PRELIMINARY ANALYSIS OF THE IMPACT OF USAID/MALI'S FTF INVESTMENTS ON INCOME GROWTH AND POVERTY REDUCTION

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Context

Food security is high on the political agenda in Mali, with a strong emphasis on the agricultural sector to encourage increased food production. Thus, the Government of Mali has developed an agricultural investment program (PNIP-SA) as the initial 5-year stage of its CAADP plan. The PNIP-SA focuses on strategic investments in five value chains: rice, maize, millet and sorghum, inland fisheries, and livestock products (both meat and dairy). It also includes cross-cutting activities aimed at strengthening nutrition education throughout the country.

The Feed the Future (FTF) Global Health and Food Security Initiative in Mali focuses on efforts to foster economic growth through increasing productivity in agriculture while reducing poverty and increasing broad based nutrition.

The current efforts of USAID/Mali to develop its Feed the Future program are aimed at identifying and designing interventions that will support key elements of the PNIP-SA that are aligned with the aims of the FTF program. Decisions about how USAID/Mali can best utilize its resources in support of Mali's CAADP investment plan involve choices about sectoral, geographical and thematic priorities. USAID/Mali will focus their efforts:

1. in areas where both development options and incidence of poverty are high;
2. on farmers who possess a "minimum" of factors of production, i.e., land, labor, perhaps equipment, and who are likely to be adopters of technology; and
3. on crops that are both largely consumed within the households and generate income.

USAID/Mali has selected three value chains: (1) coarse grains (i.e., millet, sorghum and maize), (2) rice, and (3) livestock (cattle, goats and sheep), in three regions: (1) Sikasso, (2) Mopti, and (3) Timbuktu.

Objectives of the study

Within this focus of three value chains in three regions, USAID/Mali is interested in determining how to best allocate FTF investment across value chains and regions. This document aims to guide USAID/Mali make sound decisions about how to best utilize their resources to support their priority choices.

Methods

The majority of the poor in Mali (about 80%) live in rural areas, and agriculture makes up a large share of their income, expenditures, and employment. Agricultural development can serve as an engine of growth, poverty reduction, and improved nutrition both in rural and urban areas, given there are important backward and forward linkages in production and consumption between agriculture and the rest of the economy, including in marketing and processing of agricultural products.

Increased productivity, as opposed to just increased production, is key to agricultural transformation. Links between agriculture development and poverty reduction are forged through various transmission mechanisms including (DFID 2004):

- direct and relatively immediate impact of improved agricultural performance on rural incomes;
- impact of cheaper food for both urban and rural poor; and
- agriculture's contribution to growth and the generation of economic opportunity in the non-farm sector.

Thus, increasing the pace of poverty reduction will depend upon the extent to which agricultural productivity, in both production and marketing systems, can be increased through a step change in agricultural performance. Simply increasing output at current productivity levels is likely to have little long-term impact on growth or poverty, and will increasingly be more difficult to achieve, given constraints on high-quality land and water in Mali.

While the impacts of increased productivity on economic growth and poverty alleviation are quite clear, their impacts on nutrition are not as obvious. Despite the widely accepted assumption that economic growth will ultimately lead to improved nutrition through increased incomes and food expenditures, results from limited evidence on the link between growth and nutrition are either inconclusive or conflicting. Thus, improving nutritional status will probably require balancing income growth with cost-effective health and nutrition interventions, including vitamin supplementation and nutrition education (IFPRI 2011).

This study uses a scenario analysis to estimate potential marginal benefits of improving productivity in production and marketing systems for each of the selected value chains in the three regions, and the impact of these increases in productivity on economic growth and food availability in order to guide USAID/Mali's investment decisions across their priority value chains. The first scenario aims to assess the impact of increased productivity at the farm-level production level, by either increasing yield or reducing the yield gap between medium and better performing farms, and the second scenario attempts to measure the impact of improved productivity at the marketing level, by either improving processing or storage methods. The spreadsheet tool developed to carry out the analysis enables USAID/Mali to vary key parameters, notably the expected percent change in yield level for crops, off-take rate for livestock, slaughter weight, output price and target population to be reached by the interventions. The assumptions behind the model of the tool include:

1. Fixed linear relationships;
2. Fixed land (growth is derived through intensification of agricultural activities);
3. Perfectly elastic supply of inputs and labor; and

4. No final consumption constraints (insatiation of wants).

More specifically, this analysis assesses potential direct impact on:

1. the potential impacts on economic growth by computing the total gross revenue generated from the intervention and the total number of people who would be directly affected by the intervention;
2. the potential impacts on food security/nutrition by computing the additional number of people who could meet their dietary needs as a result of the intervention;

This study also discusses relatively immediate impacts on economic growth, food security, nutrition, poverty alleviation and gender is a more qualitative manner.

Data

A major constraint in carrying out the analysis is that in Mali there are no ongoing, nationally representative farm-level survey panels. Most data on farm economics is limited to cash crops (mostly, cotton and rice), development projects, or household-level surveys in particular areas, but which are not necessarily statistically representative on a regional or national level. Thus, it is virtually impossible to make meaningful comparative analyses at the national level to assess the productivity of different agricultural systems and value chains across the different segment of the population using such data.

IER has recently established a set of surveys to collect data through monitoring and evaluation of 540 family farms for six major farming systems in Mali during two years (2006 and 2008). These production systems include:

- the cotton production system in Sikasso (cotton, coarse grains and livestock);
- the rice production system in Ségou (irrigated rice, horticulture);
- the millet / sorghum production system in Kayes and Cinzana (coarse grains and livestock);
- the pastoral production system in Mopti (livestock and irrigated rice);
- the peri-urban system in Koulikoro (intensive farming, horticulture);
- the flood-recession production system in Gao / Timbuktu (coarse grains, horticulture).

In each production system, data collection focused on 90 farms in three villages. Farms were classified as “poor”, “medium” or “better off” based on their level of productive assets. While believed to be “typical” of these different farming systems, there is no guarantee that the surveys are statistically representative of the broader regions in which the farming systems are located. The data exhibit significant differences in smallholder farming circumstances in Mali, not only in terms of agro-ecological factors but also among households in the same zone. This heterogeneity and the limited sample of the IER dataset pose significant challenges in applying this dataset for evaluating the FTF investment options; thus, the results of the analysis should be interpreted cautiously. Nonetheless, the IER dataset, on which this report extensively builds on, provides a good indication of the different production systems and enables one to make some comparisons across different economic, geographic and social segments of the population. In order to extrapolate the IER dataset to the regional level, additional information on population and production were collected from the INSTAT latest population census (2009), and the World Bank-supported

RURALSTRUC II study (2008) carried out by IER, CIRAD, and Michigan State University. Finally, commodity prices on various markets in Mali were obtained from the Malian agricultural market information system, OMA. More detailed data assumptions are provided in the three worksheets, SikassoData, MoptiData and TimbuktuData, of the spreadsheet tool.

Results and discussions

This section presents results of a base-case scenario analysis, using the spreadsheet tool. The results are illustrative, but the spreadsheet tool is designed so that USAID/Mali-AEG staff can change key parameters to see alternative results. These key parameters include such things as the percentage of the yield gap between well-off and less-well-off farmers to be closed for a given crop in a given region and the percentage increase in farm-level prices that result from improvements in the marketing system. The results discussed below are best reviewed while also looking at the Excel spreadsheet tool, which is attached. Additional instructions on how to use the spreadsheet tool is also included in the appendix.

