

South Sudan Maize Production Cost and Agricultural Labor Analysis

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Executive Summary

South Sudan has been affected by two civil wars since 1955. The first was fought between the Sudanese government and the Anyanya rebel army, from 1955 to 1972. The second was between the government and the Sudan people's Liberation Army/Movement (SPLA/M) from 1983 to 2004. The half century of almost uninterrupted civil war resulted in infrastructural neglect and destruction. Although the economy is largely rural and relies heavily on farming, the labor force is shifting towards urban centers.

The objective of this study is to estimate the cost of production of maize in order for P4P to more effectively target purchases and programs to incentivize increased local maize production. It was found that producers lose about \$45 per hectare when fully accounting for purchased inputs (negligible), hired labor, laborers meals and imputed value of family labor. Labor is normally paid by the task, making calculations of total costs straight forward. Daily wage rates were calculated by dividing the wage bill by the number of person-days worked. The imputed wage rate for Central and Western Equatoria is just under \$4/day.

Western Equatoria is a surplus cereal producing state, while Central Equatoria is deficit in cereals. In both states, markets are isolated due to poor roads and transport infrastructure. Western Equatoria should be targeted first for purchases, while interventions to increase production could be strengthened in both Western and Central Equatoria. Minimum price contracts to farmers and the provision of storage and processing facilities, integrated with other donor activities, would likely increase maize production and food security.

Objective

The objective of this study is to identify and measure average production costs for maize in Western and Central Equatoria – breadbasket areas where P4P is operating and has made or plans to make purchases – inclusive of labor and meal costs for current market conditions. Daily wage rates were also estimated and analyzed on a task by task basis.

Methodology

The study was framed by discussions held in Juba in early June, 2011, among WFP staff from Rome and Southern Sudan, and P4P and Borlaug Institute staff. Background information on the current context was gained, and a consensus was reached to amend the original scope of work by studying cost of production of maize rather than rice. This was due to the relative importance of maize over rice in terms of output, consumption, number of farmers and overall contribution to the economy. Basic survey forms and methodology were carried over from previous data collection missions. Security procedures and logistical constraints posed some limitations to field access, but ample field time was achieved due to the hard work and persistence of the entire P4P team in Juba.

This study was undertaken in May and June, 2011. A total of 23 individual farmer surveys were conducted in Western and Central Equatoria. They were from the counties of Ibba, Mundri East, Mundri West, Nzara and Yambio in Western Equatoria, and Kajo Keji, Morobo and Yei in Central Equatoria.

Table 1. Summary of Farmers Surveyed. South Sudan, 2011.

	Total	Females	Av HH size	Av farm size (feddans)	Av farm size (ha)
Western Equatoria	13	4	11	5	2.1
Central Equatoria	10	2	9	6	2.4

A total of six of the farmers surveyed were female. Average household size was about 10 persons, and average farm size was about 2.2 hectares.

Data were collected on a per feddan basis, and converted to hectares: 1 feddan = 0.42 hectares. A comprehensive database was developed. Labor costs for specific tasks were divided by the number of person-days required to estimate daily wage rates for each activity. The resulting analysis, results and discussion follow.

Analysis, Results and Discussion

Data

Data were collected from larger, more commercial scale farmers primarily because they were more accessible through donor organizations, NGOs and local governments. Reported yields were above local averages, but well below international norms. Average size for all farms in the area is about one hectare, and average size of the farms surveyed was more than 2 hectares.

The data were separated for analysis in this paper by state – Central Equatoria and Western Equatoria. Given the similarity in data between the two states, the data are combined and the region of origin is referred to as Greater Equatoria, though no data was taken from the third state, Eastern Equatoria.

Non-labor inputs

Non-labor inputs are omitted from the analysis because of the 23 farmers surveyed, only 1 reported purchasing seeds (Longe 5 and Pan 67) and fertilizer (Super-Grow) from Uganda. This farm had about 65 hectares under cultivation, and had a high level of donor support. A few others received the Longe 5 seed variety free from FAO or other NGOs. No pesticides or other purchased inputs were used. Therefore, overall, farmers incurred negligible costs for non-labor, purchased inputs and this category of costs omitted from the analysis. ***Calculation of Wage Rate and Labor Valuation***

Labor is mostly paid on a per job basis. Farmers pay a fixed price for task, and the laborer will decide how many workers, how many hours per day to work, and the intensity of the effort. These variables make calculation of a consistent daily wage rate somewhat complex.

