



**Smallholder Oil Palm Support
(SHOPS)
Final Impact Evaluation**

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I. Executive summary

The **Smallholder Oil Palm Support project (SHOPS)** fosters grassroots economic growth in rural Liberia by building local capacity in technology manufacture and commercialization, agricultural production and processing, and small business development. Winrock International is implementing the project under a subcontract with ACDI/VOCA with funding from USAID to support growth in Liberia's agricultural sector. The project began in April 2011, rapidly building on the solid foundation of the Liberia Smallholder Oil Palm Revitalization Project (LSOPRP) implemented by Winrock International from 2008 to 2010 under the Sustainable Tree Crops Program. As of January 31, 2014, SHOPS had spent 90% of its budget of USD 3.1 million after 33 months of project implementation. The three-year project is slated to end May 31, 2014 and is on track to achieve and even exceed most of its objectives. The final evaluation survey was conducted from January 15th, 2014 to February 17th, 2014.

The findings of this final evaluation show that **SHOPS technical and business development activities have aided over 9,000 Liberian farmers, technology users, and entrepreneurs to generate USD 8.3 million dollars in increased income over the duration of the project.** Table 1 summarizes selected SHOPS performance indicators based on the objectives and intermediate results indicated in the Performance Management Plan, comparing projected impacts to those achieved thus far.

Table 1: Performance Indicator Summary				
Intermediate Results	Performance Indicators	Midterm Evaluation Value	Final Evaluation Value (Cumulative)	Life of Program Target
1.0 Stimulate economic activity (custom indicators)	Number of participants generating increased income or savings	5,257 1,787 F 3,470 M	9,187 3,401 F 5,786 M	2,650 662 F 1,988 M
	Incremental increases in annual net income	USD 4.5 million	USD 8.3 million	USD 3.97 million
	Number of enterprises generating profits	277	327	250
	Private investment generated through technology and seedling sales	\$195,720	\$625,555	USD 760,000
1.1 Improved access to inputs	Number of nurseries producing at least 1,500 seedlings per year	22	43	40
1.2 Increased oil palm production	Tenera seedlings produced by nurseries and sold to farmers	30,977	75,977 (anticipated sales)	90,000
1.3 Increased palm oil processing	Manufacturing enterprises producing motorized technologies	1	3	3
	Manufacturing enterprises producing the manual expeller	2	2	3-6
	Motorized equipment units sold	6	21	90
	Manual palm oil expellers	140	240	450

Table 1: Performance Indicator Summary				
Intermediate Results	Performance Indicators	Midterm Evaluation Value	Final Evaluation Value (Cumulative)	Life of Program Target
	sold			
	New or expanded enterprises engaged in mechanical processing	149	185	400
2.1 Improved market linkages	Number of Oil Palm Producer groups linked to MOA or seedling importers for seedling importation	3	30	3
	Processing clients benefitting from links to FM2 owners	3,802 1,141 F 2,359 M	6,720 2,621 F 4,099 M	9,000
3.1 Increased access to credit	Enterprises applying for credit	105	279	130
	Amount of credit requested	\$35,715	USD 275,59 (USD 197,477 approved)	USD 130,000

Project participants representing 327 small businesses have utilized their own capital to invest USD 625,555 in the agricultural sector, not including annual wages and in-kind payments to over 3,805 employees and seasonal workers. SHOPS has initiated and supported concrete economic development at the community level, providing tangible benefits including production, marketing, and consumption of high-value commodities derived from the oil palm tree, an important natural resource indigenous to Liberia. The combination of technical assistance and small enterprise development characterizing SHOPS strategy has generated benefits accruing directly to rural Liberian producers and consumers. SHOPS has engaged in capacity building in lucrative technical skills including metal fabrication, nursery operations, and business administration procedures for applying for and managing credit.¹

II. Methods

This study was guided by a series of questions intended to reveal whether the products and services promoted through SHOPS generated meaningful economic, social, and environmental impacts for the Liberian farmers and entrepreneurs who participated in the project activities:

- Who were the participants and how did they benefit from SHOPS?
- Did the activities stimulate income generation and if so, approximately how much?
- What other types of impacts can be linked to the project activities?
- What types of concerns and feedback did the participants express concerning SHOPS?

The research framework entails a mixed-method approach that combines a) descriptive statistics drawn from quantitative economic data with b) an empirical, qualitative account of participant reactions to SHOPS. While the quantitative data reveals the economic impacts of the project, the

¹ For more detailed information regarding project background, rationale, and context, please refer to SHOPS Performance Management Plan, SHOPS Qualitative Baseline Study (2011), and the LSOPRP Final Project Evaluation (2010).

subjective interpretations of the project participants themselves provide key information helping to explain how and why social, economic, and environmental relationships are altered through processes of technology diffusion.

The information in the following report was drawn from an assortment of sources, including: interviews with 147 project participants; focus group discussions; annual and quarterly project reports; project monitoring records; and, the final evaluation of LSOPRP, SHOPS midterm evaluation, and the SHOPS qualitative baseline study.

A. Sample

The sample frame for this survey is based on data collected during the monitoring activities of the staff and the sales records of the equipment manufacturers, nursery owners, and cooperatives. With a limited amount of time (less than three weeks) to conduct the survey and with consideration of road conditions, travel time, and staff knowledge of the processing sites, the staff of SHOPS Liberia selected a sample of participants representing ethnic and geographic diversity. The survey targeted 145 participants in Bong, Lofa, and Nimba counties.

A total of 147 individuals speaking as an individual or on behalf of cooperatives were interviewed. Seven categories of participants were interviewed including manufacturers, palm processing equipment owners, Freedom Mill 2 (FM2) owners from LSOPRP, FM2 users/customers, nursery operators, cooperative loan recipients, and individual loan recipients. Please see Table 2 below for the disaggregation of respondents.

No.	Category	Number Interviewed
1	Manufacturers	3 of 4
2	Palm processing equipment owners	30 of approximately 260 at the time
3	FM2 Owners from LSOPRP	5 of 180+
4	FM 2 users/customers	68 of ???
5	Nursery operators	32 of 43
6	Cooperative loan recipients	4 of 5
7	Individual loan recipients	15 of 100
Total		147

B. Survey Questionnaires

The questionnaires used in this survey for the manufacturers, vendors, and machine owners and users were nearly identical to those used in the final evaluation of the Liberia Smallholder Oil Palm Revitalization Project (LSOPRP) and SHOPS midterm evaluation. Using the same questionnaires allows for a comparative analysis. Several new questions were added to the questionnaires to collect more nuanced data concerning participant employment issues and social impacts of project activities. The questionnaires were written in English and interviewers agreed on the specific wordings to be used in the relevant local languages as part of the interviewers' responsibilities.