Millet/Sorghum

The four most important cereal value chains in Mali are millet, sorghum, rice, and maize. Millet and sorghum, when taken together, remain the most widely consumed cereals in Mali, particularly in the rural areas and among low-income Malians. There are several opportunities to absorb increased production of sorghum/millet, including growing domestic demand for both human consumption (including farm-level consumption) and animal feeds as well as growing regional demand, particularly from Senegal and Mauritania.

In order to meet that growing demand, increases for sorghum and millet of 20-30 percent might be possible if improved seed varieties were more widely available and used in combination with fertilizer and water retention technologies. In recent years, there have been two different approaches to millet/sorghum breeding and extension in Mali: (1) a high-input solution, supported by INTSORMIL and Sasakawa Global, which see chemical fertilizers and fertilizer responsive millet and sorghum varieties as the best technology, and (2) a low-input solution, represented mostly by ICRISAT's efforts to produce new seed varieties that can produce more under the low input conditions that farmers currently experience. The low-input solutions can produce a 20-30% increase in yields over farmers' conventional seeds with the farmer using the same techniques as before. Meanwhile, the high-input solutions require farmers to put approximately$100/ha into chemical fertilizers, work best with animal traction, but can produce yield increases of 75-100% over traditional varieties grown with traditional levels of fertilizer. Both systems work best with water conservation efforts and with additions of organic fertilizers such as manure (USAID 2011).

Millet and sorghum, when taken together, remain the most widely consumed cereals in Mali, particularly in the rural areas and among low-income Malians; thus, the performance of these value chains has important implications for the food security of a large number of poor Malians (see table 1 and 2). Of the total area planted to millet nation-wide, 30% is located in Mopti, and 9% in Sikasso, while fewer households are involved in millet/sorghum production in Timbuktu. Similarly, of the total area planted to sorghum in Mali, 22% is located in Sikasso, compared to 6%

in Mopti and about 1% in Timbuktu for a total of 170,548 ha in those three regions. Given the relatively low importance of millet/sorghum production in Timbuktu, analysis of the impact of increased agricultural productivity only focuses on the region of Sikasso and Mopti.

Table 1: Millet production in selected regions

	Millet - Sikasso			Millet - Mopti			Millet - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	2.36	2.75	4.29	3.76	4.57	5.06	0.74	2.27	4.45
Mean Yield (kg/ha)	428	631	798	503	618	588	507	685	862
Land allocation (ha)	11,390	37,921	53,241	155,992	168,531	128,288	47,390	35,776	2,112
Total annual gross revenues (million CFAF)	658	3,230	5,736	10,593	14,061	10,184	3,244	3,308	246
Total annual gross revenues (million $)	1.37	6.73	11.95	22.07	29.29	21.22	6.76	6.89	0.51
Total annual regional gross revenues (million $)		20.05			72.58			14.16	
Number of households	4,826	13,789	12,410	41,487	36,878	25,353	10,370	7,070	3,771
Number of individuals	80,224	229,211	206,290	408,420	363,040	249,590	100,472	68,504	36,535
Total number of individuals in region residing in households that are involved in farm-level production		515,725			1,021,049			205,512	

Source: computations of the authors

Table 2: Sorghum production in selected regions

	Sorghum - Sikasso			Sorghum - Mopti			Sorghum - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	1.31	2.54	5.00	0.56	0.17	0.23	1.44	4.45	2.27
Mean Yield (kg/ha)	445	585	821	616	850	606	569	507	664
Land allocation (ha)	7,794	43,176	76,492	36,801	9,930	9,237	2,899	6,108	1,662
Total annual gross revenues (million CFAF)	416	3,031	7,536	2,720	1,013	672	198	372	132
Total annual gross revenues (million $)	0.87	6.31	15.70	5.67	2.11	1.40	0.41	0.77	0.28
Total annual regional gross revenues (million $)		22.88			9.18			1.46	
Number of households	5,949	16,998	15,298	65,716	58,414	40,160	2,013	1,373	732
Number of individuals	98,893	282,550	254,295	646,936	575,054	395,350	19,506	13,299	7,093
Total number of individuals in region residing in households that are involved in farm-level production		635,738			1,617,340			39,898	

Source: computations of the authors

Scenario 1: Improving productivity in production systems

In Sikasso, all farm households in the IER survey are above the consumption norm of 214 kg of cereals per person per year. Sorghum production is more important than millet, and better off farmers have higher yields per ha than medium farmers for both sorghum and millet. If medium farmers in Sikasso were to close the yield gap between their yields and those of the better-off farmers by 70%, they could produce an additional 7,133 MT of sorghum and 4,433 MT of millet. If USAID/Mali's intervention were to target 20% of these farms, they could generate a marketable surplus of 1,426 MT of sorghum and887 MT of millet, which could help feed about 6,666 additional consumers with sorghum and 4,143 people for millet, assuming a consumption norm of 214 kg/person). The increases in sorghum production would contribute an additional $ 0.36 million per year to the gross revenue of the region from sorghum and $ 0.25 million for millet.

In Mopti, all farm households in the IER sample are also above the consumption norm, but in contrast to Sikasso, medium farms in Mopti have higher yields than better off farms; and thus, there is no yield gap to close (see table 1 and 2). The better-off farm households in this region produce more millet and sorghum than the medium households simply by cultivating more area (a strategy of extensification). Because over the long-term, further extensification of millet and sorghum production is not an environmentally sustainable strategy, our analysis focuses instead of increasing the yields of the medium group of farmers. If this group were to increase their yield by 20% , by using either the high-input or low-input solution discussed above, they could produce an additional 20,830 MT of millet and 1,688 MT of sorghum. If USAID/Mali were to target 20% of these farms, they could generate a marketable surplus of 4,166 MT of millet (338 MT of sorghum), which could help feed more than 19,500 additional people with millet and 1,600 people for sorghum and generate about $ 1.2 million per year in farm-level revenues from millet and $0.08 million per year from sorghum.[1]

In addition to increasing farmers' income and augmenting food security/nutrition in both rural and urban areas due to increased quantity of cereal available for consumption, improving productivity in production will create additional employment opportunities for on-farm labor (in farm-level production) and off-farm labor in production; thus further contributing to creating greater urban food security by slowing down the rate of exodus from rural to urban areas and creating more jobs in the marketing system.

Scenario 2: Improving productivity in marketing systems

In addition to improving productivity at the farm level by adopting appropriate technical packages, there is considerable need to develop better output market links between farmers (e.g., grouped together in cooperatives) and processors who are willing to pay higher prices (i.e., 15-20% price premiums) for regular supplies of higher quality millet and sorghum. Such trends could transform the production of millet and sorghum for commercial purposes, and will require better processing and storage equipment.

[1] Additional analysis could look at a scenario that also include the better off farms, as these farms are likely to be reached with the extension services.

