

## **Liberia Rice Production Cost Analysis**

**Prepared by  
Andy Hale, Trent McKnight and Piyasena Abeygunawardena  
The Borlaug Institute for International Agriculture  
Texas A&M University System**

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## Executive Summary

The prolonged conflict displaced farmers, destroyed infrastructure, and devastated the agricultural value chain. Most paddy farmers live at a subsistence level, with little surplus available for sale in the markets. Liberia is one of twenty-one pilot nations chosen for the World Food Program's (WFP) Purchase for Progress (P4P). According to WFP, the purpose of P4P is "to transform the way the WFP purchases food in developing countries, giving small-scale farmers access to reliable markets and the opportunity to sell their surplus at competitive prices." In its current year, Liberia P4P contracted 800 mt of clean, parboiled rice from five cooperatives in Nimba, Bong and Lofa Counties. The rice is distributed under the Girls Take-Home Ration Program, which targets girls in the 4th-6th grades at schools where the gender gap is at least 15%.

The objective of this study is to identify and measure average costs of production for paddy purchased by the WFP under P4P in Liberia, compare it with the local market prices, and estimate breakeven prices for farmers under different ecosystems, inclusive of labor. To undertake this study, a team of three agricultural scientists from the Borlaug Institute spent 42 person-days in the field. Data was collected in Nimba, Bong and Lofa Counties during the months of February and March 2011. The team interviewed 103 farmers of which 60% were men and 40% were women. Of the total surveys conducted, 83 were included in the final database. Farmers cultivate two paddy ecologies: upland and lowland. Forty-nine surveys studied lowland farms and thirty-four studied upland farms.

Data were collected on three different paddy production systems: (i) traditional lowland; (ii) lowland with inputs such as improved seed, fertilizer, herbicide/pesticide, power tillers; and (iii) traditional upland. The following tables show the costs and profit/loss by production system and wage rate.

**Table 1. Labor person days and costs on Liberian rice farms, 2011.**

<b>Costs by Daily Wage Rate</b>	<b>Non-Labor Inputs</b>	<b>Labor Days</b>	<b>Labor Cost</b>	<b>Total Cost per Ha.</b>
<b><i>Traditional Lowland</i></b>				
<b>\$1</b>	\$20	170	\$170	\$190
<b>\$2</b>	\$20	170	\$340	\$360
<b>\$3</b>	\$20	170	\$510	\$530
<b><i>Lowland w/ Inputs</i></b>				
<b>\$1</b>	\$122	126	\$126	\$248
<b>\$2</b>	\$122	126	\$252	\$374
<b>\$3</b>	\$122	126	\$378	\$500
<b><i>Traditional Upland</i></b>				
<b>\$1</b>	\$20	158	\$158	\$178
<b>\$2</b>	\$20	158	\$316	\$336
<b>\$3</b>	\$20	158	\$474	\$494

**Table 2. Yield and profitability of Liberian rice farms, 2011.**

<b>Profit/Loss by Daily Wage Rate</b>	<b>Yield (MT/Ha)</b>	<b>Revenue*</b>	<b>Total Cost</b>	<b>Profit/Loss per Ha.</b>
<b><i>Traditional Lowland</i></b>				
<b>\$1</b>	1.1	\$374	\$190	\$184
<b>\$2</b>	1.1	\$374	\$360	\$14
<b>\$3</b>	1.1	\$374	\$530	(\$156)
<b><i>Lowland w/ Inputs</i></b>				
<b>\$1</b>	1.1	\$374	\$248	\$126
<b>\$2</b>	1.1	\$374	\$374	\$0
<b>\$3</b>	1.1	\$374	\$500	(\$126)
<b><i>Traditional Upland</i></b>				
<b>\$1</b>	0.9	\$306	\$178	\$128
<b>\$2</b>	0.9	\$306	\$336	(\$30)
<b>\$3</b>	0.9	\$306	\$494	(\$188)

*\*Based on WFP's price of \$17/50KG of Paddy Rice*

1. The value of rural labor, in particular, family labor is the most critical cost consideration in setting a profitable price for paddy. Labor represents 88% of total production costs for lowland farmers and 98% of upland farmers. Many farmers use family or exchanged labor through a traditional method called the Kuu System. Contract labor and mechanization are used, but rarely. Though varying by location, the most common daily-wage rate, inclusive of in-kind wages such as food, is about \$3 per day.
2. There is little use of material inputs including fertilizer, herbicide or pesticide. Almost 100% of all fertilizer or pesticide used by farmers was given by the FAO or NGOs. It appears there are major gains to be tapped through high quality inputs usage. Credit was informal and used by approximately one-third of the sample population. Interest rates varied widely, but averaged about 30% per annum. Credit was used for seed purchase or paying for labor. There was no network of formal lending institutions in rural areas.
3. Transportation costs, due to poor and limited transport fleets, poor road networks, non-availability of electric power, and lack of storage facilities, are high. This exacerbates problems of post-harvest loss, quality deterioration, and timely market availability. Because of the limited accessibility of marketing support, WFP subsidizes transport of paddy rice from the farm to the cooperative.
4. Most farmers do not produce in excess of household consumption. This causes reluctance by farmers to sell in the market. Paddy sold to the coops was reportedly in support of the coop and community, as well as in return for the provision of inputs. Farmers also sold rice for cash, often at a discount in return for prompt payment.
5. Purchase For Progress should be viewed as one component to a larger, collaborative, smallholder-rice development project. P4P provides the market for processed rice and other

national and international organizations to lend technical, financial or cooperative assistance. Organizations include FAO, UNDP, and the EU in addition to numerous NGOs. In several cooperatives, the Ministry of Agriculture (MoA) and Cooperative Development Agency (CDA) have designated a full or part-time staff person to assist the farmers and cooperative in general training and management. The Ministry of Gender (MoG) is very involved within the women's cooperatives. This collaboration is essential to the success of P4P; and P4P is essential to the success of various collaborative rural development projects.