The questionnaires were administered in each surveyed plantation, farm, business center, manufacturing workshop/garage and house for eligible women and men, representing seven categories of project beneficiaries. All eligible respondents in various categories were interviewed (some appointments were made to return later in the day or the following day). The questionnaires were administered through a face-to-face method where surveyors and respondents chatted through questions and answers using the best level and medium of communication for the respondents' understanding. The completed questionnaires were reviewed and coded appropriately in the field, to permit immediate correction and clarification.

C. Data Collection

The survey team was accompanied by SHOPS extension agents and drivers assigned to the various counties and districts in which the survey was conducted to extend guidance to the process by providing a vivid picture of the localities and individuals/institutions to be surveyed. That enabled the team to better and more easily cluster these areas and the individuals and institutions for smooth movements and contacts. The survey team was also able at the time to update the contact information of the project participants.

D. Ethical Considerations

The surveyors used rigorous standards of ethical recommendations for data collection. Before carrying out the survey, permission was granted from community leaders and local elders, and in some cases government officials presiding in the districts. Survey sites were notified prior to the survey by SHOPS field staff to obtain permission for entry into villages and to conduct interviews. During the study, the surveyors solicited informed consent from each respondent at the beginning of the interview to confirm their willing participation. Their confidentiality and respect were honored throughout the duration of the survey. Respondents' names were neither taken nor written on the questionnaires.

During interviews, SHOPS staff members accompanying the surveying team respected all ethical recommendations for data collection including leaving the premises of the interview and in no way interfering with it. Their respect for these rules made the survey less likely to be biased.

E. Data Tabulation and Analysis

The survey data was manually entered into Microsoft Excel worksheets. Excel was used to perform descriptive statistical analysis. In addition, the lead researcher utilized Minitab 16 in order to perform further statistical analysis based on graphical summaries of key indicators.

The qualitative data was analyzed for trends in thematic content concerning the relative perspective of each participant. For each category of participant, a broad selection of direct quotes has been included in order to:

- a) provide a forum in which a diversity of participants may directly communicate their concerns with project managers and administrators

- b) reveal new and/or unexpected information concerning project performance that can contribute to more nuanced project strategy
- c) emphasize the qualitative and unique distinctions within and across the quantitative and generalizing dimensions of the analysis.

F. Challenges and Constraints

Overall, there were no major challenges or constraints encountered during the data collection process, due in part to the proper planning process that preceded the administration of the questionnaires. However the team faced, on some occasions, the situation of not meeting with the respondents in town as originally scheduled and had to return at a later date or time to meet and complete the questionnaires. These miscommunications occurred primarily due to poor contact information for respondents or lack of reliable cellular network coverage in interview areas. The team found solutions to the problems by visiting such respondents as early as possible before people could leave for the bush or other activity areas. Also, some of the respondents were wrongly tracked - they either didn't own equipment attributed to them, or were not active participants under the SHOPS program. These individuals were replaced by some of the stand-by individuals to achieve the targeted number of respondents. These anomalies likely stem from errors in transcribing data from handwritten business records as well as errors in the manufacturer's bookkeeping. This data quality issue will be addressed as project monitoring continues over the duration of the project.

III. Background

Elaeis guineensis, the African oil palm tree, is central to an urgent and intensifying global discussion regarding the direction of industrial agriculture, land tenure, environmental conservation, and human welfare. Palm oil derivatives, fractions and oleochemicals are a basic ingredient in margarines, processed foods, soaps, lotions, shampoos, cosmetics, detergents, pharmaceuticals, agro-chemical products, and biofuels. The use of palm oil in this broad suite of common products has triggered massive changes in dietary and bodily practices worldwide, as people have developed a taste for processed foods like margarine and industrial hygienic products. To feed the global supply chain, transnational palm oil corporations have installed millions of hectares of oil palm plantations throughout the global tropics. Since the 19th century, local and international actors in Africa have made great efforts to increase palm oil production through technological means including the use of mechanical expellers and hybrid palm seedlings. Like cotton, tobacco, and coffee, the oil palm tree is considered a "motor of development." However many of the global plantations, including those in Liberia, are located in politically disputed territories.

Archaeological evidence suggests that the oil palm tree, indigenous to coastal West and Central Africa has played a key role in the cultural ecology of the region for at least the past 5,000 years. In addition to providing a staple food (red palm oil), the tree serves as a source of palm wine, medicine, fuel, fiber for weaving, and construction materials. A wide variety of methods are used to expel oil from palm fruits. Many of the techniques are labor intensive and entail climbing palm trees, picking the fruits off of bunches, transporting, cleaning, fermenting, and

steaming the fruits, pounding them, and then soaking them to extract the oil. It takes several days to carry out this process. Many Liberians (and West African consumers more generally) prefer the “soft” palm oil processed from *dura* that remains liquid after cooking and retains its bright red tint and distinctive flavor. Liberians add red palm oil to cooked greens, vegetables, meat, fish, shellfish, and other foods, almost always served with rice or yams. In many parts of Liberia, *dura* fruit is steamed and crushed in small batches and the oily, strained pulp is served as *palm butter* sauce. While *tenera* is a major source of palm oil used in local soap making, most people do not consider it edible. The oil of the *tenera* hardens as it cools, or “goes to sleep,” and is deemed unpalatable.

Apart from the fruit and its pulp, the oil palm tree is used for diverse purposes, producing highly malleable and durable leaf fibers. The principal nerves of oil palm fronds are rigid, appropriate for basket weaving and building windbreaks and enclosures. Secondary nerves serve as brooms. Leaves may be used as bedding. The smallest leaf fibers are woven into various types of nets such as those used in fishing. Many parts of the tree may be burned to create fertilizer or used as combustible material. Rural Liberians rely on the oil palm as a low cost source of raw materials for everyday needs. It is unlikely that unaffordable and scarce commercial products such as factory-made cooking oil, fishing equipment, and construction materials will soon replace what is locally available from oil palms. The oil palm provides material resources to rural populations that are as important as cash income. Deeply implicated in social, economic, and ecological practices, the oil palm is the basis of a way of life.