Thus, if USAID/Mali were to design an intervention that would help 20% of better off farmers, who have the capacity to produce adequate cereals, access better processing and storage facilities, it could help generate an additional $ 0.48 million from millet and $0.63 million from sorghum in Sikasso and $ 0.85 million from millet and $0.06 million from sorghum in Mopti. In addition to promoting economic growth by directly increasing the gross revenues of 99,414 farmers in Sikasso and,141 farmers in Mopti, this measure could help: (1) stabilize grain supply and quality, which reduces risks, promotes greater entrepreneurship, and facilitate regional export opportunities, (e.g., animal feed and blended flours), (2) increase women's income involved in processing (given many women's organizations are involved in millet processing), and (3) improve food security and nutrition by increasing ability to many households to afford more nutritious food.

Overall, an intervention that targets 20% of selected farms and aims at reducing the yield gap by 70% in Sikasso and increasing yield by 20 % in Mopti while providing a 20% price premium to progressive farmers engaged in improved processing/storage activities in both regions, would generate a total of 5,052 MT millet and 1,764 MT of sorghum, would help 31,854 additional people meet their dietary needs, and would have a direct impact on 516,757 farmers, whose gross income would increase by $ 3.8 million, assuming prices remain constant.

Maize

For two decades, maize has experienced the fastest growth of the rainfed coarse grains cereals in Mali. Maize accounted for 7.7 percent in Mali's total agricultural GDP in 2008, and the prospects to sustain growth in maize production are numerous. Maize consumption has more than doubled in Mali over the past ten years, increasing from 250,000 MT in mid 1990s to 704,000 MT in 2007. In addition to increased human consumption, more than 70,000 tons of maize grains are used yearly as feed for cattle and poultry, with maize grain accounting for 60 to 70 percent of poultry feed rations. The rapid urbanization in Mali has expanded substantially the demand for poultry, which is estimated at 21,000 tons of poultry per year. Mali's exports of maize ranged officially from around 5,000 to 10,000 tons from 2002 to 2006 (INSTAT), with the main exports markets being Cote d'Ivoire, Senegal, Mauritania and Niger. Other opportunities for maize are within the food industries (biscuits, breads, baby foods, etc.). Also, it should be noted that Mali's brewing company (*BRAMALI*) has a yearly demand of 1,080 tons of maize grits (USAID 2011). Combining all these potential demands, Diallo (2011) estimates total potential demand for Malian maize at roughly 1.3 million tons in 2015 at current price levels.

As a response to this growing demand, production of maize has also significantly increased. Production has grown in response improved varieties that have increased yields, fertilizer subsidies that have encouraged fertilizer use, and farmers' attempts to diversify away from cotton in recent years as the cotton value chain has contracted sharply. Maize is mainly cultivated in Sikasso, Koulikoro and Kayes, with Sikasso accounting for more than 60% of the national production. Maize production involves a

substantial proportion of the population in southern Mali, particularly in the southern CMDT region, where the crop has benefitted from prior investments in the cotton system. Compared to millet and sorghum, there is a real potential to spur economic growth by increasing maize productivity at both the production and marketing level. However, fewer people grow maize than millet or sorghum, and maize production is more concentrated among medium and better off farmers, with average yield ranging between 1MT/ha and 1.5MT/ha (see table 3). Given that maize production is negligible in Mopti and Timbuktu, the following section will only focus on the impact of improved agricultural productivity in Sikasso.

Table 3: Maize production in selected regions

	Maize - Sikasso		
	Poor	Medium	Better off
Average farm size (ha/hh)	0.46	1.24	2.00
Mean Yield (kg/ha)	1,091	1,003	1,507
Land allocation (ha)	7,844	56,999	148,280
Total annual gross revenues (million CFAF)	1,027	6,860	26,815
Total annual gross revenues (million $)	2.14	14.29	55.86
Total annual regional gross revenues (million $)		72.30	
	17,052	45,967	74,140
Number of individuals	283,446	764,071	1,232,372
Total number of individuals in region residing in households that are involved in farm-level production		2,279,889	

Source: computation of the authors

Scenario 1: Improving productivity in production systems

If medium farmers in Sikasso were to close the yield gap by 70% by increasing their use of improved varieties and fertilizer they could produce an additional 20,109 MT of maize (i.e., 5 times more grain tonnage than millet and 3 times more than sorghum in the same region assuming a similar percentage reduction in yield gap). If USAID/Mali's intervention were to target 20% of these farms, they could generate a marketable surplus of about 4,021MT of maize, which could help feed about 18,794 additional consumers and would increase gross income of the 152,814 farmers by about $1 million per year.

In addition to increasing farmers' income and augmenting food security/nutrition in both rural and urban areas, improving productivity in production will create additional employment opportunities for on-farm labor and in the marketing system due to the increase in the marketed surplus.

Scenario 2: Improving productivity in marketing systems
In addition to improving productivity at the production level by increasing the use of improved varieties and fertilizer, farmers also need quality improvements in order to meet competitive standards, particularly for the feed industry, which could be achieved through better processing and storage equipment.

Thus, if USAID/Mali were to design an intervention that would help 20% of better off farmers improve their processing and storage systems, it could help generate an additional $ 1,073 million in gross revenues from maize. In addition to promoting economic growth by directly increasing the gross revenues of nearly 250,000 rice farmers in Sikasso, this measure could help: (1) stabilize grain supply and quality, which reduces risks, promotes greater entrepreneurship, and facilitates regional export opportunities, (e.g., animal feed and blended flours), (2) increase women's income involved in processing, given that many women are involved in maize marketing (particularly of fresh maize) and in small-scale maize processing, and (3) improve food security and nutrition by increasing ability to many households to afford more nutritious food.

Overall, the combined effect of these two interventions (i.e., reducing the yield gap by 70% and providing a 20% price premium for improved processing/storage of maize to 20% of selected farms), would have a direct impact on nearly 500,000 farmers, whose gross income would increase by $ 3.24 million, assuming prices remain constant.

Despite the bright prospects for maize, it is necessary to put a word of caution in light of recent measures undertaken by the Government of Mali. As discussed above, productivity levels of maize have been dependent in part on the rise and fall of cotton production, since maize benefits from residual fertilizer nutrients applied to cotton through crop rotation. Historically, large spikes in maize acreage and production have corresponded with declining cotton production in the CMDT zone. However, the Government of Mali has recently announced its decision to set cotton producer price at 255 CFAF, i.e., 70 CFAF above the price offered during the previous cropping season. This measure puts a lot of uncertainty on maize production for the upcoming cropping season as farmers are more likely to grow cotton, in order to take advantage of the significant price increase, and there may be some substitution of acreage from maize to cotton.

Rice

Rice is increasingly favored by Malian consumers—primarily in urban zones but also in the rural areas where it is grown. National consumption of rice increased from 34 kg per person in 1989 to 57 kg per person in 2007 (USDA 2009). This increase in rice consumption per capita is mainly due to increased urbanization in large cities, and the exponential growth of fast food restaurants (or *gargotières*), as more people are working over lunch in urban areas. Because the demand for rice is growing rapidly and it is

largely consumed by politically influential urban consumers, who represent about 32 percent of Mali's population and are growing at about 4.8 percent per year, the government places a high priority on increasing rice production (USAID 2011). Over the past decade, rice production has increased at an annual rate of 7.7 %. This rapid growth reflects both area expansion and substantial yield increases (3.6% annual yield growth for rice and 2.6% for maize). However, despite the significant increases in production, Mali is still a net rice importer, but the prospects for increasing rice productivity are bright.