6. Liberia P4P rice is parboiled. Based on contractual prices from WFP, processing adds approximately \$100 of value per MT to the end product. This processing includes parboiling, milling and bagging rice.

7. Our observations are fully consistent with Liberia's good record on gender equality. Women work in the field, farm, offices or school in a comparable manner with men. They play a vital role in household chores. During the survey we did not find a major wage difference between men and women.

We recommend a three-pronged paddy sector development strategy for the country: (1) Introduce high quality seed, inputs and technical training at the farm level. This is essential and must be coupled with agricultural extension and technical training in order to bolster production capacity. (2) Build local level infrastructure such as wells and irrigation systems, and farm to market roads. These will collectively enable rice production on a larger scale. P4P is undertaking the important task of subsidizing transport of the products to market. Coops are vitally important in harnessing collective behavior of rural farmers, allowing for sharing of best practices. These types of intervention are necessary to optimize farm level technology improvements and training. (3) Create an enabling policy environment for increased rice production, a responsibility of GoL. Tariffs on rice imports are politically unpopular and unfeasible in the current production context. As national production increases, GoL must protect its farmers by ensuring a fair market price for local production through market-based interventions. Major transport and power infrastructure are also needed.

## **Background**

Liberia is Africa's oldest independent democratic republic. Settled in 1822 by freed American slaves, it declared independence in 1847. Seventeen ethnicities make up social the fabric of this diverse country, but the 5% Americo-Liberian minority has historically maintained political power. Roughly the geographic size of Tennessee, the country is divided into fifteen counties, which are further divided into districts. The capital, Monrovia, is the largest city with a population of one million out of the nation's 3.5 million. In April 1979, massive demonstrations began in Monrovia to protest the rise in price of a bag of rice. The "rice riots" became violent and resulted in the loss of civilian life. These riots sparked a military-led coup in 1980, which ultimately resulted in two civil wars and the loss of several hundred thousand lives. The civil war, which ended in 2003, displaced many people, discouraged investment, and destroyed infrastructure and agricultural systems.

## Agriculture

Approximately 70% of Liberia's labor force is in agriculture, and agriculture represents 77% of GDP. Rice and cassava are the main staple foods grown, while rubber, oil palm and cocoa remain the country's main export crops. Rice is the country's most important crop with per capita consumption around 53 kilograms (kg) per year. Most domestic production is consumed by the farmers who produce it, with little surplus being sold in the markets. Liberians prefer parboiled rice, and most imported rice is parboiled. Long-grain rice is imported from the United States. It is the highest quality and most expensive. Most rice is imported from China, India, Thailand, Vietnam, Pakistan, EU and Brazil. Though domestic production waned during the war, it is estimated that 71% of farmers grow rice. The following chart illustrates rice supply and demand trends over the previous twenty years<sup>1</sup>.

**Table 3: Main statistics related to rice production and consumption in Liberia from 1990 to 2007-08.**

	1990	2000	2002	2004	2005-06	2006-07	2007-08
<b>Area (1000 ha)</b>	175	143	120	120	110	152	190
<b>Production (1000 MT)</b>	180	183	110	110	100	144	170
<b>Average Yield (MT/Ha)</b>	1.03	1.28	0.92	0.92	0.87	0.90	0.90
<b>Consumption (1000 MT)</b>	-	-	-	300	310	320	332
<b>Assistance (1000 MT)</b>	-	-	-	100	74	22	20
<b>Import (1000 MT)</b>	70	100	100	120	160	154	140
<b>Value US\$ million</b>	25	37	20	22	140	170	200*

Ministry of Agriculture of Liberia. "Liberia National Rice Development Strategy." Liberia: Ministry of Agriculture, February 2009 (based on 2001 and 2008 crop surveys). As published by USAID. "Global Food Security Review Liberia Rice Study." August, 2009. \*The rise in price in 2007-08 is due largely to global food price increases.

Farmers use two predominant methods for growing rice: upland and lowland. Upland farmers select a new area each year using laborious slash and burn methods to clear the area. After the rice season, many farmers plant cassava, bananas, coffee or other cash crops for subsequent seasons; but they will select a new farm for rice. Traditional lowland, or swamp, farmers use similar slash and burn methods to "make" a farm each year; however, some have been trained in bund/irrigation construction and are beginning to continue farming the same lowland area for multiple years.

### Rice Production During and Post-Conflict

Fourteen years of civil war destroyed rice production infrastructure. Approximately 86% of Liberian households were displaced because of the war. Farms were abandoned and farmers fled into the bush or neighboring countries for safety. It has taken several years for farmers to return to their farms, and the redevelopment of value-chain will take longer. The Central Agriculture Research Institute (CARI), Liberia's only government-owned agricultural research entity, was completely destroyed during the war. The CARI served as the base for three successive warring factions and a home to approximately 100,000 refugees during the crisis. One of UNMIL's (United Nations Mission in Liberia) sector commands continues to occupy 95% of usable structures, continuing to limit pre-war levels of productivity and effectiveness. CARI performs production test plots and develops improved seed varieties for rice and

other crops. As a result of CARI's limited abilities after the war, no rice certified seed supply existed until recently. With the help of international partners, the Ministry of Agriculture (MoA) has restarted its seed certification system, but there is still no service for ensuring seed quality standards.

During the 1970s, the GoL administered the Liberian Marketing Corporation to procure local rice for domestic markets. The Corporation soon closed after the coup in 1980 and has yet to be resurrected with no national rice marketing initiative performing its function. The MoA Extension Service is inadequate and reaches few farmers—a necessary function to train a postwar agrarian labor force.