The Smallholder Oil Palm Support Project (SHOPS) has focused its efforts in Bong, Grand Bassa, Lofa, and Nimba counties. The selection of the regions where the project’s activities take place is due in part to the emphasis the Government of Liberia and USAID have placed on stimulating agricultural development in these rural areas (or what were formerly, colloquially known as the “hinterlands”) that have historically remained most marginalized in terms of infrastructure, economic opportunities, and political participation.

SHOPS extension agents work with Liberian nursery owners to build a local supply chain for *tenera* oil palm seedlings. During the civil war, most *tenera* plantations were neglected, and the majority of *tenera* trees in Liberia are now 30 years of age or more and have begun to decline in productivity. In addition, they are very tall and the fruit is difficult to harvest. SHOPS has promoted the local propagation and commercialization of seedlings from imported hybrid *tenera* seeds in order to encourage local farmers to replace the old trees with newer and higher-yielding oil palms.

IV. Findings

In general, SHOPS enjoyed a highly favorable environment in which to promote the diffusion of small scale palm oil processing equipment and introduce hybrid oil palm seedlings. Local knowledge of and experience with oil palm farming and processing coupled with a strong local demand for oil palm products led to rapid spread of interest and investments in the Freedom Mill 2 and production of *tenera* seedlings. Liberians were eager to adopt the technologies and services promoted through SHOPS because they complemented and enhanced, rather than

replaced or disrupted, local palm oil production methods. In addition, most of the loan recipients expressed satisfaction with the outcome of the loan process.

In terms of constraints, SHOPS operated mainly in Bong, Nimba, and Lofa counties where there is still a severe lack of infrastructure, capital, and technical training that hampers the establishment and growth of small enterprises. The cost of materials and transport were cited as consistent challenges for the project participants, and employment opportunities linked to the oil palm sector tend to favor men rather than women. Despite these constraints SHOPS met and/or exceeded most of its performance indicators.

These findings are divided into three sections based on the three major activities under SHOPS: 1) commercialization of palm processing equipment; 2) tenera seedling production and commercialization; and 3) microfinance. The final section focuses on women's participation.

A. Freedom Mill 2 Owners and Users/Customers

i. Technology manufacturers

Technical training in metal fabrication skills such as welding and machine manufacture is a fundamental component of SHOPS. SHOPS technical trainers and several international consultants have worked intensively with Liberian metal shops to build local production capacity and foster grassroots economic growth. Four technology manufacturers have received technical training and promotional support under SHOPS. The workshops are located in Gbarnga (Bong County), Ganta (Nimba County), Bensonville (Montserrado County), and Foya (Lofa County).² The manufacturer in Gbarnga who originally participated in LSOPRP, Moonlight Metal Works and Garage, has built and sold the greatest number of FM2 units by far. Moonlight Metal Works reported building and selling 195 machines during SHOPS, while the manufacturers in Ganta and Foya sold 12 and 33 machines, respectively, for a total of 240 FM2 commercialized. In addition to the FM2, the manufacturer in Gbarnga has also built 13 motorized expellers, 5 motorized kernel crackers, 3 kernel presses, and 1 kernel separator. Table 3 below presents the total profits of USD 59,665 earned by all three manufacturers from the sale of the promoted technologies.

The total amount that the manufacturers have invested in production activities is USD 123,600 for the FM2, USD 27,300 for motorized expellers, USD 4,000 for the motorized kernel crackers, USD 6,300 for the kernel press, and USD 310 for the kernel separator. Therefore, the total amount manufacturers have privately invested in producing the technology is USD 161,510. The gross income from technology sales is USD 168,000 for the FM2, USD 35,100 for the motorized expeller, USD 6,000 for the motorized kernel cracker, USD 11,400 for the kernel press, and USD 675 for the kernel separator for a total of USD 221,175. This amount represents private investments that Liberian farmers and entrepreneurs have invested in purchasing the technology. Liberians have therefore commercialized and diffused the technologies promoted through SHOPS by generating **USD 382,685 in private investments**.

² The manufacturer in Bensonville was not interviewed for this survey due to inactivity.

Table 3: Profits from technology commercialization					
Technology	Cost of production	Sales price	Profit margin	Number sold	Total profits
Freedom Mill 2	USD 515	USD 700	USD 185	240	USD 44,400
Motorized expeller	USD 2,100	USD 2,700	USD 600	13	USD 7,800
Motorized kernel cracker	USD 800	USD 1,200	USD 400	5	USD 2,000
Kernel press	USD 2,100 ³	USD 3,800	USD 1,700	3	USD 5,100
Kernel separator	USD 310	USD 675	USD 365	1	USD 365
TOTAL					USD 59,665

The manufacturers employ a total of 9 full time employees, mainly welders. Only 2 (22%) of the employees are women. Metalworking is typically considered a male occupation. As noted in SHOPS qualitative baseline study, women are rarely employed in metal fabrication and this is unlikely to change without major recruiting efforts and technical training programs specifically for women. This issue was flagged in the SHOPS midterm evaluation as well. However, it was not within the purview of SHOPS to help women gain access to training in metal fabrication or to establish women-owned businesses in the manufacturing sector.

All three manufacturers reported that sourcing materials and the costs of transportation are the primary challenges associated with technology production. This is not surprising given the lack of infrastructure and transport options in Bong, Nimba, and Lofa counties. Despite these issues, all three manufacturers rated the training in production, safety measures, and environmental protection they received from SHOPS as very good.

In terms of impact on their businesses, the manufacturers stated:

- “We are able to get other customers, build new equipment and it has increased my income.”
- “The project has made my business to expand and increase my income.”
- “It has made me to be known in my community, it made me to own properties like house, car etc.”

All three of the manufacturers stated that they would be able to continue producing the manual FM2 without direct project assistance. However, one manufacturer stated that he would like to receive a loan to increase his production capacity.

ii. Owners

According to project records, a total of 240 FM2s have been sold during SHOPS. A variety of actors have purchased the mills, from individual farmers and business owners to agricultural cooperatives. The majority of FM2 owners are individual men (57%), 20% are women, and 23% are groups including schools, missions, and community cooperatives. The proportion of men to women owners reflects cultural norms common throughout much of West Africa surrounding gendered access to capital and capacity to invest in business ventures. One way to increase the number of equipment owners who are women would have been for SHOPS to subsidize purchases for women and women’s groups. This approach would have contradicted the market-

³ The manufacturer reported an estimated cost of USD 2,100 to build the kernel press. This amount conflicts with projects estimates of USD 3,200.

based character of SHOPS strategic approach, however. Although women are not as likely to own a mill, they are still very involved in oil processing and machine operation. For all 240 mills sold, there are a total of 137 male owners, 48 female owners, and 55 cooperative (or group) owners. The owners interviewed had purchased between one and three machines. Five had purchased 2 machines and two had purchased 3 machines, for a total of 44 machines or 1.3 machines per owner.