Mali is one of the four highest rice-producing countries in West Africa, along with Nigeria, Guinea and Ivory Coast (Africa Rice Center, 2008). Rice occupies 11 percent of the total cultivated land, which represents about 283,400 ha, and its production is based on a variety of production systems that exhibit significant differences. Mali has a high potential for increases in rice production given its extensive water and land resources. For the 2008/2009 season, Mali's rice production reached 1.6 million tons, which covered about 85% of Mali's needs. Irrigated systems accounted for half of the rice production with over 800,000 tons. Rainfed systems in the south produced about 32,350 tons (2%), production in the lowlands reached 273,560 tons (17%), and the rest of the rice production came from naturally flooded rice production systems (USAID 2010).

To date, most attention has been given to the large gravitational irrigation scheme of the Office du Niger in the Segou region, which accounts for nearly half of the entire production in the country. Current efforts to develop Mali's potential in producing rice are considering alternative production systems, notably small village irrigated perimeters (PIV) in Timbuktu, Mopti and Gao, and *basfonds* or lowlands systems in the south.

The Timbuktu region is the second region after Segou in irrigated rice production with over 20,000 ha in 2009/2010, followed by Mopti with about 6,500 ha and finally, Gao with less then 500 ha (USAID 2010). In the PIVs, surface area per farmer is small with about 0.3 hectares with average yield between 4.5 and 5.5 MT/ha, putting Mopti below national average and Timbuktu above average (see table 4).

In Sikasso, rice is produced in four distinct rice production systems: one upland system and three basfond systems[2] In the basfonds, average rice yield is about 1MT/ha, and about 60,000 ha were allocated to basfond rice production in 2009 (INSTAT). In each system, different varieties are grown as adapted to the respective flooding levels. Infrastructure to regulate water are still rare in Sikasso, but have a potential to contribute to a better water distribution across the systems and during the length of the season. About 90% of the basfond rice in Sikasso is cultivated by women. For women, rice is their only main cereal crop, and rice productivity determines much of their food security and income.

Even though productivity is low in the basfonds compared to the PIVs, average production costs are also lower (i.e., 96 CFA/kg compared to 192 FCFA/kg in 2009) (Ministère de l'Agriculture, 2009 and Diakité, 2009). Furthermore, the costs of

[2] The three basfond systems are: (1) high zone with water levels below 25cm; (2) medium zone, with water levels between 25 and 50 cm; and (3) low zone, with water levels superior to 50 cm.

improving water infrastructure in flooded plains far exceed the costs of comparable endeavors in the *bas-fonds* (up to 1.6 million FCFA/ha in flooded plains versus 600 000 FCFA/ha in *bas-fonds*) (USAID 2009).

Table 4: Rice production in selected regions

	Rice (bas-fond) - Sikasso			Rice (PIV) - Mopti			Rice (PIV) - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	-	0.64	0.61	0.08	-	0.22	0.46	0.63	1.02
Mean Yield (kg/ha)	-	416	1,040	667	-	716	1,290	1,114	1,673
Land allocation (ha)	-	32,361	27,759	2,425	-	4,075	7,299	6,816	5,885
Total annual gross revenues (million CFAF)	-	3,769	8,084	453	-	817	2,636	2,126	2,757
Total annual gross revenues (million $)	-	7.85	16.84	0.94	-	1.70	5.49	4.43	5.74
Total annual regional gross revenues (million $)		24.69			2.65			15.67	
	-	50,563	45,507	30,311	-	18,523	15,867	10,819	5,770
Number of individuals	-	840,478	756,430	298,394	-	182,352	153,736	104,820	55,904
Total number of individuals in region residing in households that are involved in farm-level millet production		1,596,908			480,746			314,461	

Source: computations of the authors

In the PIV, most farmers use chemical fertilizers and improved seeds, but at rates below the recommended doses, whereas in the basfonds, most of the rice production is still traditional and efforts to modernize rice farming in those systems have largely centered on promoting the adoption of modern varieties, and increased use of fertilizer, herbicide and labor saving technologies (e.g., seeding machine). Thus, there is a high potential for improving yields in these systems.

Scenario 1: Improving productivity in production systems

If medium farmers in Sikasso were to close the yield gap between them and the better off farmers by 70%, by increasing their use of improved varieties, fertilizer and herbicides, they could produce an additional 14,135 MT of rice (compared to 2,667 MT in Timbuktu). If USAID/Mali's intervention were to target 20% of these farms, they could generate a marketable surplus of about 2,827 MT in Sikasso and 533 MT in Timbuktu. Given that in Mopti, medium farms are not involved in rice production, it may be best for USAID to focus on the most performing farms. Thus, if better off farmers were to increase their yield by 20%, they could generate a marketable surplus of 544 MT in Mopti, which amounts to 109 MT if USAID were to target 20% of these farms. Thus, the marketable surplus generated within the 3 regions could help feed about 16,210 additional consumers and would increase gross income of 168,096 farmers in Sikasso by $ 1.65 million, 21,168 farmers in Mopti by $ 0.06 million, and 35,000 people in Timbuktu by $ 0.31 million per year.

In addition to increasing farmers' income, especially women's income in the basfonds, and augmenting food security/nutrition in both rural and urban areas, improving productivity in rice production can contribute to poverty reduction by creating employment opportunities for agricultural laborers and increasing the demand for inputs and services. Furthermore, given that rice is a politically sensitive staple, increasing production and availability of rice can contribute to social stability in Mali.

Scenario 2: Improving productivity in marketing systems

Despite the strong underlying demand for Malian rice and constant growth in production, imports have not diminished, and exports are still negligible due to several difficulties in the marketing of local rice, notably: (1) the lack of a common vocabulary governing quality and varieties, (2) the lack of standard grading systems for rice, and (3) the significant levels of impurities (i.e., pebbles, bran, straw, and rice flour) in local rice due processing deficiencies. Given the potential for increasing value added, a diverse group of value chain actors, including the two industrial mills belonging to wholesaler/importers, a small number of SME "mini rice mills" and some informal market retailers/sorters who hand sort and clean mixed lots of rice, have started to develop business strategies to capture part of the 15 to 20 percent price premium for the high-end market segment. This market remains quite small with limited quantities available, and the new private investments flowing to rice production or processing that have been undertaken in recent years are unrecorded.

Thus, if USAID/Mali were to design an intervention that would help 20% of better off farmers improve their processing systems, it could help generate an additional $ 0.96

million in gross revenues for the 3 regions. In addition to promoting economic growth by directly increasing the gross revenues of nearly 205,569 people in the 3 regions, especially women's income (given most value-added processing conducted by women or women's organizations), this measure could also help increase ability to afford more nutritious food.

Overall, the combined effect of these two interventions (i.e., reducing the yield gap by 70% and providing a 20% price premium for improved processing rice to 20% of selected farms), would have a direct impact on nearly 430,000 farmers, whose gross income would increase by $ 3 million, assuming prices remain constant.

Livestock

Livestock production accounts for approximately 30% of Mali's agricultural GDP, and 85% of Mali's agricultural households own some form of ruminant (cattle, goats, sheep, or camels). Cattle represent Mali's third most important export commodity, after gold and cotton. Furthermore, cattle are the main draft animals, and animal manures are an important contributor to soil fertility.