In addition to limited improved inputs and education, one of the greatest challenges to agriculture within Liberia is logistics. Of the 1800 km of primary roads in Liberia, only 561 km are paved. Because roads have received little attention over the past two decades of war, they are in extreme disrepair. Many secondary and tertiary roads have reverted back to jungle, limiting farmers' access to markets. There are an estimated 20-30 trucking companies in Liberia with a total capacity of less than 2000 MT. Trucks are imported, typically used vehicles with an average age of 8-10 years.

### **World Food Program & Purchase for Progress**

The United Nations World Food Program (WFP) imports Bulgur Wheat for three food assistance programs in Liberia: 1.) School Meal Program, 2.) Nutrition Program, and 3.) Livelihood, Asset, and Rehabilitation (Food for Recovery) Program. In cooperation with the MoA and the Ministry of Gender (MoG), WFP also has two strategic roles within agricultural development in Liberia. First, WFP supports small-scale farmers in rice production. Second, it develops marketing infrastructure with farmer programs and farmer unions. These development roles are fused together through the five-year pilot project, Purchase for Progress (P4P).

The purpose of P4P is “to transform the way the World Food Programme (WFP) purchases food in developing countries, giving small-scale farmers access to reliable markets and the opportunity to sell their surplus at competitive prices” (World Food Programme, n.d.).

Purchase for Progress should be viewed as one component to a larger, smallholder-rice development project. P4P provides the market for processed rice while other national and international organizations lend technical, financial or cooperative (institutional) assistance. Kokoya Multipurpose Farmers' Cooperative in Botota, Bong County is one example. WFP contracts 200 MT of rice from the cooperative. They also provide a storage tent, parboiling equipment and logistical support to transport paddy from the farm to the cooperative. UNDP is in the process of building “drying floors” and digging a well for processing. FAO and the EU provided a thresher, miller, power-tiller, improved seed and fertilizer. FAO, an NGO, and a local farmer organization trained forty women and ten men of the Coop to process and parboil rice. Other cooperatives and communities where WFP is purchasing rice cited technical assistance from government and non-government organizations including Alliance for a Green Revolution in Africa (AGRA), Catholic Relief Services (CRS), Visions in Action, Greenstar, USAID, Irish Aide, and others. In several cooperatives, the Ministry of Agriculture (MoA) and Cooperative Development Agency (CDA) have designated a full or part-time staff person to assist the farmers and cooperative in bookkeeping, agricultural and processing training and supervision, elections, and general cooperative management. The MoG is very involved with women's cooperatives and provides assistance to them in both technical and educational ways that empower women. A P4P tripartite agreement among FAO, MoA and WFP was signed in March 2009. This collaboration is essential to the success of P4P; and P4P is essential to the success of the collaborative development project.

**Figure 1: P4P Assisted Areas in Liberia**



Source: World Food Programme. (2010, September). Liberia: Purchase For Progress. United Nations.

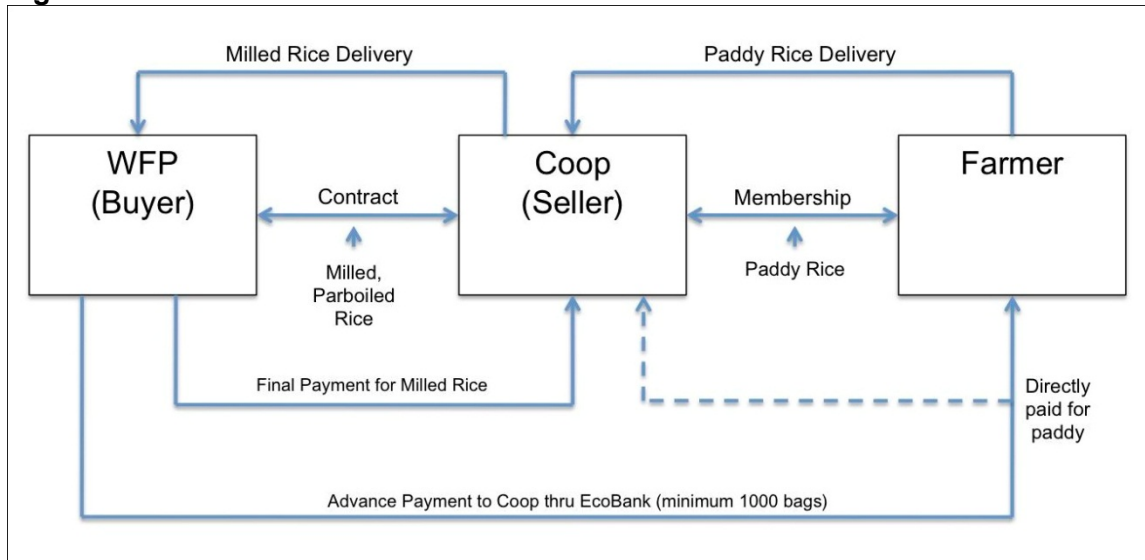
Liberia P4P currently purchases rice in the three “rice bowl” counties: Lofa, Bong and Nimba. These counties are not necessarily the most productive, but they are the most accessible. P4P has conducted an assessment in Gbarpolu County and there are plans to assess Grand Gedeh County for future contracts. They currently have five contracts with seven more planned for the future.