Prior to purchasing equipment, the owners had heard about the FM2 through several avenues including local demonstrations (66%), radio advertisements (31%) and through personal contacts (26%). The demonstrations arranged through SHOPS were clearly the most important form of marketing although the radio advertisements had reached a large portion of the owners as well. It is interesting to note that those who had heard about the FM2 on the radio were all located in Bong and Nimba counties. None of the survey participants in Lofa County had heard the radio advertisements.

To purchase the FM2, 60% of the owners had used their own money. Far fewer had obtained loans from a credit union (8%) or bank (3%). Three percent had received money from family or friends to make the purchase. Notably, 20% of the owners reported that NGOs (including CPOP, ORT, ALP, Concern Worldwide, SAD, and ADF) had given them the equipment or funds to buy it. This finding suggests that the commercial approach of the project will be compromised by the activities of other NGOs, since the charitable donation of equipment to the owners is perpetuating the “hand out” model of development which conflicts with the market-based strategy of SHOPS. On the other hand, the donated FM2s may prove beneficial in marketing the technology to other potential buyers more remote areas.

The FM2 operators typically employ various categories of workers to carry out the multiple phases of palm oil processing. The employees were categorized as managers, clearers, harvesters, and millers/pickers.

Table 4: Processing employees

Job	Men	Women	Total	Daily wages
Manager	103	14	117	USD 1.92
Clearers	1,147	267	1,714	USD 1.72
Harvesters	192	0	192	USD 2.38
Millers/pickers	213	103	315	USD 1.75
TOTAL	1,655 (81%)	384 (19%)	2,039	

The mean number of employees per mill is 8, of which approximately 81% are men and 19% are women. For 240 mills, there are 2,039 employees of which 1,655 are men and 384 are women (Table 4). The estimated proportion of men to women workers differs from the proportion calculated during the midterm evaluation which was closer to half men, half women workers. This difference may be due to the small sample size of both studies, or this could indicate that as time has passed, men are taking more of the oil palm related jobs available. Historically in West Africa it is not uncommon for men to take over and dominate profitable market-based activities regardless of previously established divisions of labor. Examples of this trend include the market gardening sector in many countries, sales of textiles or other goods, and production of cash crops such as rice and groundnuts.

The employees working for palm oil enterprises generally receive compensation in cash or in a predetermined number of gallons of oil. On average, managers earn USD 1.92 per day or work, clearers earn USD 1.72, harvesters earn USD 2.38 due to the physical dangers associated with the job, and millers/pickers earn USD 1.75.

By far the most common variety of palm processed in the mills is *tenera* (mean 83%, median 95%) rather than *dura* (mean 17%, median 5%). Although some owners reported processing between 60% and 90% *dura* palm fruits the majority of owners were processing *tenera* most of the time. The proportion of *tenera* to *dura* that the owners reported processing correlates to findings in the previous evaluation studies. The preference to process *tenera* reflects the perception of the technology users that the FM2 operates more efficiently using *tenera* rather than *dura*.

The owners operated the mills for a mean period of 6 months per year. During those 6 months, the owners worked a mean of 6 hours per day, 4 days per week, or approximately 24 hours per week. Assuming an average of 16.8 days of operation per month, the total number of days of operation per mill per year is approximately 101, or a total of 606 hours per year. This result is substantially less than the estimated annual hours of operation reported in the SHOPS midterm evaluation (1,072 hours per year) and the LSOPRP final evaluation (1,080 hours per year). However, the lower figure of 606 hours per year is a more realistic estimate because the earlier findings did not capture the daily periods of resting, preparing the palm fruits, and switching between operators that happen in between periods of active oil pressing. The previous studies assumed a full 8 hours of operation per day, while this study assumes 6 hours per day leaving several work hours available for the various other tasks mentioned above.

The owners reported that one fifty-gallon drum of palm fruits can be processed in 40 minutes to produce 2.88 tins (5 gallons) of crude palm oil. This results in an average output of 21.6 gallons of palm oil per hour. For 606 hours of operation, this equals an output of **13,090 gallons of oil annually per machine** or 3,141,600 gallons of oil for 240 mills. As noted above, oil from *tenera* fruits constitutes approximately 95% of the total amount of oil processed. At an average value of USD 2.58 per gallon as of March 2014, the total amount of *tenera* oil produced is worth **USD 7.7 million**. The palm oil produced from *dura* fruits has substantially higher value of USD 2.94 for a value of **USD 461,815** for 5% of the total number of gallons produced (Table 5).

	<i>Tenera</i> (Mekindo)	<i>Dura</i> (Country)	All
Percent of output	95%	5%	100%
Annual output (gallons)	2,984,520	157,080	3,141,600
Value (per gallon)	USD 2.58	USD 2.94	
Total value	USD 7,700,062	USD 461,815	USD 10,406,550
Annual increase in income (per FM2)	USD 13,750	USD 825	USD 14,575
Annual increase in income (240 units)	USD 3,300,000	USD 198,000	USD 3,498,000

In order to present a conservative estimate of the average increase in income to the expeller owners, it will be assumed that 75% of the palm oil the mill owners and customers produce is

due to project intervention. This takes into account a 60% increase in extraction rate, as well as a further 15% (minimum estimate) in increased throughput due to the substantial time-savings per gallon of oil processed and therefore the increased amount of palm fruits harvested and processed. Fifty percent of the owners interviewed stated that they were now harvesting their trees more frequently due to the introduction of the technology. Assuming that 13,090 gallons per machine per year represents a 75% increase in production, then approximately 7,480 gallons were produced annually prior to the use of the Freedom Mill 2. Thus at least 5,610 gallons of palm oil valued at USD 14,575 (assuming 95% tenera and 5% dura fruits processed) are produced annually per FM2 in addition to what was being processed before the project began (Table 5). This monetary amount represents the incremental increase in annual income accruing to the FM2 owners and their employees and customers. For 240 operating units, this equals USD 3,498,000. The net increase in annual income recorded in the midterm evaluation was USD 4,460,260. **Therefore, over the life of the project, these units would have earned USD 7.95 million in increased income.**

The FM2 owners produce palm oil that is used in multiple ways. Among the 31 owners, the palm oil may be sold in small, local markets (90%) or sold to centralized depots at larger markets (11%). Sixty-one percent of the owners stated that the oil they produce is used as food. This was most common in Nimba County. Forty-five percent of the owners store the palm oil for future use.