Mali has an estimated 11.3 million sheep and 15.7 million goats. In contrast to cattle numbers, nearly half (48%) of the small ruminant population is located in the northern regions of Gao, Kidal, and Timbuktu, where these animals constitute a critical component of pastoral livelihoods. But small ruminants are also widely held in other regions of Mali and are important sources of income, especially for women, and stores of wealth for poorer households (see table 5, 6 and 7).

Livestock are an extremely important form of rural savings account, and income is derived from livestock (especially milk sales) year-round, helping to relieve the cash-flow constraints that rural households would face if they relied solely on crop income. Furthermore, because demand for livestock products typically increases rapidly as incomes increase, the demand outlook for Malian livestock production is strong, both domestically and in the sub-region. The major constraints on production are poor nutrition seasonally (due to the seasonal variation in pasture quality and limited access to feed complements, such as oilseed cake); a low offtake rate (estimated at 11% per year for cattle and 34.5% for small ruminants), which is partly due to poor nutrition; and to a lesser degree, disease control. Thus, there is a clear potential in improving productivity in livestock through animal fattening, given that market price incentive in these value chains is based on weight.

Table 5: Cattle production in selected regions

	Cattle - Sikasso			Cattle - Mopti			Cattle - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	-	2.00	19.00	3.00	12.00	59.00	1.68	1.68	25.17
Mean Yield (kg/ha)	-	119,267	1,019,733	129,298	459,727	1,553,974	46,168	31,478	251,823
Land allocation (ha)	-	1,469	12,563	1,593	5,664	19,145	569	388	3,102
Total annual gross revenues (million CFAF)	-	2,351	20,101	2,549	9,062	30,632	910	620	4,964
Total annual gross revenues (million $)	-	4.90	41.88	5.31	18.88	63.82	1.90	1.29	10.34
Total annual regional gross revenues (million $)		46.77			88.01			13.53	
	-	59,634	53,670	43,099	38,311	26,339	27,518	18,762	10,006
Number of individuals	-	991,241	892,117	424,290	377,147	259,288	266,617	181,784	96,952
Total number of individuals in region residing in households that are involved in farm-level production		1,883,359			1,060,725			545,353	

Source: computation of the authors

Table 6: Sheep production in selected regions

	Sheep - Sikasso			Sheep - Mopti			Sheep - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	1.00	5.00	13.00	3.00	8.00	14.00	3.45	6.90	20.71
Mean Yield (kg/ha)	11,947	170,674	399,378	225,321	534,095	642,583	94,971	129,506	207,210
Land allocation (ha)	54	765	1,791	1,011	2,395	2,882	426	581	929
Total annual gross revenues (million CFAF)	107	1,531	3,582	2,021	4,791	5,764	852	1,162	1,859
Total annual gross revenues (million $)	0.22	3.19	7.46	4.21	9.98	12.01	1.77	2.42	3.87
Total annual regional gross revenues (million $)		10.88			26.20			8.07	
	11,947	34,135	30,721	75,107	66,762	45,899	27,518	18,762	10,006
Number of individuals	198,589	567,398	510,658	739,388	657,234	451,848	266,617	181,784	96,952
Total number of individuals in region residing in households that are involved in farm-level production		1,276,645			1,848,470			545,353	

Source: computation of the authors

Table 7: Goat production in selected regions

	Goat - Sikasso			Goat - Mopti			Goat - Timbuktu		
	Poor	Medium	Better off	Poor	Medium	Better off	Poor	Medium	Better off
Average farm size (ha/hh)	2.00	3.00	7.00	4.00	7.00	16.00	3.45	6.90	20.71
Mean Yield (kg/ha)	40,880	175,200	367,920	327,600	509,600	800,800	94,971	129,506	207,210
Land allocation (ha)	183	786	1,650	1,469	2,286	3,592	426	581	929
Total annual gross revenues (million CFAF)	330	1,414	2,970	2,645	4,114	6,465	767	1,046	1,673
Total annual gross revenues (million $)	0.69	2.95	6.19	5.51	8.57	13.47	1.60	2.18	3.49
Total annual regional gross revenues (million $)		9.82			27.55			7.26	
	20,440	58,400	52,560	81,900	72,800	50,050	27,518	18,762	10,006
Number of individuals	339,758	970,738	873,664	806,260	716,676	492,714	266,617	181,784	96,952
Total number of individuals in region residing in households that are involved in farm-level production		2,184,160			2,015,650			545,353	

Source: computation of the authors

Scenario: Improving productivity through better animal nutrition

If USAID/Mali were to design an intervention that would help 20% of better off farmers in the three regions increase the off take rate and the slaughter rate by 20%, by improving pasture and water-point management and improving access to feed concentrates,, then they could produce an additional 3,063 MT of beef, 493 MT of mutton and 543 MT of goat meat, with Sikasso accounting for more than half of the total meat production for both cattle and small ruminants. The marketable surplus generated within the 3 regions could help 19,156 more people meet their meat dietary requirement (assuming that the meat consumption norm is set at 4.2 kg per person per year) and would increase gross income of 455,288 farmers in Sikasso by $ 4.89 million, 406,536 farmers in Mopti by $ 7.86 million, and 99,798 people in Timbuktu by $ 1.56 million per year.

In addition to increasing livestock producers' income and stores of wealth, notably for women, given heavy women's involvement in small ruminant production, such an intervention would further:

- support the development of upstream and downstream transactions (i.e., increase demand for animal feed, and cottonseed cake, forage, etc…) as well as animal and meat processing and marketing
- increase demand for labor to care for animals (job creating opportunities)
- increase export opportunities and earnings of foreign exchange (Cote d'Ivoire and Senegal)
- develop secondary direct effects on multiproduct systems (i.e., dairy, hides etc…)
- increase meat availability and protein consumption in both rural and urban areas
- increased milk production and thus women's income (given women high involvement in dairy production and the fact that most cattle in Mali are dual-purpose. Thus, even if the USAID/Mali interventions are aimed at the meat portion of the livestock industry, they will have indirect positive effects on the dairy enterprise as well.)
- increase ability to afford more nutritious food
- improve ecosystem preservation by reducing pressure on pasture land
- increase soil fertility due to increased animal manure production
- support the development and demand for agrochemical products (e.g, vaccine).

Conclusion

For this base-run set of scenarios, investing in improving the livestock value chain seems to be the activity that has the most potential to generate economic growth, as it generates more than 4 times more gross revenues than maize, which is the second best economic growth generating value chain (see figure 1).

Millet, maize and rice (in this order) have the most potential for improving food security given that these value chains are the one that could generate more marketable surplus (in tonnage), which could be used to help feed many urban and rural poor who are currently food insecure (see figure 2).

