate on the multiple potential benefits of HGSF; Provide a global resource for HGSF information, advice and networking; Provision of an evidence base for improved HGSF operations on the ground;

Online resources; Personal presentations; Printed materials;

Online resource will contain a regional platform which will contain information from each of the country portals; Global links will be made with S & C America through Nutrinet.org; Representation of HGSF at global meetings;

Academic

- Agricultural research and teaching institutes;
- International development research and teaching institutes;
- Think tanks;

Promotion and dissemination of programme theory for HGSF; Assessment of HGSF as a social safety net; Provision of an evidence base for improved HGSF operations on the ground;

Presentations and workshops; Online resources; Journals; Printed materials;

Academic conferences; Articles in peer reviewed research journals; Direct mailing of evaluation findings; Promotion of online resource to academic organisations involved with wider HGSF agenda.

10 Ethical clearance

Ethical clearance is being sought from the appropriate boards in Mali and at Imperial College London.

11 Timeline

The impact evaluation is incorporated within the national M&E system strengthening activities that are currently underway in Mali. This paper capturing the detailed evaluation design for Mali has been presented for feedback and review to a number of technical partners from the HGSF technical review group during the course of July 2011. The impact evaluation design and survey tools have been formally presented for review and validation at the HGSF technical meeting held in London in September 2011. The design paper was peer reviewed by Harold Alderman at the World Bank and by two internal J-PAL-/IPA reviewers. Baselines surveys are planned for January 2012. Monthly monitoring visits, spot checks and quarterly reporting will be undertaken as part of the regular programme monitoring activities. Evaluation surveys are planned for 2014.
References


USDA. 2009. Assessment of Local Production for School Feeding in Mali. USDA Foreign Agricultural Service.

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Appendix 1: Power calculations
The designed adopted by this study consists of (a) a multi-site cluster randomized trial to detect the impact of the HGSF and HGSF+ intervention against a control group without intervention, and of (b) a cluster randomized trial to detect the impact of the HGSF+ intervention against the HGSF intervention.

Comparing HGSF to no-HGSF (multi-site cluster randomized trial)
In the multi-site cluster randomized trial the sites are blocks and clusters are randomly assigned to treatment and control within each site. In each commune (site), 2 schools (clusters) are selected and randomly assigned to the treatment and the control groups. This is equivalent to conducting a randomization of schools stratifying by commune.

There are a total of 58 communes selected for the intervention and 2 schools are chosen by local education authorities in each commune. In each school/village, 25 households will be interviewed. Only families with children in the age range from 5 to 15 will be selected, which implies that some 55 children in each community and a total of more than 6,500 children will take part to the interviews. The average number of children aged 5 to 15 in rural Mali was 2.58 in 2006 based on the data collected by the DHS. Care will also be taken to obtain a sizable sample of farmers and potential providers of staples for school feeding in each village.

We calculate power and minimum detectable effect size for the following outcomes:

- enrolment rates
- test scores
- farm income

Enrolment
Public education in Mali is compulsory for 9 years from age 7 to age 15 and split in a 6-year primary cycle and a 3-year lower secondary cycle. Enrolment rates in rural areas are very low and lower for girls compared to boys. The table below reports the attendance rates for the age groups 7-12 and 13-15 in rural Mali calculated from the DHS survey of 2006.

<table>
<thead>
<tr>
<th></th>
<th>Primary (age group 7-12)</th>
<th>Lower secondary (age group 13-15)</th>
<th>Age group 7-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>35.6</td>
<td>33.8</td>
<td>35.1</td>
</tr>
<tr>
<td>Male</td>
<td>39.1</td>
<td>39.9</td>
<td>39.3</td>
</tr>
<tr>
<td>Female</td>
<td>32.1</td>
<td>27.4</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Ahmed (2004) found a 14% difference in enrolment rates between project and control groups in Bangladesh. Kazianga et al. (2009) found an effect of 6% in Burkina Faso, Jacoby (2001) found a difference of 3% in Peru, while Buttenheim et al. (2010) found no effect in Laos. We adopt an increase in attendance rate by 5 percent points as a minimum expected impact of the programme. The chart below illustrates power for per cent difference in enrolment in the project group versus the control group. A 5% difference will be detected with 80% probability, while differences of 10% and 15% will be detected with certainty. At 80% power, the minimum detectable difference is 5%.
Test scores