On larger farms, families often conduct the labor for a section, and paid laborers conduct the labor on other sections. Although family members may not put in full eight-hour workdays due to other household responsibilities, the wages paid to other laborers represents the opportunity costs of working on the family farm in lieu of working for wages on a neighbor's farm.

The wage rate in Juba was reported to be \$7/day, decreasing toward more remote areas. Areas rich in livestock production have higher wage rates, as workers prefer tending herds to working in fields. Labor is cheaper in Uganda, such that integration of these markets in the border areas drive wage rates still lower. In the areas of study here – Central and Western Equatoria – the wage rate was calculated at \$4 per day, which is high relative to the daily wage rate in other African P4P countries, Liberia and Sierra Leone.

Meals as a Labor Cost

As is common in the region, laborers do not take their own lunch to the fields, but expect that lunch be provided by the employing farmer. Meals for workers are treated as labor costs, and are included in both production costs and wage rate analysis in this paper. A conservative estimate of \$0.50 per worker per day was included as the cost of food.

Geographic Scope

The study focused on the two states with the highest potential for purchases by P4P – the Greenbelt region of Western Equatoria and Central Equatoria.

Western Equatoria vs. Central Equatoria

Production costs and wage rates were found to be similar in Central and Western Equatoria. Farmers in Western Equatoria, however, were willing to accept the price of \$380/mt offered by P4P, and in Central Equatoria they were not. The difference is the level of local marketable surplus.

Table 2. Central and Western Equatoria Cereal Balance Summary. South Sudan, 2011.

	Population	Cereal Ha	Ha/Person	Cereal Balance (mt)
Western Equatoria	661,696	111,669	0.17	24,179
Central Equatoria	1,119,805	126,706	0.11	(63,878)

Estimates from 2011 FAO/WFP Crop and Food Supply Assessment Mission.

According to the 2011 FAO/WFP Crop and Food Supply Assessment mission, 88% of households in Western Equatoria are involved in farming, whereas 66% of households in Central Equatoria are involved in farming. In cereals, both states are reported to be about 70% maize, and 30% grain sorghum production.

As detailed in Table 2, the population of Western Equatoria is 59% of the population of Central Equatoria, while the amount of land under cereal cultivation in Western Equatoria is 88% of the total for Central Equatoria. The ratio of land under cultivation per person is 73% higher in Western Equatoria than Central Equatoria, and this explains the dramatic difference in estimated cereal balance, i.e. the surplus in Western Equatoria and deficit in Central Equatoria.

Mechanization

Tractors are available for rent for plowing and harrowing in some areas of Central and Western Equatoria. The tractors were donated, or provided on loan, with the expectation that they be available for hire by the community. The lowest reported price for hiring a tractor for plowing last year was about \$85/hectare. This price is about 35% lower than labor cost of about \$130 associated with digging by hand, and it also breaks the land more consistently and quickly. In this situation, only the politically powerful and connected farmers are able to hire tractors for plowing, while less powerful producers are relegated to digging the land by hand.

The current fuel crisis has caused the cost of tractor hiring to more than double, to as much as \$185/hectare in some areas. Most farmers are unable to pay this amount of cash, when a cheaper alternative is available. In most instances the costs are not cash costs, but opportunity costs for family labor. Affluent farmers may pay the premium for convenience, timeliness and quality of work, but the effect on the bottom line is negative.

There were no working hand tractors observed in the field. It was reported that hand tractors are undesirable because the clay vertisol soil accumulates on the machine and renders it nearly useless. Repairs and replacement parts are also difficult.