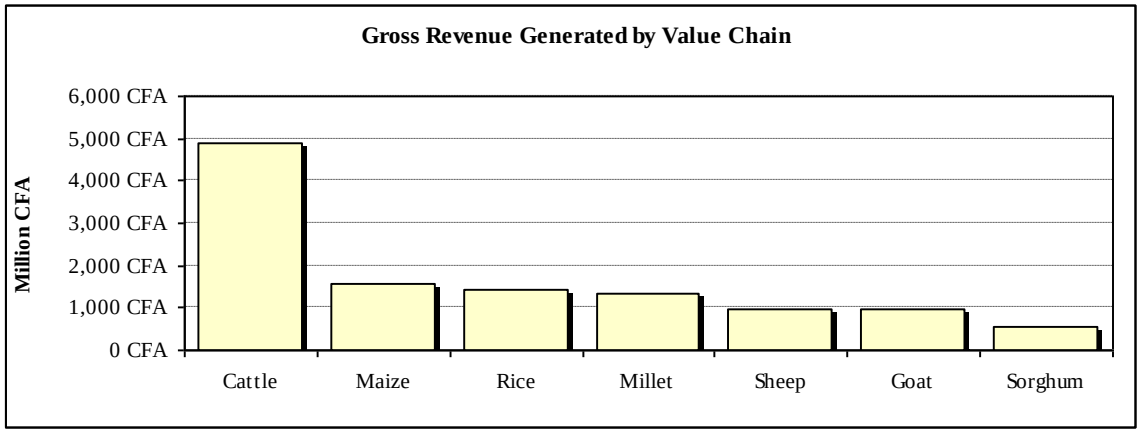
Rice, maize, millet, and goat (in this order) have the most potential for reducing poverty as they have the potential to directly impact the livelihood of more people compared to the other value chains (see figure 3).

In terms of regions, Sikasso seems to be the region that could contribute most to both spurring economic growth and reducing poverty, followed by Mopti. Timbuktu will have the least impact on achieving these specific objectives (see figure 4 and 5), given its much lower population.

More details on actual figures are provided in the "Summary" sheet of the tool.

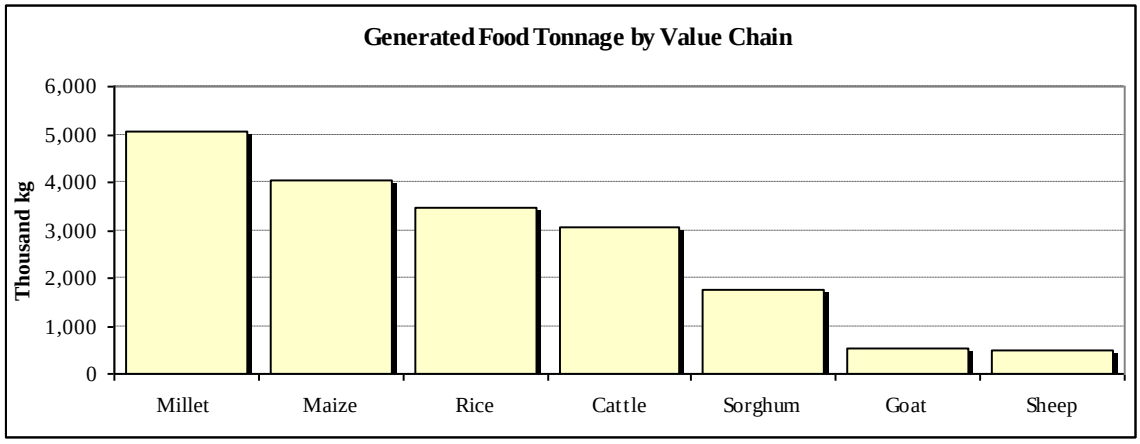
Of course, given this tool, the USAID/Mali-AEG team can use the spreadsheet tool to analyze other options than those described here for the base-case scenario. The strength of the tool lies it its ability to compare alternatives rather than the presentation of a single set of results, as shown in this paper.