Approximately 66% of the mill owners operate the machines on small plantations. The reported number of hectares harvested ranged from 2 to 96 hectares. The farm covering 96 hectares was a major outlier, however, with the next largest farm measuring 13 hectares. The median surface area planted is 3.5 hectares, while the median area harvested is 2.5 hectares. For 240 mill owners the total surface area planted is 840 hectares while the area harvested is approximately 600 hectares.

FM2 owners described their experiences with technology performance and maintenance issues. Over 90% of the owners pay for monthly machine repair and maintenance, ranging from a minimum cost of LRD 300 to a maximum of LRD 2,520. Many of these costs are associated with replacement of the ball bearings. The median cost of repairs is approximately LRD 840 (USD 9.88) per month or approximately USD 60 for six months of operation. Ball bearings are generally available in the market towns in Bong, Lofa and Nimba Counties. Other than ball bearing replacement, only one mill owner reported a problem with the handle breaking. No other technical problems were reported.

The owners provided the following feedback regarding their satisfaction with the technology:

- “It makes life easy for us.”
- “It makes the work easy and produces more oil.”
- “It is productive and profitable.”
- “It reduces hard labor and increases income.”

The FM2 owners described the following challenges:

- Constant repair of the bearings
- High cost of transportation

- Limited access to barrels, tubs, and other forms of oil storage

The FM2 owners made the following suggestions to improve the activity:

- “The technical team should increase their level of visits to help orientate us on the use and repair of the machine.”
- “Let Winrock link me to big oil buyer.”
- “Let Winrock produce FM2 for country palm.”
- “We need more extension services.”
- “Let the project extend to other parts of Liberia to help reduce poverty.”
- “Reduce the price of the FM2.”
- “Let Winrock link me to a regular customer to buy my oil and assist me get loan to buy kernel press and expand my business.”
- “Improve the quality and durability of the bearing.”
- “Extend nursery activities to our community.”

iv. Users/customers

Nearly all of the FM2 owners (95%) reported that they rent out the expellers as service units to customers. According to project records, each unit serves approximately 21 customers. For 240 units, this equals 5,040 customers. The customers constitute the largest proportion of project participants, and with the FM2 owners they are ultimately responsible for the success of the diffusion of the mill in Liberia. A total of 68 customers were interviewed, 61% of whom were men and 39% women. For 5,040 customers this equals 3,074 men and 1,966 women.

The customers produce palm oil for a variety of reasons, although the majority (94%) plans to sell their oil in local markets while only 4% sell the oil to depots in larger towns. Approximately 50% also use the palm oil for food, and 29% use it for making soap. Another 16% of the customers also store some portion of their palm oil for later use.

Prior to the introduction of the Freedom Mill technology, all of the customers interviewed stated that they produced palm oil manually. Manually processing one drum of palm fruits took on average 8 hours. When using the FM2, the time to process one drum of palm fruits is reduced to approximately 42 minutes. With the FM2, processing takes only 9% of the time needed for manual processing. The saved time is generally used to prepare an increased amount of palm fruits to process or is spent on other activities. When asked why they chose to use the FM2, most customers (93%) said that it required less work than the manual method. Ninety percent also reported that the quality of oil produced was better, and 40% noted that the use of the FM2 reduced production costs. Thus the reduction in labor time and effort and the improved oil quality were considered the most beneficial aspects of the technology. Only 10% of the customers stated that they also continue to produce palm oil manually. Several noted that they still use the “pit” method to make country (dura) oil and they also use the pits when the FM2 is not available.

To use the mill services, all of the customers report that they pay between 1 and 2 gallons of oil per drum of fruits processed. In Bong and Lofa counties, the customers paid 1.5 or 2 gallons per

drum while in Nimba County, most people paid 1 gallon of oil per drum of fruit processed. This spatial grouping is consistent with findings from the SHOPS midterm evaluation and reveals dissimilar economic and cultural norms shaping owner-customer relationships pertaining to palm oil businesses in different regions of Liberia.

The customers provided detailed information regarding the amount of palm oil obtained from the use of the mills compared to oil yields obtained through manual processing methods. Prior to the use of the mills, the customers obtained a mean value of 1.76 tins (8.79 gallons) of oil per drum of palm fruits processed. When using the mills, the mean oil yield per drum of fruit increased to 2.99 tins (14.92 gallons) for an average increase of 1.23 tins (6.1 gallons).

This represents a 70% increase in extraction efficiency. The correlation between oil yields before and after the use of the FM2 reveals the tendency of yields to increase with mill use. Approximately 72% of the customers processed *tenera* fruits, 24% processed both *tenera* and *dura*, and only 4% processed *dura* fruit exclusively. Ninety-five percent of all fruit processed was of the *tenera* variety.

Over half (57%) of the customers interviewed reported that they employ a total of 210 workers to process palm oil (or approximately 3 workers per customer). Thus in addition to the employment opportunities generated by the FM2 owners themselves, the FM2 customers are also providing seasonal jobs to approximately 15,120 people in rural areas (Table 6). These jobs are linked to the various phases of harvesting, preparing, and processing palm fruits into palm oil.

Table 6: Workers employed by FM2 customers						
Job	Men	Women	Total	Wage per drum	Drums per year	Wages paid per year
Picker	1,344	3,360	4,704	USD 1.61	48	USD 363,525
Miller	13,440	1,747	15,187	USD 1.42	48	USD 1,035,146
TOTAL	14,784 (74%)	5,107 (26%)	19,891			USD 1,398,671

iii. FM2 owners from LSOPRP

In addition to the FM2 owners who purchased their machines during the SHOPS project period, the surveyors interviewed five owners who had purchased their machines under LSOPRP between 2009 and 2010. The goal of interviewing these owners was to gauge whether the 180 mills sold during LSOPRP are still in operation, whether they are experiencing different kinds of technical issues, and if the technology generates impacts after 4 to 5 years of use. The five mills were still in operation and being used in much the same way as the newer mills sold under SHOPS. The owners did not report any significant technical problems.