No ox plows were observed in Central or Western Equatoria, but there were numerous reports of widespread use in the northern states, including large training programs for teams of oxen and men being conducted in Lakes state. A team of two oxen and two men can cover about 3.2 hectares per season. Cost of training is about \$70/team. Data on cost of keeping, maintaining and utilizing a team of oxen were not available.

Maize Yields

Although the reported average yields of about 2 mt/ha for maize in Central and Western Equatoria are much higher than historical averages for the whole of South Sudan, they are still very low relative to regional averages². US farmers' maize yields in 2009 were recorded as high as 14.3 mt/ha³. The yield of

2 mt/ha found in this survey, relatively high for Southern Sudan, can be attributed to the focus of the survey in areas with the highest productivity and production potential, as well as the targeting of the most productive farmers due to increased accessibility through NGOs and local agricultural ministries. Average yields have also improved over the past decade due to access to improved seeds through donor activity, improving production practices, and a decrease in civil war conflict.

Land Preparation, Clearing and Planting Costs

Tree Felling and Clearing

Clearing of previously uncultivated land consists of three distinct activities: tree felling, cutting and removal of felled trees, and clearing of underbrush, grass and weeds. Farmers consistently reported the need to rotate crops after six maize harvests, normally to cowpeas or cassava. Since maize is typically cultivated twice per year in the Equatoria states, tree clearing, cutting and hauling is divided by six in order to distribute the costs evenly across each harvest. Although it is common to pay for tree felling and removal on a per feddan basis, the activities were separated for the purpose of determining daily wage rates. Clearing of underbrush, grass and weeds is counted for each planting.

The cost and amount of labor used for tree felling and clearing depends on the size and density of trees in the selected area. Site selection depends on a number of factors, including proximity to homes and water sources, perceived fertility of land, and land tenure arrangements. Land is often owned by the community, and a farmer's social status in the community contributes to the level of access and power in negotiation for land..

Table 3. Greater Equatoria land clearing, preparation and maize planting costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Tree clearing *	\$ 37.93	7	\$ 41.59	\$ 5.69
Cutting/hauling*	\$ 16.35	2	\$ 17.59	\$ 7.12
Clearing	\$ 50.69	28	\$ 64.58	\$ 2.32
Digging	\$ 112.79	34	\$ 129.62	\$ 3.85
Planting	\$ 87.51	19	\$ 96.94	\$ 5.14
Total	\$ 305.27	90	\$ 350.31	\$ 3.89

*Maize is cultivated six times in the same plot on average. Costs and labor totals associated with tree clearing were divided by six to distribute costs evenly across each harvest.

Digging and Planting

“Digging” represents plowing or turning of the soil by hand with a shovel. Planting is done in teams of three or four. Twine is tied off lengthwise on a feddan (70m X 60m) to make a straight row. One person leads and uses a stick to make holes in the ground. Another follows and places seed in the hole. Sometimes the planter covers the seed, and sometimes another person follows and covers the seed. Reported seed rates vary, with some reporting a single seed per station, and others reported 3-4 seeds per station. Of the fields observed, most appeared to be spaced more closely than the optimal single seed per station at a spacing of 20 to 25 cm. None of the farmers surveyed reported thinning of maize in instances where more than a single seed per station germinated. Longe 5 is the most common variety of seed for maize cultivation, with a growing period of about 90 days.

The average number of person labor days required per growing season for clearing, land preparation and planting is 90 days. Total cost is \$350.31, giving a calculated daily wage rate of almost \$3.89. Digging represents the largest component of total costs and labor. Cutting and hauling of trees demands a higher wage rate, and the task tends to be reserved for stronger, harder workers.

Table 4. Western Equatoria land clearing, preparation and maize planting costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Tree clearing *	\$ 30.44	7	\$ 34.04	\$ 4.73
Cutting/hauling*	\$ 12.14	2	\$ 12.96	\$ 7.87
Clearing	\$ 37.79	25	\$ 50.14	\$ 2.03
Digging	\$ 115.32	33	\$ 131.68	\$ 4.02
Planting	\$ 96.46	20	\$ 106.27	\$ 5.42
Total	\$ 292.15	86	\$ 335.09	\$ 3.90

*Maize is cultivated six times in the same plot on average. Costs and labor totals associated with tree clearing were divided by six to distribute costs evenly across each harvest.