Figure 1: Gross Revenue Generated by Value Chain



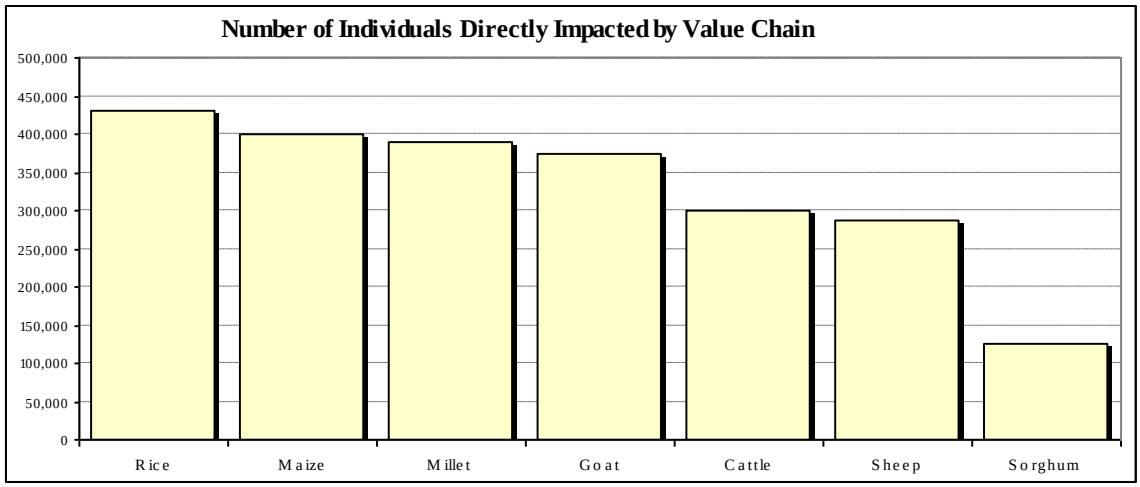
Source: Computation of the authors

Figure 2: Generated Food Tonnage by Value Chain



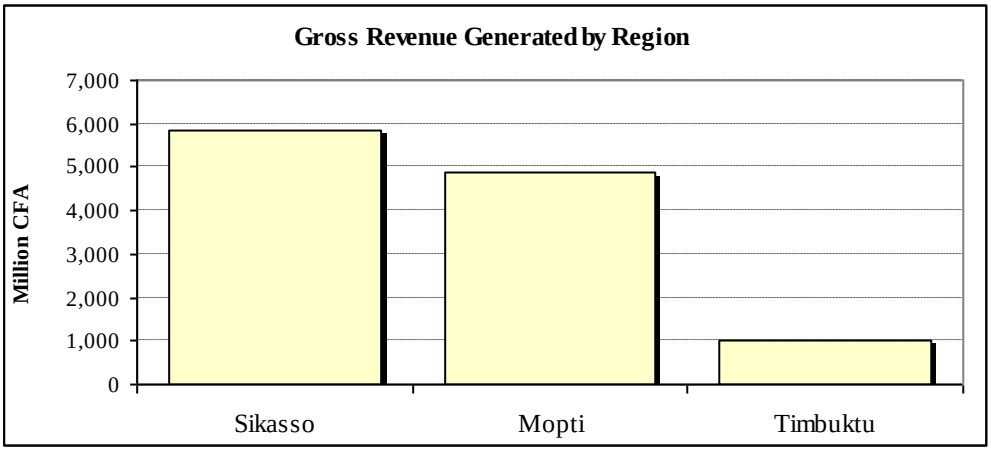
Source: Computation of the authors

Figure 3: Number of Individuals Directly Impacted by Value Chain



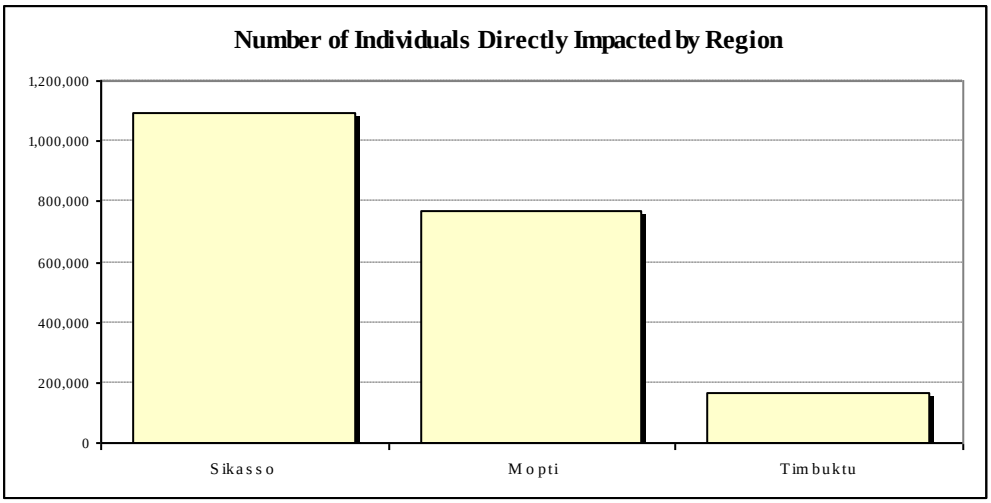
Source: Computation of the authors

Figure 4: Gross Revenue Generated by Region



Source: Computation of the authors

Figure 5: Number of Individuals Directly Impacted by Region



Source: Computation of the authors

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APPENDIX

User Guide for USAID/Mali Decision Support Tool

The MSU Evaluation Team, using data described in the **Data** section of this document, developed a decision support tool for evaluating the potential economic impacts of alternative program investment options. This tool was developed with general policy options that allow the user to assign the anticipated productivity impacts at the farm level and the reach of the program in terms of percent of total farmers impacted directly, with the dual goal that the tool be useful for program administrators for planning as well as for evaluators to gauge the outcomes. The user requirements for operating the model are general enough to be useful for those with limited knowledge of program evaluation, yet extensive enough to provide meaningful and objective results. Additionally, the model is customizable and expandable for incorporating additional commodities and value-chain components, should further data and need be recognized.
The FTFMatrix.xls tool is a spreadsheet model built on separate data sheets that house regional-specific baseline data. This baseline data represents the data assumptions that go into the model for each value-chain/region combination. Such data assumptions are stored and reviewable in the **SikassoData**, **MoptiData** and **TimbuktuData** sheets of the tool, for the Sikasso, Mopti and Timbuktu regions. Each region has its own impact calculation sheet which combines policy inputs and respective impacts based on such inputs.

Cereals Interventions

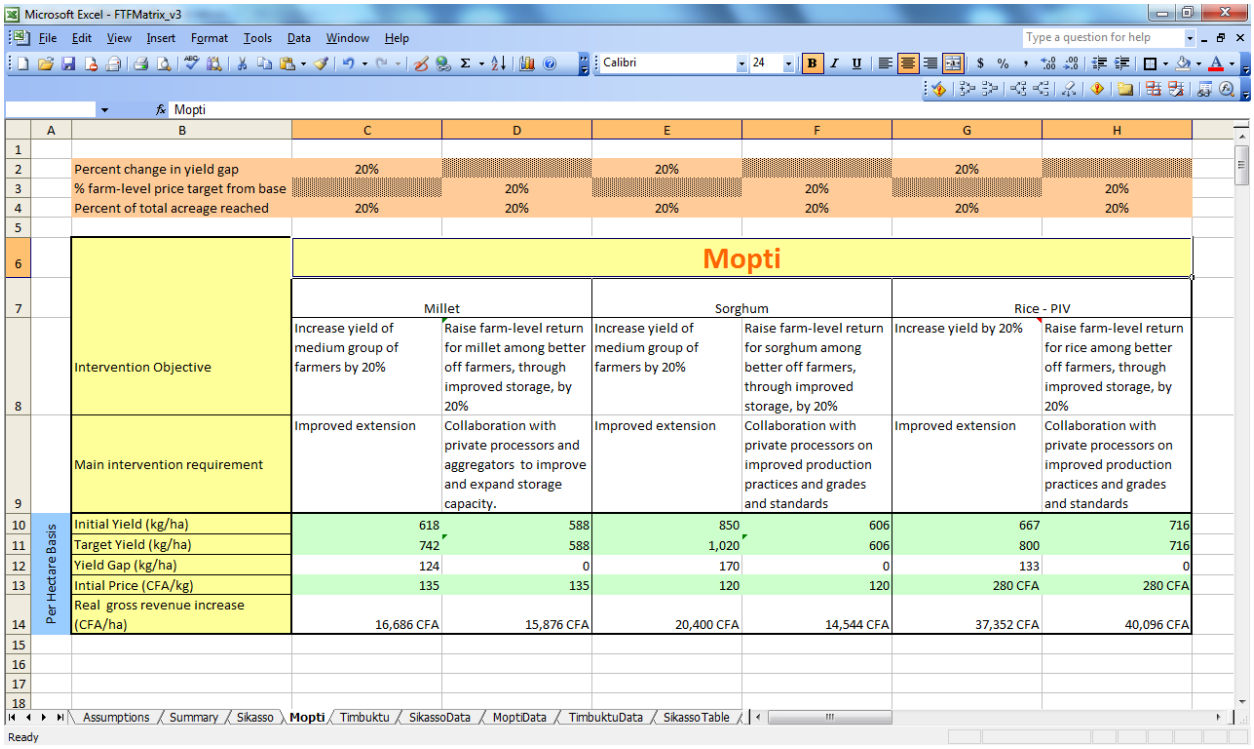
Each crop commodity has two potential intervention groups, medium group and better off group. The policy option for medium crop farmers is to raise productivity, while that of the better off farmers is to raise the sale price (or demand) for production. For the second the policy assumption is an investment in upstream processes such as storage and marketing that make coarse grain production of better off producers more marketable. Policy variables that can be changed in shaded in orange in rows 2 through 3 of the regional impact calculation sheets – **Sikasso**, **Mopti** and **Timbuktu**. Row 8 describes the policy objectives, and Row 9 describes the anticipated means of reaching the policy objectives. Cells in light green are baseline figures that do not change with policy objectives, While the blue left hand boarders indicate if the provided measure is on a per hectare, per person or regional basis. All policy interventions have a *Percent of total acreage reached* that is specified by the user. This represents the anticipated reach of the intervention in terms of total number of producers directly impacted. The user sets this in Row 4.

Yield Increases of Medium Farmers

Where there is a yield gap between the medium group and the better off group (Sikasso and Timbuktu regions), the intervention for the medium group is to raise their productivity (yield) to some percentage (up to 100%) of the productivity of the better off group. This helps assure realistic expectations of impacts. The policy variable is the *Percent change in yield gap* and is located in Row 2. In cases where there is no crop yield gap between the medium and better off groups (Mopti region) the policy variable is to increase the total yield of medium farmers by some percent increase.

Increase Farm-Level Returns for Better-Off Farmers

The model assumes intervention objectives of better-off farmers are to increase the return on existing production, through better storage and marketing. As appose to increasing yield, the assumption of price increase is the same over all regions and differ by commodity/region by the amount of the *percent farm-level price target from base* specified by the user. This policy is assumed to not impact total yield. It is further assumed that it does not increase the total number of calories consumed, though the actual impact of improved storage is to reduce inventory shrinkage.