**Table 4: Liberia P4P Current and Planned Contracts**

Cooperative	Current Contract	Planned Contract	Quantity (Milled Rice in MT)
<b>Nimba County</b>			
Dokodan Famers Coop	Yes		200
Gbelay-Geh Rural Women's Structure		Yes	75
<b>Bong County</b>			
Kokoyah Farmers Coop	Yes		200
Palala Rural Women's Structure		Yes	75
Welekamah Rural Women's Structure		Yes	50
<b>Lofa County</b>			
Intofawor Farmers Coop	Yes		200
Voinjama Farmers Coop	Yes		100
Gboni Farmers Coop	Yes		100
Fissebu Rural Women's Structure		Yes	75
Kolahun Rural Women's Structure		Yes	50
<b>Gbarpolu County</b>			
Gbonkuma Women's Group		Yes	75
Dakaitee Women's Group		Yes	75

In its current year, P4P contracted 800 MT of clean, parboiled rice. Because farmers have no money for delivery, P4P collects paddy from the farmer and delivers it to the cooperative processing facility. Rice is weighed in kilograms (kg), and farmers are given a ticket. (Empty 50 kg bags are distributed to farmers from P4P with which to bag paddy rice.) P4P pays EcoBank, which takes the money to the cooperative and pays the farmer according to his/her ticket. Farmers receive payment after the cooperative has 1000 25 kg bags of parboiled, milled rice ready for delivery. This occasionally causes a delay in farmer payment of up to one month from delivery. The following flow-chart, provided by Liberia P4P, illustrates the contractual obligations and flow of money.

**Figure 2: Liberia P4P Rice Procurement Process**



Processed rice is distributed for WFP’s Girls Take-Home Ration Program, which targets girls in the 4th-6th grades at schools where the gender gap is at least 15%.

**Objective**

The objective of this study is to identify and measure average costs of production for paddy purchased by the WFP under P4P in Liberia, compare it with the local market prices and import parity price, and estimate breakeven prices for farmers in different eco-systems under likely scenarios, inclusive of labor.

**Methodology**

This study was conducted in February and March, 2011. A total of forty-two person days were spent in the field, with 103 farmers individually surveyed in the counties of Lofa, Nimba and Bong, Liberia. Sixty-one of the farmers were male, with an average of twenty-three years farming experience. Forty-one male farmers were coop members, and twenty were not. Forty-two of the farmers were female, averaging sixteen years of farming experience. Twenty-five female farmers were coop members, and seventeen were not. The average household size for male farmers was ten, and average household size for female farmers was eleven.



**Table 5: Summary of Farmers Surveyed**

Summary of Farmers Surveyed				
	Count	Years Farming	Household size	Coop Members
Male	61	23	10	41 of 61
Female	42	16	11	25 of 42

Upon arrival in Monrovia, the team consulted with P4P staff and other WFP stakeholders in order to establish a baseline understanding of P4P, its working arrangements and the current context. A survey form was developed to be administered as a participatory rapid rural appraisal for rice production in the target areas of Liberia. The team then went on a two-day mission to assess the completeness and relevance of the survey. Revisions were made to the draft survey form, and then a three-person team spent two weeks surveying rice farmers and the rice production landscape.

Upon completion of field data collection, a comprehensive database detailing regional rice production enterprise budgets was developed, and survey data was entered into the database. Of the total surveys conducted, eighty-three were included in the final database. Those included thirty-four upland farms and forty-nine lowland farms surveyed. In some remote areas, subsistence rice producers were unable to detail input cost estimates, so only qualitative data were used from those surveys. These data were compared to other sources for relevant information as an initial quality-check measure.

An out-briefing was held with P4P and WFP stakeholders, including the country director, in Monrovia in order to share preliminary findings. The team then returned to the Borlaug Institute to complete comprehensive data analysis and prepare the final report with findings and alternatives.

## **Analysis, Results and Discussion**

### **Data**

An inherent data bias exists, as farmers who were unable to quantify the amount of seed planted or amount harvested, in any terms, were excluded from the database. Although the scale of these operations is small, they represent roughly 20% of the farmers surveyed, and qualitative data from these surveys were taken into account in the analysis. The disparity in technical knowledge between coop members and non-coop members was great. In almost every case, coop members had a strong grasp of both capital and labor inputs. Non-coop members were unlikely to spend any cash on inputs aside from labor, and the figures provided by them about their operations were often tenuous.

### **Labor Inputs**

An important element of rice production analysis is labor valuation. Labor accounted for 88% of total production costs for lowland farmers surveyed, and 98% of upland farmers surveyed, on average. Most farmers spend little or no cash on inputs for rice production, except wages for laborers. The average reported wage rate was 150LD (Liberian Dollars)/day. In addition to cash daily wages, workers also

receive meals. Meals were calculated and reported to be about 50LD/person/day, so a starting wage rate of 200LD/person/day was used for the primary analysis. This amounts to approximately \$3 per day.

Sensitivity analysis has been done on different wage rates. Changing wage rates greatly impacts the breakeven price to farmers for a bag of paddy rice. The reported average wage rate for Liberia is about \$1/day, derived by dividing per capita annual income of \$228 by number of working days per year<sup>1</sup>. This is a crude estimate only. Farmers surveyed consistently reported the wage rate that they pay to be about \$3/day, including food.

### Farm Size

Upland farms are typically not symmetrical, and area estimates by farmers for the same plots varied greatly. Many farmers were unable to provide acreage estimates, and reported numbers were often proven inaccurate after field surveys. Farmers were much better able to detail the amount of seed planted, and therefore this analysis focuses on costs and returns per unit of seed planted. We assume 50kg of seed rice to be planted on one hectare, so any estimates given on a per-hectare basis were derived with this in mind.

### Land Preparation

Land preparation requires the largest labor component in terms for person-days for both upland and lowland production. “Brushing” is the process of initial clearing of vines, shrubs and trees from the land. Site visits verified brushing to be a very labor intensive process, done by teams of workers with machetes, or “cutlasses.” In upland production, new plots are cleared for rice production each year. In subsequent years, the cleared areas are used for planting of cassava, peppers, vegetables or other crops.

**Table 6: Land Preparation Labor Summary**

Land Preparation						
<i>Ave person-days labor per 50 kg seed planted (Ha)</i>						
	Lowland			Upland		
	Borlaug	stdev	USAID	Borlaug	stdev	USAID
Brushing	28	19	15.0	25	14	25
Tree Felling	0		5.0	13	10	10
Burning/Clearing	0		2.0	20	17	17
Tilling	22	23	40.0	0		0
Puddling	16	14	18.0	0		0
TOTAL	66		80	58		52

Proper fertilization of the soil would likely increase productivity and allow upland producers to grow rice more than one season on a piece of land. This would reduce labor costs, and have positive environmental impacts due to reductions in forest clearing.