Table 5. Central Equatoria land clearing, preparation and maize planting costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Tree clearing	\$ 45.42	7	\$ 49.13	\$ 6.63
Cutting/hauling	\$ 20.56	3	\$ 22.21	\$ 6.74
Clearing	\$ 63.59	31	\$ 79.03	\$ 2.56
Digging	\$ 110.26	35	\$ 127.55	\$ 3.69
Planting	\$ 78.55	18	\$ 87.61	\$ 4.84
Total	\$ 318.39	94	\$ 365.53	\$ 3.88

*Maize is cultivated six times in the same plot on average. Costs and labor totals associated with tree clearing were divided by six to distribute costs evenly across each harvest.

Total costs are slightly higher in Central Equatoria than in Western equatorial, due to higher land clearing costs. Tree felling and clearing costs are greater due to larger trees and more dense underbrush for clearing among the farmers surveyed. Digging and planting costs are slightly lower in Central Equatoria.

Weeding

Weeding costs account for roughly 18% of total maize production cost in the Greater Equatoria region. Competing grasses are a big problem, and contribute to low yields by competing for moisture and soil nutrients. The first weeding occurs at 2 to 3 weeks after germination. Then second weeding takes place about 4 weeks after the first.

Table 6. Greater Equatoria maize weeding costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
1st Weeding	\$ 65.80	23	\$ 77.51	\$ 3.31
2nd weeding	\$ 50.84	16	\$ 58.82	\$ 3.69
Total	\$ 116.65	39	\$ 136.33	\$ 3.46

Total weeding costs are about \$142/ha. The first weeding is generally more expensive, as many grasses and weeds germinate and proliferate. Even though the second weeding costs about 25% less than the first, the job is less intense the second time, and the fewer labor days required results in a higher calculated daily wage rate. The average calculated daily wage rate for weeding is \$3.28/day.

Table 7. Western Equatoria maize weeding costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
1st Weeding	\$ 75.71	26	\$ 88.84	\$ 3.64
2nd weeding	\$ 54.92	18	\$ 63.87	\$ 3.82
Total	\$ 130.63	44	\$ 152.71	\$ 3.46

Table 8. Central Equatoria maize weeding costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
1st Weeding	\$ 55.90	21	\$ 66.19	\$ 3.47
2nd weeding	\$ 46.77	14	\$ 53.76	\$ 4.09
Total	\$ 102.66	35	\$ 119.95	\$ 3.47

In contrast to land clearing costs, weeding costs are higher in Western Equatoria than Central Equatoria. This may be because clearing is more thorough in Central Equatoria and including more weed removal, making later weeding activities less intensive.

Harvest/Postharvest Handling

Harvesting by hand involves twisting the ears from the stalks, and carrying heavy sacks of maize. This is difficult work, and commands higher pay than other less intense tasks. Total costs for harvesting is about \$82.50 per hectare, resulting in a calculated daily wage rate of almost \$5.

Table 9. Greater Equatoria maize harvest/postharvest handling costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Harvest	\$ 74.16	16	\$ 82.08	\$ 5.18
Drying	\$ 28.20	26	\$ 41.17	\$ 1.59
shucking	\$ 37.46	16	\$ 45.49	\$ 2.83
Transport	\$ 64.24	6	\$ 67.02	\$ 12.06
Storage/bagging	\$ 33.58	7	\$ 37.28	\$ 5.03
Total	\$ 237.63	71	\$ 273.03	\$ 3.86

Much of the postharvest activities are undertaken by family members. Drying is an important part of the postharvest process. It is done in cribs or on tarpaulins, and should be dried to less than 13% moisture content to meet WFP standards and reduce the risk of spoilage. Constant oversight during drying is required, to protect the maize from pests and atmospheric moisture. It requires an average of 26 person days of labor, at a rate of about \$1.50/day due to the low intensity of the work. Shucking and bagging are also often family activities, and sometimes hypothetical figures were provided on how much a farmer would be willing to pay.