Assuming that the LSOPRP mills are still in operation, there are approximately 480 FM2 currently in use in Liberia in 2014: 180 sold during LSOPRP, 60 sold during the interim periods between LSOPRP and SHOPS, and 240 sold during SHOPS. Taking all mills into account in the measurement of the impacts of the technology significantly magnifies the benefits of USAID's support of the promotion of the FM2. For example, while 240 mills generate USD 3,498,000 in annual increased income, 480 mills boosts this figure to USD 6,996,000. In addition, all mills combined produce an estimated 2,692,800 gallons of palm oil annually.

From the observations made by SHOPS staff and the technology users themselves, it is reasonable to expect that the life of operation of a FM2 is at least 6 years and possibly longer. This operational life may be taken into account when calculating anticipated economic impacts per machine. For example, one machine producing a total of 13,090 gallons of oil annually will produce at least 78,540 gallons worth USD 196,350 over the life of the technology if palm oil values remain a minimum of USD 2.50 per gallon.

Participant Type	Total for 240 units in operation		
	F	M	Total
Manufacturers	2	10	12
Vendors	3	17	20
Unit owners	137	48	185
Processing unit manager	14	103	117
Clearers	267	1,147	1,414
Harvesters	0	192	192
Millers	103	213	316
FM2 customers	1,966	3,074	5,040
FM2 Total Participants	2,492	4,804	7,296
Manufacturing enterprises			4
Processing enterprises			185
Total enterprises			189

B. Nursery Operators

SHOPS extension agents work with Liberian nursery owners to build a local supply chain for *tenera* oil palm seedlings. A total of 43 nurseries have been trained and 32 nursery operators were interviewed during the survey. A majority of the nursery operators are men (53%) while only 3% are women and 44% are groups/cooperatives with multiple members. A total of 18 of the nursery owners interviewed had produced seedlings during Phase 1 of SHOPS, while 30 produced during Phase 2.⁴ Only 10 nurseries produced seedlings during both phases.

	Phase 1 (23 nurseries)	Phase 2 (30 nurseries)	Total
Seedlings in pre-nursery	52,200	82,695	134,895
Seedlings survived	40,000	70,000	110,000
Survival rate	77%	85%	82%
Seedlings sold	30,977	45,000	75,977
Value of seedlings sold	USD 141,255	USD 205,200	USD 346,455
Mean gross income per nursery	USD 6,142	USD 6,840	n/a
Seedlings planted	8,692	n/a	n/a

⁴ A total of 23 nurseries participated in SHOPS during Phase 1 but not all of them were interviewed for this study. Only 24 out of 30 nurseries in Phase 2 participated in this final evaluation. The production and sales data in Table 8 is drawn from project monitoring records. These were deemed more accurate than the estimates and extrapolations collected during survey administration.

The 30 nursery operators produced between 500 and 12,000 *tenera* seedlings with a mean of 2,634 seedlings per nursery during Phase 2. The total number of seedlings grown over the two-year period was 134,895. With approximately 110,000 seedlings surviving, the survival for all seedlings was 82 percent. Of those surviving, 30,977 were sold during Year 1 worth a total of USD 141,255 (Table 8). The nursery operators estimated a retail value of USD 4.56 per seedling, only slightly less than the project-recommended price of USD 5.00 (LD 425). The seedlings produced during Year 2 were not ready for transplanting at the time of this survey and the following sales figures are estimates. The minimum number of seedlings that are projected to be sold in Phase 2 is 45,000 worth USD 205,200. The total value of all sales during Years 1 and 2 will be approximately USD 346,455.

The nursery operators reported that they sell the seedlings to several different types of customers. Nearly 90% said that they sell to small farmers, 50% sell to large farmers, 9% sell to cooperatives, 9% sell to NGOs or other institutions, 3% sell to plantations, and 3% produce for personal use. When asked if the customers have requested other varieties of tree seedlings, 66% of the nursery operators reported that their customers want access to coffee, cocoa, rubber, oranges, plantains, and vegetable seedlings. This demand for a broader variety of seedlings suggests new opportunities for the nurseries to supply a greater range of products that will likely stimulate further growth in the tree crops sector in rural areas. SHOPS is currently working with the LIFE III Cocoa Program to encourage diversification in cocoa. Approximately 72% of the nursery owners also own land on which they propagate tree crops. The number of hectares owned ranged from 2 to 56 for a total of 256 hectares, with a median of 5 hectares per owner.

	Men	Women	Total	Daily wage (USD)	Average days per year	Annual wages per employee	Total wages paid annually
Supervision	19	0	19	1.79	113	USD 202.27	USD 3,843
Clearing	222	112	334	1.81	4	USD 7.24	USD 2,418
Poly bags	242	245	487	1.78	4	USD 7.12	USD 3,467
Watering	80	99	179	1.57	75	USD 117.75	USD 21,077
Pre-nursery	118	81	199	1.55	1	USD 1.55	USD 308
Transplanting	163	155	318	1.64	5	USD 8.20	USD 2,608
Weeding	64	166	230	1.61	8	USD 12.88	USD 2,962
TOTAL	908	858	1,766				USD 36,683

Most of the nurseries employ workers to carry out the various tasks associated with seedling production including supervision, clearing land, preparing poly bags, watering, tending the pre-nursery, transplanting and weeding (Table 9). These employees generally earn daily wages.

In addition to hiring a large number of workers, the nursery operators also paid for a variety of operating costs. These costs included fertilizer, seeds, tools, fencing, transport of seeds and materials, poly bags, and fungicide. The total cost for these items was USD 66,370, or a mean of USD 2,074 per nursery (Table 10). As noted above, the nurseries participating during Year 2 earned a mean gross income of USD 6,480. According to the employment data provided above, the nurseries employ an estimated 55 workers paid USD 1,146 annually (or USD 21 per worker). Therefore **the net income earned per nursery was USD 3,260**. The total increased income

earned by all nursery participants in Phase 2 including owners and their workers was the value of all seedlings sold minus total operating costs, or USD 280,085.