Lowland production requires labor for tilling, or turning the soil, as well as pulverizing and puddling the soil in preparation for planting.

## Planting

The planting of rice is also done differently in upland and lowland production systems. In upland production, “scratching” takes place, including turning the soil, broadcast seeding, and covering of the seeds. As this is done on previously uncultivated land, the process is very labor intensive. In lowland systems, a small nursery is established near the plot, and transplanting of the seedlings takes place at about 21 days of growth. As shown in the table, upland production also requires more labor for planting.

**Table 7: Planting Labor Summary**

Planting <i>Ave person-days labor per 50 kg seed planted (Ha)</i>						
	Lowland			Upland		
	Borlaug	stdev	USAID	Borlaug	stdev	USAID
Scratching/Broadcasting	0		0	26	16	12
Nursery	2	3	2	0		0
Transplanting	<u>15</u>	15	<u>25</u>	<u>0</u>		<u>0</u>
<b>TOTAL</b>	<b>18</b>		<b>27</b>	<b>26</b>		<b>12</b>

Few farmers surveyed pay cash directly for seeds. Seeds are commonly held over from the previous year, traded among community members for diversity of seeds, or received from FAO or other NGOs. In cases where seed costs were not specified, seed costs were assumed to be the market price of a bag of harvested rice.

Seeding rates are also a concern in Liberian rice production. The recommended seed rate for lowland rice production is about 20-25kg/acre. We are reasonably certain that seed rates are much lower in Liberian rice production systems, although consistency of seed rates was difficult to gauge.

## Field Management

Weeding is a major cost component of field management of rice production. It is done by hand, and is labor intensive in both upland and lowland systems. Irrigation management includes bund repair, as well as management of water application to crops. Irrigation only takes place in lowland production. Table 8 shows the amounts of labor used for various crop management operations.

**Table 8: Field Management Labor Summary**

Field Management <i>Av person-days labor per 50 kg seed planted (Ha)</i>						
	Lowland			Upland		
	Borlaug	stdev	USAID	Borlaug	stdev	USAID
Weeding	23	22	25	20	14	15
Fencing	17	18		18	13	27
Bird Scaring	14	11	10	6	5	10
Irrigation Management**	12	12	15	0		0
Fertilizer Application	<u>1</u>	2	<u>0</u>	<u>0</u>		<u>0</u>
<b>TOTAL</b>	<b>44</b>		<b>25</b>	<b>24</b>		<b>37</b>

\*\*Assumes routine maintenance, exclusive of construction of new bunds , canals and irrigation systems.

Fencing is also a labor intensive component of production, and it requires more labor days in upland than lowland production. This is because additional clearing is required around upland plots, where in lowland systems with bunds in place, less additional clearing time is required. Wild animals including elephants, hogs, etc. makes fencing a highly labor intensive task in upland farms. Flooding of lowland plots is also a deterrent for pests, reducing the importance of fencing around the plots.

The primary purpose of fencing is to protect the fields from African groundhogs, or grasscutters (*Thryonomys swinderianus*), a major threat to rice crops in all three counties. Fences are required, and traps are set to catch them near fields. It is typical to catch one or two grasscutters per year, and a market value was reported of about \$7-\$8 for food. Some farmers reported eating the front half of the grasscutter, and selling the hind quarters in the market. Birds are a major problem at planting time in all three areas. They are also a problem after maturity, when full grains may be taken from the panicle. All told, fields must be guarded against birds for 25-30 days. Elephants are a major problem for upland producers in Lofa County, particularly in the Voinjama area. Several farmers lost entire farms to elephant destruction.

### **Harvest/Post-Harvest Handling**

Harvest is typically done with a knife, cutting the plant near the head (panicle), and the panicles are immediately tied into bundles in a process called "shocking." (When rice is threshed mechanically, sickles are used to ensure longer stems to aid in the threshing.) This process takes longer in the upland, because lowland fields are cleaner at harvest, despite higher labor inputs for weeding. This is due to several factors, including upland plots being previously uncultivated, and suppression of weeds by irrigation water in lowland plots. Herbicide use by some lowland producers also contributes to reduced harvesting costs.

**Table 9: Harvest/Postharvest Labor Summary**

Harvest/Postharvest Handling <i>Ave person-days labor per 50 kg seed planted (Ha)</i>						
	Lowland			Upland		
	Borlaug	stdev	USAID	Borlaug	stdev	USAID
Cutting/Shocking	24	20	30	30	20	22
Thresh/Dry/Winnow/Bag	13	15	0	16	16	0
Transport	<u>5</u>	5	<u>0</u>	<u>5</u>	4	<u>0</u>
<b>TOTAL</b>	<b>42</b>		<b>30</b>	<b>50</b>		<b>22</b>

After cutting and bundling, the threshing/winnowing/bagging process is generally done at one time, and is difficult to disaggregate. In some cases, the entire process may be entered into the database as threshing.

Many farmers also build “kitchens,” or small huts, to store/dry harvested rice. It is usually stored and dried in bundles. Labor requirements for construction of these facilities is 8 to 20 person days. Since they are multi-purpose shelters, they are excluded from the analysis. Rats and mice were reported to be the biggest cause of postharvest loss in this phase in all three counties.

#### **Total Labor Inputs**

Lowland production requires more labor for land preparation and field management, and upland production requires more labor for planting, field management and harvest. Total labor inputs for lowland production averages 170 person-days, while upland production averages 158 person-days.