Table 10. Western Equatoria maize harvest/postharvest handling costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Harvest	\$ 77.45	18	\$ 86.51	\$ 4.78
Drying	\$ 25.43	25	\$ 37.78	\$ 1.53
shucking	\$ 37.76	15	\$ 45.17	\$ 3.05
Transport	\$ 71.17	6	\$ 74.25	\$ 12.02
Storage/bagging	\$ 31.84	10	\$ 36.78	\$ 3.72
Total	\$ 243.65	74	\$ 280.49	\$ 3.81

Table 11. Central Equatoria maize harvest/postharvest handling costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Harvest	\$ 70.86	14	\$ 77.66	\$ 5.72
Drying	\$ 30.97	27	\$ 44.56	\$ 1.64
shucking	\$ 37.17	17	\$ 45.81	\$ 2.65
Transport	\$ 57.31	5	\$ 59.78	\$ 12.10
Storage/bagging	\$ 35.31	5	\$ 37.78	\$ 7.65
Total	\$ 231.62	68	\$ 265.58	\$ 3.91

Transportation

Transportation is expensive due to poor road conditions, and empty vehicles often have difficulty passing. Vehicles carrying loads quickly fall into disrepair, and finding replacement parts is a costly process, if possible at all. This cost is often the difference in willingness to sell maize in the market rather than save for home consumption.

Poor roads and access to markets are common in all areas of the country. This can cause markets to be isolated, and this may provide opportunities for P4P to create market incentives in areas that do not produce marketable surpluses at the state level, but do have marketable surpluses at the local level.

Storage

Lack of adequate drying and storage facilities is a common problem in both Central and Western Equatoria. According to the African Post Harvest Losses Information System (APHLIS), postharvest loss averaged 22.4% in Africa in 2008⁵. The provision of storage facilities is an opportunity to increase value and profitability for producers, while leveraging the benefits of other donor activities such as technical assistance, demonstration plots, provision of inputs, etc.

Total Costs and Returns

Aggregate data on production costs and returns are presented in Tables 12 – 15 below.

Table 12. Greater Equatoria total maize production costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Clear, prep, plant	\$ 305.27	90	\$ 350.31	\$ 3.89
Weeding	\$ 116.65	39	\$ 136.33	\$ 3.46
Harvest/postharvest	\$ 237.63	71	\$ 273.03	\$ 3.86
Total Cost	\$ 659.55	200	\$ 759.68	\$ 3.79

Total costs for Greater Equatoria are about \$760 per hectare. Clearing, land preparation and planting costs are about \$360, or about 48% of the total. Weeding costs are about \$135 per hectare, and represent about 18% of total costs. Harvest and postharvest handling costs are about \$273 per hectare, and account for about 34% of total production costs.

Table 13. Western Equatoria total maize production costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Clear, prep, plant	\$ 292.15	86	\$ 335.09	\$ 3.90
Weeding	\$ 130.63	44	\$ 152.71	\$ 3.46
Harvest/postharvest	<u>\$ 243.65</u>	<u>74</u>	<u>\$ 280.49</u>	<u>\$ 3.81</u>
Total Cost	\$ 666.43	204	\$ 768.29	\$ 3.77

Table 14. Central Equatoria total maize production costs. South Sudan, 2011.

	Labor Cost (\$/Ha)	Av Labor Days/Ha	Total Cost w/Meals (\$/Ha)	Imputed Wage Rate (\$/day)
Clear, prep, plant	\$ 318.39	94	\$ 365.53	\$ 3.88
Weeding	\$ 102.66	35	\$ 119.95	\$ 3.47
Harvest/postharvest	<u>\$ 231.62</u>	<u>68</u>	<u>\$ 265.58</u>	<u>\$ 3.91</u>
Total Cost	\$ 652.67	197	\$ 751.06	\$ 3.82

The differences in average labor costs, person days of labor, and imputed wage rates in Central and Western Equatoria are small. Production systems and conditions are similar, and the consistency among the data provides confidence in the accuracy of the data.