Table 10: Nursery operating costs			
Item	Number of owners	Mean individual cost	Total cost
Fertilizer	29	USD 126	USD 3,666
Seeds	26	USD 1,712	USD 44,501
Tools	20	USD 145	USD 2,903
Fencing	19	USD 176	USD 3,340
Transport	19	USD 128	USD 2,434
Poly bags	17	USD 503	USD 8,550
Fungicide	13	USD 75	USD 976
TOTAL			USD 66,370

The nursery operators described a number of challenges they faced while producing the seedlings. Nearly 45% stated that they have problems with irrigation, either because their water source is far away or watering is labor intensive. Another 31% said that they have experienced problems with insect pests, and several nursery owners also had problems with rodents. Two owners experienced difficulties in obtaining fertilizer and one owner complained of seedling theft. The majority of the owners had no problems obtaining the tenera seeds although one person mentioned that they had trouble transporting the seeds, and one person received their seeds a bit late.

When asked if the technical training was satisfactory, the nursery owners provided the following feedback:

- “The training support given by Winrock was very good because it gives both technical skills and confidence in managing my nursery and selling to other small farmers.”
- “The training was very good but we need more training in pest and insect management.”
- Several owners requested further training in business management, transplanting, compost making and fertilizer application, transplanting, and pest control

Because this activity is still relatively new to most of the nursery owners, they would benefit from ongoing training and extension services in order to solidify the training they have already received. When asked if they would be able to continue producing palm seedlings without the support of the project, 34% of the owners stated that they would require further support to continue production activities. The rest of the owners stated that they believed they could work on their own now that they had technical skills and business contacts.

Table 11: Nursery Participants			
Participant Type	Total for 32 nurseries interviewed		
	F	M	Total
Individual nursery owners	1	17	18
Supervision	0	19	19
Clearing	112	222	334
Poly bags	245	242	487
Watering	99	80	179
Prenursery	81	118	199
Transplanting	155	163	318
Weeding	166	64	230
Total nursery participants	859	925	1,784
Individual nursery enterprises			18
Group nursery enterprises			14
Total enterprises			32

C. Loan Recipients

i. Cooperative recipients

SHOPS facilitates the process of applying for and managing microfinance loans and has thus far assisted 5 farmer cooperatives and 2 businesses in obtaining loans worth at total of USD 197,477. This analysis will consider the impacts to the cooperatives and their members (Table 12). The cooperatives engage in myriad economic activities including production of cash crops such as oil palm, coffee, cocoa, sugar cane, rice, vegetables and rubber. The cooperatives also engage in animal husbandry and provide other services including savings and loan, advocacy and conflict mediation, and rice purchasing.

Table 12: Cooperative Loan Recipients			
Cooperative Name	Location (County)	Members	Individual loan recipients
Panta Farmers Multi-purpose Cooperative Society(PANFAMCOS)	Bong	450	13 men, 7 women
Pulukpeh Multipurpose Cooperative Society	Bong	197	12 men, 8 women
Gbehlay-Geh Rural Women Structure	Nimba	700	4 men, 21 women
Kwakerdoe Farmers Multipurpose Cooperative Society	Nimba	60	12 men, 8 women
Gbehlay-Geh Oil Palm Farmers Cooperative	Nimba	125	14 men, 6 women

The cooperatives received three rounds of loans and dispersed the loans to individual members. The first round of loans was dispersed in May 2012; the second round was dispersed in February 2013. These loans were expected to provide funds for expanded agricultural production at the beginning of these two seasons. A third round of loans was dispersed to one of the groups in July 2013. The pay back period for each round of loans was 6 months. Four of the cooperatives

dispersed 20 loans each, while one cooperative dispersed 25 loans. The loan recipients were selected by special committees designated to screen applications within each cooperative. The funds were obtained from Liberia Entrepreneur and Access Development (LEAD), Ecobank, and Afriland Bank. In some cases the experience of taking and repaying loans has improved the credit standing of the cooperative and has allowed them to conduct business with commercial banks that provide lower interest rates and longer loan duration. This has occurred with 2 cooperatives that have moved on from LEAD to Afriland.

The cooperative leaders provided feedback regarding the attitudes of the recipients of the loans. One statement in particular sums up the responses of all five groups: “The members have misfeelings (sic) about the repayment. While they were all happy to have received loan they felt embarrassed because the repayment schedule was short and stressful.” All of the groups felt that the repayment period was too short. One group also expressed that the interest rate was too high, and that the disbursement was made at an unfavorable time during the rainy season. The short repayment period posed challenges to the groups in the form of delayed payments made by the individual recipients. In addition, two groups faced bad road conditions during the period when repayment was due to LEAD and this forced them to incur extra costs to ensure that the money was transported and deposited on time.

In general, however, the groups reported success in terms of the activities undertaken by the recipients. Specifically they stated:

- The loans helped members to recondition their farms and enabled them to engage in new business and expand existing ones. This helped to increase yields from the farms and also increase profit and income of small businesses of loan beneficiaries.
- Many recipients expressed progress in their businesses, and this has enabled them to take care of some of their family responsibilities such as school fees, medical, food etc.
- It allowed them to engage into some form of businesses, expand their existing businesses and help to take care of their family affairs.
- The loan enabled them to recondition their farms/gardens, increased yields and brought more income. The loan help beneficiaries to pay their children school feels, medical and feeding.
- It helped to recondition farms and increase vegetable production. It helped members to engage in businesses that serve as employment for them.
- The loan opened up a window of togetherness/unity among members and strengthened the cooperative. The loan also opened business opportunities for our cooperative members to be self-employed.
- The loan increased and improved the standard of living of our members by enabling them to easily cater to their social and economic responsibilities such as sending children to school, buying cloths, and household utensils, footing medical bills, etc. These were possible because of the increase in income brought about by the loan.

The cooperative leaders also made the following suggestions to improve the loan process:

- “We would like to suggest that LEAD lower their interest rate and live up to their promise in terms of the loan disbursement time/schedule. We are experiencing some

delay in that area right now. We would also like for LEAD to give both seasonal and development loans that will not only be meant for cooperative members but that will also help to improve the cooperative herself as an institution.”