**Table 10: Total labor inputs for rice cultivation, Liberia, 2011.**

Total Labor Inputs <i>Av person-days labor per 50 kg seed planted (Ha)</i>				
	Lowland		Upland	
	Borlaug	USAID	Borlaug	USAID
Land Preparation	66	80	58	52
Planting	18	27	26	12
Field Management	44	25	24	37
Harvest/Postharvest	<u>42</u>	<u>30</u>	<u>50</u>	<u>22</u>
<b>TOTAL</b>	<b>170</b>	<b>162</b>	<b>158</b>	<b>123</b>

The estimates of lowland rice labor that are based on data collected by the Borlaug Institute are slightly higher than the estimates given in the 2009 Global Food Review Liberia Rice Study (USAID), and about 28% higher for upland rice production.

## Non-Labor Inputs

### Seeds

Most farmers hold over seed from the previous year, or trade seed with neighbors. The most common varieties reported were Nerica and LAC 23 for upland production, and Suakoko 8 and FKR 19 for lowland production. It is estimated that a 50 kg bag of seed is used for one hectare.

**Table 11: Summary of Non-Labor Production Inputs**

Non-labor Production Inputs				
Av in LD per 50 kg Bag Seed Rice Planted (Ha)				
	Lowland		Upland	
Seeds	\$ 20.15		\$ 17.15	
Fertilizer		# of Farmers		
NPK*	\$ 27.85	16	\$ -	
urea*	\$ 8.53	12	\$ -	
Total	\$ 36.38		\$ -	
Pest Control				
Herbicide*	\$ 11.40	5	\$ -	
Pesticide*	\$ 8.41	2	\$ -	
Fence/trap materials	\$ 2.93	15	\$ 3.28	
Machine Rent*	\$ 42.97			

\* Reported only in lowland systems.

### Fertilizer

Fertilizer was used only by lowland farmers surveyed by the team. Lack of fertilizer use in upland production likely contributes to continued slash and burn practices, as lowland must be cleared each year for rice production to ensure adequate soil fertility. A total of 4 of 49 lowland producers reported purchasing NPK and Urea, at an average cost of \$27.85 and \$8.53 per hectare, respectively. Another 12 of 49 lowland producers reported receiving both NPK and Urea from FAO, at no charge.

### Machine Rental

Machinery was available for rental only through cooperatives. Small power tillers were available for rent at Dokodan Coop in Gbedin, Nimba county for LD1500, or about US \$21.50 per acre, plus fuel. Fuel cost for an acre of power tilling is estimated to be about \$4. Machine rentals were reported only by lowland producers. Only seven of forty-nine lowland farmers surveyed reported

machine rentals, and all were coop members. It is believed that only a very small percentage of producers rent machinery.

### Credit

Many farmers take out credit on a short-term basis, mainly for paying wages and other inputs where applicable. Nine out of thirty-four upland farmers surveyed, and seventeen out of forty-nine lowland farmers surveyed took out some form of credit. Interest rates varied widely, from 0% to more than 100%, on fixed short-terms. The terms for most loans was six months or less, with an average annualized interest rate of about 30%.

### Breakeven Analysis

Although improved technology inputs are not commonly purchased, costs for each component were estimated. Herbicide use reduces weeding labor by an average of twenty-two person days. Rental of a power tiller reduces land preparation labor by an average of twenty-two person days. At the prevailing wage rate of \$3/day, total costs are reduced by purchasing fertilizer, herbicides, pesticides and renting the tilling machine. If a wage rate of \$2/day is assumed, total costs are increased by purchasing these inputs. Yield and output gains are also expected due to the use of fertilizer and improved seeds, as well as reduced losses to pests.

**Table 12: Rice Production Total Cost Summary**

Average Total Cost Per Hectare			
<i>Non-labor Inputs</i>	Traditional Lowland	Lowland w/inputs	Traditional Upland
Seeds	\$ 17.15	\$ 20.15	\$ 17.15
Fertilizer	\$ -	\$ 36.38	\$ -
Herbicide/Pesticide	\$ -	\$ 19.80	\$ -
Fencing Materials	\$ 2.93	\$ 2.93	\$ 3.28
Power Tiller Rental	\$ -	\$ 42.97	\$ -
<b>TOTAL</b>	<b>\$ 20.08</b>	<b>\$ 122.24</b>	<b>\$ 20.44</b>
<i>Labor Person Days</i>			
Land Preparation	66*	44*	58
Planting	18	18	26
Field Management	44	22	24
Harvest/Postharvest	<u>42</u>	<u>42</u>	<u>50</u>
<b>TOTAL</b>	<b>170</b>	<b>126</b>	<b>158</b>
Labor Cost @ \$3/day	\$ 511	\$ 378	\$ 475
Labor Cost @ \$2/day	\$ 341	\$ 252	\$ 317
<b>Total Cost @ \$3/day</b>	<b>\$ 531</b>	<b>\$ 500</b>	<b>\$ 495</b>
<b>Total Cost @ \$2/day</b>	<b>\$ 361</b>	<b>\$ 374</b>	<b>\$ 337</b>

\*Land preparation for lowland systems does not include construction of bunds and irrigation systems. Annual irrigation system maintenance is included in field management.

At the current P4P price of \$17/50kg bag of paddy rice to farmers, the net return is \$0.34 per kg. At the most commonly reported wage rate in rice production, wages account for 88% of production cost in lowland systems, and 98% of production cost in upland systems. For each kilogram of seed planted by, lowland producers harvested 22.4 kg and upland producers harvested 18.5 kg.