Table 15. Greater Equatoria maize costs and returns. South Sudan, 2011.

	WE	CE	AV
Yield (mt/ha)	1.9	1.8	1.8
Price (\$/mt)	\$ 382.69	\$ 391.67	\$ 387.18
Gross Returns (\$/ha)	\$ 721.72	\$ 708.03	\$ 715.05
Total Cost (\$/ha)	\$ 768.29	\$ 751.06	\$ 759.68
Net Returns (\$/ha)	\$ (46.58)	\$ (43.03)	\$ (44.63)
Net Returns (\$/mt)	\$ (24.70)	\$ (23.80)	\$ (24.16)

Despite relatively high yields in the area of study, net returns were negative when accounting for family labor and meals for laborers. These costs are substantial and affect producer decisions to expand production, hire additional labor and invest in new technology. For the producers surveyed, an average loss of about \$45 per hectare is incurred under current conditions. Producers lose about \$24/metric ton when all costs are accounted for.

For subsistence farmers, the absolute value of losses are lower due to smaller plot sizes and less total labor requirements, but total losses would be greater when aggregated to the per hectare level because of lack of economies of scale.

Comparison with Other Data

In February and March of 2011, the World Bank conducted a similar study. Although the number of observations specifically for maize production in Greater Equatoria was smaller than the number in this study, and different assumptions and data collection methods were followed, the numbers are comparable.

The main differences in assumptions and methodologies are:

- Accounting for family labor – WB accounted for family labor at 67% of hired labor costs. This study assumes family labor to be 100% of hired labor cost, as it represents the opportunity cost of working for wages on another farm.
- Meals for workers – inclusion of meals for laborers is expected. This study uses a conservative estimate of \$0.50/day/worker based on interviews in the field, and the actual cost could easily be higher.

Table 16. Comparison with Recently Collected Data and Analysis. South Sudan, 2011.

	P4P			World Bank*		
	Total Cost	Labor days	Daily Wage Rate	Total Cost	Labor days	Daily Wage Rate
Total Clearing	\$ 350.31	71	\$ 4.92	\$ 148.19	29	\$ 5.17
Digging/Tilling	\$ 129.62	34	\$ 3.85	\$ 275.04	53	\$ 5.17
Planting	\$ 96.94	19	\$ 5.14	\$ 27.50	5	\$ 5.17
Total Weeding	\$ 136.33	39	\$ 3.46	\$ 165.02	32	\$ 5.17
Harvest	\$ 82.08	16	\$ 5.18	\$ 165.02	32	\$ 5.17
Postharvest	<u>\$ 190.95</u>	<u>55</u>	\$ 3.47	<u>\$ 137.11</u>	<u>27</u>	\$ 5.17
Total	\$ 986.23	234	\$ 4.22	\$ 917.88	178	\$5.17

There are differences in clearing costs and tilling costs between the studies. Given that the aggregates are similar, this could be due to differences in data collection methodology. The main difference in data collected by World Bank and those from P4P is the wage rate and total costs. In this paper, costs were reported on a per task basis, and estimates of time spent on each task were used to determine an effective wage rate for each task. In the World Bank study, daily wage rates for different states were provided, and the methodology for estimation of the rate was not provided.

Conclusions and Recommendations

- When fully accounting for paid labor, family labor and meals, producers in the areas surveyed lose about \$45 per hectare. This loss may not be fully understood by farmers because fields are small and provide food security insurance, and unpaid family labor often accounts for the bulk of the costs. Family labor should be fully accounted for in production cost analysis, because it represents the opportunity cost of a family member working on a neighboring farm. Producers realize this -- even if unconsciously -- and it serves as a disincentive for investment in improved technology for increasing production.
- Labor is typically paid on a per task basis. This makes cost of production analysis straight forward, and labor valuation and analysis sometimes complex. Time worked and intensity of work from laborer to laborer varies greatly. The calculated wage rate for the Greater Equatoria

region is \$3.86 per day. This figure is high relative to neighboring countries. Central and Western Equatoria have similar production costs and wage rates. Western Equatoria should be given priority in targeting for P4P purchases, as it is the only state in Southern Sudan that produces a marketable surplus at the state level.