Few studies have investigated the impact of school feeding on learning outcomes. Kristjansson et al. (2007) reviewed the experimental evidence on the impact of school feeding on standardised test scores and found an average standardised effect size of 0.31 for maths achievement tests, while no effect was found on reading tests. We adopt a 0.3 difference as the expected effect of the intervention on maths test scores. Based on the Scrochet report, the recommended intra-cluster correlation coefficient for maths and reading tests is 0.15. We also assume that only about half of the children interviewed will be able to take the test and we set the number of children tested per village at 25. The chart below shows power as a function of minimum standardised detectable effect. A standardised difference of 0.1 would be detected in 24% of cases, a difference of 0.2 would be detected in 68% of cases and a difference of 0.3 would be detected in 95% of cases. With power set at 80% the minimum detectable difference is 0.23

Income

No previous studies have investigated the impact of home grown school feeding on farmers’ income and indeed this type of programme is entirely new. In addition, it is difficult to find programmes with effects similar to those of school feeding programmes. The Purchase for Progress programme by the World Food Programme, which similarly to the Malian school feeding programme purchases food for local producers, has modelled an increase in income by $50 dollars as a reasonable target for small African farmers. With a per capita GDP of $700 this
corresponds to 7.5% of the average Malian income, though the income of small farmers is likely to be less than half the national average income. In addition, farm income is about 50% of total household income and the impact of a $50 increase on farm income is therefore much larger. We adopt 15% and 30% as minimum detectable effects of the programme on agricultural incomes of small farmers.

We adopt a conservative estimate of 10 farmers surveyed in each village, and based on data on agricultural incomes of Ghanaian farmers, we estimated the intra-class correlation coefficient ($\rho=0.25$) and the variance explained by site variability ($B=0.40$). The chart below shows power as a function of the standardised effect size. Note that given the high value of the standard deviation of income, similar in size to average income, the standardised difference and the percentage difference are almost equivalent. The probability of detecting an increase by 15% in agricultural income is 35% and the probability of detecting an impact of 30% is 88%. A power of 80% will be able to detect an income increase by 26%.

Summary table of values used in the power calculations

<table>
<thead>
<tr>
<th></th>
<th>Enrolment</th>
<th>Test scores</th>
<th>Agricultural income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>N (observations)</td>
<td>55</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>J (schools)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>K (clusters)</td>
<td>58</td>
<td>58</td>
<td>58</td>
</tr>
<tr>
<td>Intra Cluster Correlation</td>
<td>-</td>
<td>0.15</td>
<td>0.25</td>
</tr>
<tr>
<td>Between sites variability</td>
<td>-</td>
<td>0.20</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Comparing HGSF to HGSF+ (cluster randomized trial)

To estimate MDES we assume that 58 clusters (schools) will be randomly assigned to HGSF or HGSF+. The chart below illustrates power for per cent differences in enrolment in the project group versus the control group. A 5% difference will be detected with 60% probability, while differences of 10% and 15% will be detected with certainty. At 80% power the minimum detectable difference is 6%.
The chart below shows power as a function of minimum standardised detectable effect on maths test scores. A standardised difference of 0.1 would be detected in 15% of cases, a difference of 0.2 would be detected in 41% of cases and a difference of 0.3 would be detected in 79% of cases. With power set at 80% the minimum detectable difference is 0.32.

The chart below shows power as a function of the standardised effect size on agricultural income. The probability of detecting an increase by 15% in agricultural income is 17% and the probability of detecting an impact of 30% is 50%. A power of 80% will be able to detect an income increase by 40%.
Conclusions

The power analysis suggests that the study will be able to detect an increase in enrolment by 5%, a 0.2 difference in test scores and an increase in farmers’ incomes by 25% between the HGSF intervention and the control group. The study will be able to detect changes in enrolment by 6%, differences in test scores by 0.3 and changes in income by 40% between the HGSF and the HGSF+ components of the intervention.

While the sample size is well suited to the analysis of programme impact on attendance rates and test scores, it is clearly insufficient for the analysis of income effects of the HGSF+ intervention. However, we hope to overcome this problem in two ways: by increasing statistical power through restricted randomisation and by focusing on intermediate outcomes rather than on household income, a variable that has large variance and high within cluster correlation. First, in order to increase statistical power we will adopt ‘restricted randomisation’ (Hayes and Moulton 2009). We will use the baseline data collected at the village and school levels to remove the randomisation outcomes that would result in an unbalanced comparison of project and control communes. The randomisation of the HGSF+ component of the project within the 58 communes will be performed only within the restricted sample of balanced randomisation outcomes. Second, we will analyse intermediate indicators of household income such as input use (labour and other farm inputs, such as land, seeds and fertiliser) and farm capital use like animal traction, tools and simple machinery.