**Table 13: Output and Breakeven Scenario**

	Outputs and Total Costs at wage rate of LD \$ 3.00 per day	
	<i>lowland</i>	<i>upland</i>
Kg Harvested/Kg Planted	22.4	18.5
Returns USD/Kg @ \$17/bag	\$ 0.34	\$ 0.34
Total Cost USD/Kg Harvested	<u>\$ 0.39</u>	<u>\$ 0.37</u>
Net Returns USD/Kg harvested	\$ (0.05)	\$ (0.03)
Net Returns USD/Kg Seed Planted	\$ (1.11)	\$ (0.55)
Breakeven USD/Bag	\$ 19.47	\$ 18.49

### Lowland vs. Upland Yields

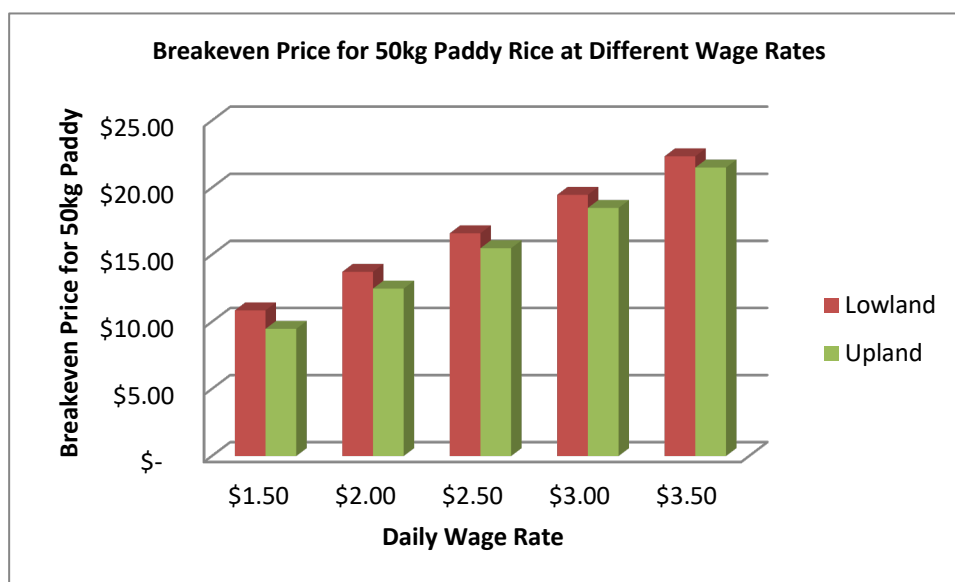
The data show upland yield to average 18.5 kg per kg of seed planted, and lowland yield to be 22.4 kg per kg of seed planted. This translates to roughly 0.9mt/ha for upland, and 1.1mt/ha for lowland production.

Observations in the field suggest that yields are likely higher than reported. Producers begin to consume rice from the fields at harvest. They often feed large teams of laborers, or the “Kuu.” This is not accounted for in total yield, as it is not a transported bag of rice. Postharvest loss to rats and mice is also a major problem. As total yields are small relative to other global production systems, these losses are significant percentages of total production, and could have a large effect on per hectare yield estimates.

The chart below summarizes the sensitivity analysis for changes in the value of labor for rice production.



**Figure 14: Breakeven Analysis for Different Wage Rate Scenarios**



At the current prevailing wage rate of \$3/day, the breakeven price for a 50kg bag of paddy rice is \$19.47 in lowland production and \$18.49 in upland production. A \$0.50 increase in the daily wage rate increases the breakeven prices to \$22.34 in lowland and \$21.50 in upland systems. If we assume the value of daily labor to be \$2, the breakeven price is \$13.73 in lowland and \$12.48 in upland systems.

### Processing

After the farmer or cooperative has harvested their crop, the rice is threshed (See Illustrations). Many individual farmers do this manually; however, most cooperatives own threshers that have been donated by the EU and FAO (A). In addition to threshing cooperative farm rice, member-farmers can rent the equipment to thresh privately-grown rice as well. After rice is threshed, it is put in 50 kg bags and stacked in a storage facility (B). The women of the cooperative parboil the threshed grain in giant parboilers donated by WFP (C). The vat holds approximately 125 gallons of water. The parboiler sits on four legs with enough room underneath to place logs and create a fire (D). It takes approximately ten logs to bring the fire to a boil. After the water has been brought to a boil, the fire is removed and 14 bags (700 kg) of paddy rice are placed in the vat and covered with a lid to soak overnight. In the morning the water is drained to a false bottom (E). The false bottom is lightly perforated and stands five inches above the actual bottom (F). Approximately 15-20 logs are used to create a fire under the parboiler to steam-parboil the rice through the perforated false bottom for about two hours, until the husks crack open. Parboiled rice is removed and spread on tarps to sun-dry for approximately one hour (G). Throughout the drying process, women constantly rake and spread the grain across the tarpaulin. In several locations, UNDP has constructed, or is in the process of constructing, concrete drying floors. After the parboiled rice has dried, it is milled (H) and bagged in 25 KG bags (I).



A



B



C



D



E



F



G



H



Based on contractual prices from WFP, processing adds approximately \$100 of value per MT to the end product. This value is based on the following assumptions:

**Table 15: Paddy to Parboiled Conversion**

	<b>Paddy</b>	<b>Milled/Parboiled</b>
<b>Price/50kg</b>	\$17	\$31.50
<b>Price/mt</b>	\$340	\$630

Paddy to Milled Conversion = 0.65 Or 1000kg Paddy = 650kg Milled Rice

Using this standard conversion factor for milled rice in Liberia, it takes approximately \$523 of paddy rice to produce one mt of milled rice with a WFP value of \$630. The remaining \$107 is the value added by the parboiling and milling process.

### End Markets

End markets in Liberia can be divided into rural and urban. Urban markets (markets in Monrovia) sell mostly imported rice and rural markets sell mostly country rice. The chart below illustrates the disparity between imported rice and country rice the farther the market lies from the port in Monrovia. The road to Voinjama is several hundred kilometers of dirt road, further adding to the logistical difficulty and transportation costs.