- Postharvest losses significantly affect the value of output for producers. The provision of storage facilities by P4P represents an opportunity to add value and increase profitability for producers, while leveraging the benefits of other supply side donor activities such as technical assistance, demonstration plots, provision of inputs, etc. Obtaining support from local agricultural ministries and farmer associations, and collaboration with other donor activities and implementers is critical for success and important for optimizing the value of warehouses.
- Transport costs account for about 25% of harvest and postharvest handling costs, and about 9% of total production and marketing costs on average. Roads are poor, and many areas are not accessible to any type of commercial transport. Frequent breakdowns and need for continual maintenance and upkeep contribute to high transport costs. Poor road networks and high transport costs effectively segment the markets. This means there may be local marketable surpluses in areas where there is no marketable surplus at the state level. This creates a situation where P4P could incentivize production through minimum price contracts, but only if able to subsidize the high transport costs that created the situation to begin with.
- The ox plow is an appropriate technology to investigate, as they were reportedly widely used in other states of South Sudan. They are mechanically appropriate for the sticky vertisol soil, easy to maintain and repair, and the draft power derived from animal feed is more reliable than petrol and diesel fuel under current conditions. More data collection and analysis is needed to determine the ultimate feasibility of actively increasing ox plow utilization.

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Appendix A – Other Thoughts

The following are some additional observations made during the study in Juba. They are outside the original scope of work, and solely represent the opinion of the author based on discussions and observations while in the field.

Minimum Price Contracts

Minimum price contracts were consistently sought by farmers, even in areas where farm level surplus were easily cleared in the market and there were no local level marketable surpluses. The guarantee of a buyer for maize incentivizes increased cultivation and investment in increasing production. Minimum price contracts can be structured to pose nominal risks to WFP, and the upside potential for increased production is great, particularly over the medium and long term. P4P has approval for executing minimum price contracts, and will likely have contracts with farmers in place at the time of publication.

Measuring Impacts

The success of P4P should be measured based on increased production rather than volumes purchased. The FAO/WFP Crop and Food Security Assessment Mission to Southern Sudan, conducted annually in January, provides adequate estimates of acreage, yields and outputs for P4P monitoring concerns.

P4P could be most successful by enabling increased local production capacity, without purchasing a great deal of maize. Increased production shifts the supply curve to the right, decreasing consumer prices. P4P purchases shift the demand curve to the left, increasing local consumer food prices.

Media Campaign

To avoid misinformation and promote P4P as an agent to drive increased production, local radio commercials could be used. Rumors have been heard that P4P will be paying large premiums in purchasing maize. For projects charged with increasing agricultural production, it is in their interests to spread such misinformation.

There is an FM radio station in each of the major market centers. Radio commercials are valuable tools for advertising P4P contracts to farmers, while alleviating some possibilities for misinformation about commodity purchases and prices.

Warehouses

As mentioned in the body of the text, the provision of proper drying and storage facilities would decrease postharvest losses, increase profitability for producers, and leverage the supply-side activities of other donors and implementers. P4P has discussed locations for warehouses with a range of

stakeholders, and partners for managing and leveraging the facility along with complementary activities have been identified.

Purchasing posts

Implementing partners could identify areas with marketable surpluses, and establish collection points where they buy from farmers and aid in transport to larger markets. Farmers are paid on the spot, and IPs are paid to transport product to regional warehouse facility.

Timeliness of payments to farmers

The ability to make payments upon receipt of product is essential to the success of P4P as a driver for increased production. Untimely payments discredit WFP/P4P, and create distrust between farmers and the development community. Money has an associated time value, so farmers will prefer to sell at a discount to P4P prices in order to get cash upon delivery.

Implementing Partners

The lack of capable implementing partners in remote areas is a challenge. Capable organizations mostly have other donor obligations and priorities. A possible solution is planning and coordination at the donor level -- not the project or organization level -- so that the mandate for collaboration is a priority driven down to projects from the donors.