Microsoft Excel - FTFMatrix_v3

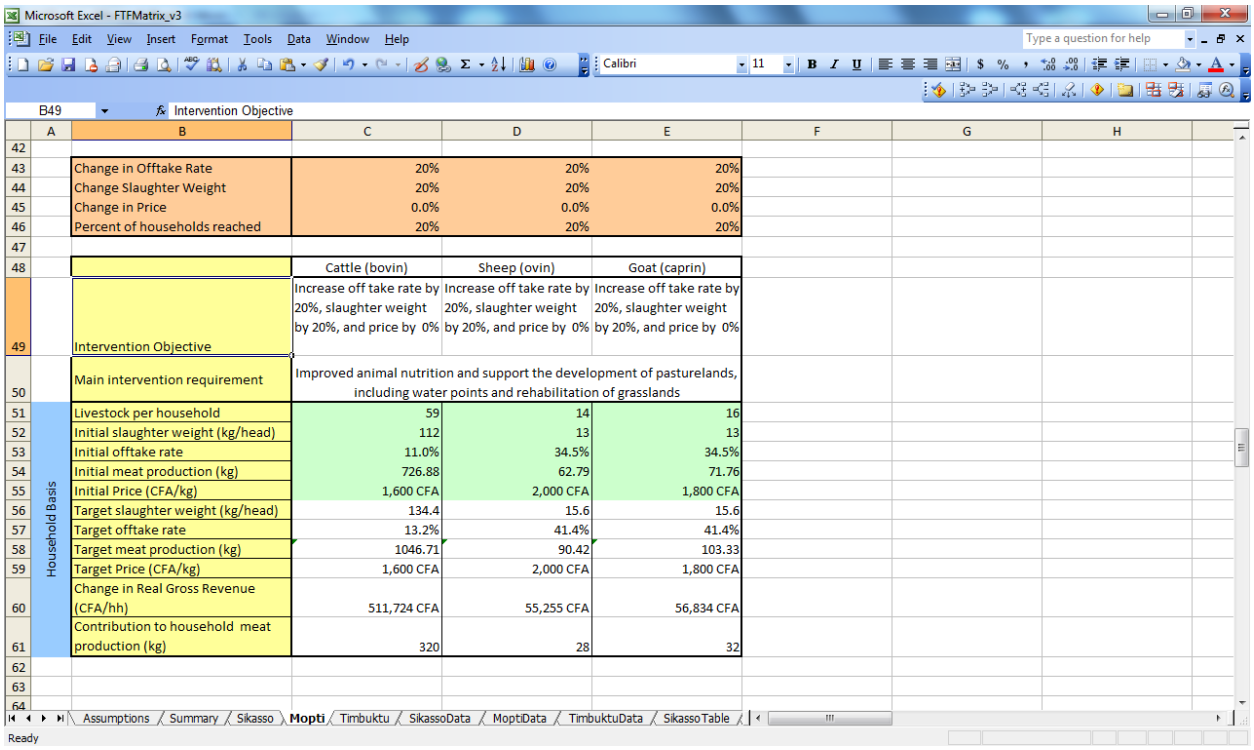
			C	D	E	F	G	H
2		Percent change in yield gap	20%		20%		20%	
3		% farm-level price target from base		20%		20%		20%
4		Percent of total acreage reached	20%	20%	20%	20%	20%	20%
6			Mopti					
7			Millet		Sorghum		Rice - PIV	
8		Intervention Objective	Increase yield of medium group of farmers by 20%	Raise farm-level return for millet among better off farmers, through improved storage, by 20%	Increase yield of medium group of farmers by 20%	Raise farm-level return for sorghum among better off farmers, through improved storage, by 20%	Increase yield by 20%	Raise farm-level return for rice among better off farmers, through improved storage, by 20%
9		Main intervention requirement	Improved extension	Collaboration with private processors and aggregators to improve and expand storage capacity.	Improved extension	Collaboration with private processors on improved production practices and grades and standards	Improved extension	Collaboration with private processors on improved production practices and grades and standards
10	Per Hectare Basis	Initial Yield (kg/ha)	618	588	850	606	667	716
11		Target Yield (kg/ha)	742	588	1,020	606	800	716
12		Yield Gap (kg/ha)	124	0	170	0	133	0
13		Intial Price (CFA/kg)	135	135	120	120	280 CFA	280 CFA
14		Real gross revenue increase (CFA/ha)	16,686 CFA	15,876 CFA	20,400 CFA	14,544 CFA	37,352 CFA	40,096 CFA

Assumptions | Summary | Sikasso | Mopti | Timbuktu | SikassoData | MoptiData | TimbuktuData | SikassoTable

Ready

Livestock Interventions

There are three livestock value chains modeled for each region. Livestock impact calculations for each region are shown on the impact sheets **Sikasso**, **Mopti** and **Timbuktu**, starting at Row 39. For each value chain/ region the user selects the combination of intervention objectives in percent change from baseline of *Change in Off-take rate*, *Change Slaughter Weight*, *Change in Price*, and *Percent of Household Reached.* The policy variables for change are highlighted in orange. Cells highlighted in green are baseline values derived from the respective data sheets, while white cells are cells with impact calculations.



Microsoft Excel - FTFMatrix_v3

File Edit View Insert Format Tools Data Window Help

B49: Intervention Objective

43	Change in Offtake Rate	20%	20%	20%	
44	Change Slaughter Weight	20%	20%	20%	
45	Change in Price	0.0%	0.0%	0.0%	
46	Percent of households reached	20%	20%	20%	
48		Cattle (bovin)	Sheep (ovin)	Goat (caprin)	
49	Intervention Objective	Increase off take rate by 20%, slaughter weight by 20%, and price by 0%	Increase off take rate by 20%, slaughter weight by 20%, and price by 0%	Increase off take rate by 20%, slaughter weight by 20%, and price by 0%	
50	Main intervention requirement	Improved animal nutrition and support the development of pasturelands, including water points and rehabilitation of grasslands			
51	Livestock per household	59	14	16	
52	Initial slaughter weight (kg/head)	112	13	13	
53	Initial offtake rate	11.0%	34.5%	34.5%	
54	Initial meat production (kg)	726.88	62.79	71.76	
55	Initial Price (CFA/kg)	1,600 CFA	2,000 CFA	1,800 CFA	
56	Target slaughter weight (kg/head)	134.4	15.6	15.6	
57	Target offtake rate	13.2%	41.4%	41.4%	
58	Target meat production (kg)	1046.71	90.42	103.33	
59	Target Price (CFA/kg)	1,600 CFA	2,000 CFA	1,800 CFA	
60	Change in Real Gross Revenue (CFA/hh)	511,724 CFA	55,255 CFA	56,834 CFA	
61	Contribution to household meat production (kg)	320	28	32	

Household Basis

Assumptions Summary Sikasso Mopti Timbuktu SikassoData MoptiData TimbuktuData SikassoTable

Ready

Summary Sheet

The Summary sheet summarizes the simulation outcomes by region, by value chain. It contains both tables and graphs. Both are automatically recalculated whenever a policy variable has been changed. There is a button that operates a single macro titled *Update Graphs*. This macro only sets the order of the graph bars from highest to lowest for ease of interpretation. It does not recalculate values. The macro will only work if the security settings on allow macros.