**Table 16: Regional Rice Prices**

Per 50kg Bag (Retail)	Nov 2009		Feb 2010	
	<b>Imported Rice</b>	<b>Country Rice</b>	<b>Imported Rice</b>	<b>Country Rice</b>
<b>Saclepea – Nimba</b>	\$35.42	\$27.08	\$33.33	\$31.25
<b>Gbarnga – Bong</b>	\$34.72	\$27.08		
<b>Voinjama – Lofa</b>	\$41.67	\$20.83	\$38.89	\$25.69
<b>Red Light – Monrovia</b>	\$31.25	\$29.86		

Data collected by WFP/MoA in November 2009 and February 2010. \*Imported Rice in this analysis is butter rice, which comes mainly from China.

## Conclusions

Data were collected on three different paddy production systems: (i) traditional lowland; (ii) lowland with inputs such as improved seed, fertilizer, herbicide/pesticide, power tillers; and (iii) traditional upland.

- *Traditional Lowland:* Average yield is about 1.1 mt/ha. At the P4P price of \$17 per 50kg bag of paddy, gross returns are \$374/ha. Non labor inputs are about \$20/ha. An average of 170 person-days of labor is required for the season. At a wage rate of \$3/day, total cost is estimated to be \$531/ha, resulting in a net loss of \$157/ha. At a wage rate of \$2/day, total cost is estimated to be \$360/ha, resulting in a net profit of \$14/ha.
- *Lowland with Inputs:* Average yield is about 1.1 mt/ha, resulting in gross returns of \$374/ha. Non-labor inputs are about \$122/ha. An average of 126 person-days of labor is required for the season. At a wage rate of \$3/day, total cost is estimated to be \$500/ha, resulting in a net loss \$126/ha. At a wage rate of \$2/day, total cost is estimated to be \$374/ha, resulting in a net profit of \$0.
- *Traditional Upland:* Average yield is about 900kg/ha, resulting in a gross income of \$306/ha. Non-labor inputs are about \$20/ha. An average of 158 person days of labor is used. At a wage rate of \$3/day, total cost is about \$495, resulting in a net loss of \$189/ha. At a wage rate of \$2/day, total cost is about \$337/ha, resulting in a net loss of \$31/ha.
- The value of rural labor on in particular family labor is the most critical consideration in setting an administered price for paddy. Labor represents 88% of total production costs for lowland farmers and 98% of upland farmers. Many farmers use family or exchanged labor through a traditional method called the Kuu System. Contract labor and mechanization are used, but rare. Though varying by location, the most common daily-wage rate, inclusive of in-kind wages such as food, is about \$3 per day.
- There is little use of inputs like fertilizers, herbicides, pesticides and credit. Almost 100% of all fertilizer or pesticide used by farmers was given by the FAO or NGOs. It seems there are major gains to be tapped through high quality input usage. Credit was informal and used by approximately one-third of the sample population. Interest rates varied widely but were consistently high (averaging about 30% per annum). Credit was used for seed purchase or labor. There was no network of formal lending institutions in rural areas.
- Transportation costs, due to poor and limited transport fleets, poor road networks, non-availability of electric power, and lack of storage facilities, are high. This exacerbates problems of post-harvest loss, quality deterioration, and timely market availability. Because of the limited accessibility of marketing support, WFP subsidizes transport of paddy rice from the farm to the cooperative.
- Most farmers do not produce in excess of household consumption. This causes reluctance by farmers to sell in the market. Paddy sold to the coops was reportedly in support of the coop and community, as well as in return for the provision of inputs. Farmers also sold rice for cash, often at a discount in return for prompt payment.

- Purchase for Progress should be viewed as one component to a larger, collaborative, smallholder-rice development project. P4P provides the market for processed rice and other national and international organizations lend technical, financial or cooperative assistance. Organizations include FAO, UNDP, and the EU in addition to numerous NGOs. In several cooperatives, the Ministry of Agriculture (MoA) and Cooperative Development Agency (CDA) have designated a full or part-time staff person to assist farmers and cooperatives in training and management. The Ministry of Gender (MoG) is very involved within the women's cooperatives. This collaboration is essential to the success of P4P; and P4P is essential to the success of various collaborative rural development projects.
- Liberia P4P rice is parboiled. Based on contractual prices from WFP, processing adds approximately \$100 of value per MT to the end product. This processing includes parboiling, milling and bagging rice.
- Our observations are fully consistent with Liberia's good record on gender equality. Women work in the field, farm, offices or school in a manner comparable with men. They play a vital role in household chores. During the survey no major wage differences between men and women were found.

## Recommendations

A three-pronged paddy sector development approach for the country is recommended. Those policies need to be focused on promoting (i) farm level resource mobilization, (ii) local community and rural society's collective approach to village level development and (iii) national level policy environment that can enable macro-level economic development. All three efforts must be undertaken simultaneously. Asymmetrical investments on one area may lead to gross inefficiency in the uses of scarce resources.

1. High quality seed, inputs and technical training at the farm level is essential to increasing rice production in Liberia. This must be coupled with agricultural extension and technical training in order to bolster production capacity. These are farm level interventions.
2. Local level infrastructure like wells, irrigation systems, and farm to market roads will collectively enable rice production on a larger scale. P4P is undertaking the important task of subsidizing transport of the products to market. Co-ops are vitally important in harnessing collective behavior of rural farmers, allowing for sharing of best practices. These types of intervention are necessary to optimize farm level technology improvements and training. These are community level interventions.
3. Creating an enabling environment for increased rice production is a responsibility of GoL. Tariffs on rice imports are politically unpopular and unfeasible in the current production context. As national production increases, GoL must protect its farmers by ensuring a fair market price for Liberian production through market-based interventions. Major transport and power infrastructure are also needed. These are national level interventions.

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[UNdata | country profile | Liberia](#) GNI: Gross national **income per capita** (current US\$), 2008, 166.6 ... Infant mortality rate (per 1 000 live births), 2005-**2010**, 95.1 <http://data.un.org/CountryProfile.aspx?crName=Liberia> - 69k -