- “We would like to appeal to Winrock SHOPS and LEAD to continue to lend money to us small farmers on a timely basis to the cooperative so as to help empower its women-based members.”
- “We would like to recommend that LEAD give us more time to repay the loan and disburse the loan on time; that is the loan should be given during the dry season (October to April) to reduce the stress on us. We will appeal that the loan amount be increased to allow more of our small farmers to benefit.”
- “We would like to thank Winrock and LEAD for the loan but would like to appeal that the repayment schedule be extended and the amount of loan be increased to enable more of our cooperative members who are all small farmers to obtain loans.”

ii. Individual recipients

A total of 105 individuals (55 men, 50 women) received loans from the cooperatives. A total of 20 individuals participated in the survey (10 men and 10 women). The mean loan value reported was LD 16,650 (USD 196). The loans were used mainly for business activities (60% of the recipients) and agricultural activities (45%). One of the recipients reported using the loan to build a house, and 20% of the recipients used part of the loan to pay for school fees. Profits were used to pay for educational costs (75%), food (40%), business investments (35%), agricultural activities (30%), house construction (10%), and to purchase assets (10%). All but one of the recipients reported that the loans had resulted in successful economic activities. The one recipient who reported an unsuccessful loan stated that the repayment time was too short and the interest rate was too high.

Sixty-three percent of the loan recipients rated their training in loan management as very good, 26% rated it as good, and 5% rated it as excellent. In addition, all of the recipients expressed interest in taking out additional loans valued between LD 10,000 and LD 200,000.

Although the individual recipients expressed general satisfaction with the outcome of the loans, many of the recipients communicated some frustration with the loan process. Seventy percent of the recipients reported that the repayment schedule was too short, 40% stated that the interest was too high, 10% stated that the loans came late, and 5% said that they came at an inappropriate time of year. The nature of the activities into which the recipients are investing loan funds require a longer time horizon in order to ensure profitable returns. This issue is especially sensitive with regard to the seasonal calendar of agricultural activities.

The loan recipients described the following impacts from their loans:

- “The loan has helped me to get steel mill to produce cane juice.”
- “The loan helped me pay my children’s school fees, feed my home and take care of my business.”
- “It has helped to get my family a house that we today sleep under with happiness.”
- “It helped me to rehabilitate my plantation and paid my children's balance tuition.”

- “The loan helped me brush my farm which allows it to bear good and gives me more money.”
- “Though I did not get profit, I was helped to go into business again and establish connections with the farmers.”
- “It helped me to start up in life as a widow. It has enabled me to send my children to school and provide food for the home.”
- “The loan has helped me own a rice mill which I use to get more income.”

The loan recipients also made the following suggestions to improve SHOPS:

- “I want to extend thanks to Winrock for the efforts and would like to appeal to them to increase the loan, reduce the interest rate and give us more time to pay back.”
- “I want to appeal that the time for repayment of the loan be extended to 12 months to allow us to invest in agricultural activities and sell the produce at the appropriate time.”
- “I will like to recommend that the lending agency extend the repayment time to at least 8 months and reduce the interest rate to 10%.”
- “I would like to recommend that the timeframe for the repayment of the loan be increased from six months to one year to enable invest the money in profitable business. Also, those giving the load should bring it on time as promised. Also, the interest rate should be reduced.”
- “I would like to recommend to Winrock/ LEAD to consult with us so that the loan is given at an appropriate time so as to make repayment easy and making profit possible and easy.”

Participant Type	Total for 32 nurseries interviewed		
	F	M	Total
Individual loan recipients	0	2	2
Cooperative loan recipients	50	55	105
Total loan recipient participants	50	57	107
Individual loan recipient enterprises			2
Cooperative loan recipient enterprises			105
Total loan recipient enterprises			107⁵

V. Social and Environmental Impacts

Some examples of the qualitative social impacts of SHOPS activities were revealed in the findings above. For example, many of the participants were able to more easily pay for everyday household needs such as healthcare, school fees, food, and shelter after engaging in income-generating activities. These types of social impacts occur at the level of individual project participants and their households. However, there are many indications that the project activities are also generating important social impacts at the level of communities. Some of these impacts

⁵ The total number of loan recipient enterprises counted in the introductory summary table is 106 rather than 107 because one of the individual recipients was one of the manufacturers and is already counted.

were identified during focus group discussions aimed at understanding the broader and more long-term effects of SHOPS interventions.

The processing and oil palm production activities have generally had a positive influence on people's attitudes toward palm oil businesses as a livelihood option. The activities have encouraged people to plant *tenera* and to invest in processing equipment to increase oil production. People now see oil palm as a positive venture for investment, since processing activities now require less labor and fewer cost inputs. In many respects these activities foster greater community cohesion by stimulating grassroots economic development, reinforcing control of local resources, and enhancing community empowerment.

The introduction of processing technology is also altering social relationships in novel ways by enabling technology and business owners to increase their own profits at the expense of community-based economic activities. For example, manual methods of palm oil processing often involve large numbers of community members who may all claim a share of the final product. This form of shared labor constitutes an important community interaction by reinforcing relationships across gender and age groups, reiterating traditional cultural practices (such as singing songs while pounding palm fruits), and providing a communal source of food and nutrition. These community interactions are disrupted and altered with the introduction of labor-saving technologies. People who formerly specialized in manual methods of production including pounding and washing palm fruits need to develop new kinds of skills to compete with or become engaged in mechanical processing methods. Community-owned resources such as *dura* oil palm trees and palm oil could potentially be replaced with individually owned *tenera* trees and processing equipment. Although many people benefit from the introduction of these new forms of technology, the technology owners tend to earn higher profits, and often enjoy greater economic power and prestige. The commercial approach of SHOPS based on private ownership of goods and property may exacerbate some forms of social and economic inequalities in rural areas.

Over the long term, processing technologies and the introduction of small-scale *tenera* farming may lead to changes in local patterns of consumption particularly with regard to palm oil as a staple food. In the short term, Liberian consumers are unlikely to abandon *dura* palm oil as the preferred cooking oil due to its flavor and consistency (despite its higher price). However, as more *tenera* palm oil is processed and circulated in local markets, decreasing prices may compel people to switch to the lower-cost option. This transition could potentially have implications for nutrition and public health linked to the differing proportions of free fatty acids in the different varieties of palm oil. For now, *tenera* is likely to remain the oil of choice for soap making and exchange while *dura* will continue to be used as the preferred edible oil.

In terms of environmental impacts of technology diffusion through SHOPS, the FM2 has reduced the amount of water needed to process each batch of palm oil. For example, the manual method of oil extraction requires up to five drums of water per drum of fruit while the use of the FM2 requires only half a drum. The total amount of water used may ultimately stay the same or increase however due to the increased number of batches processed with technology use. Wastewater from processing activities is considerably decreased with the FM2, which has resulted in less contaminated processing water directed into streams and rivers. *Tenera* seedling

production has increased water usage for irrigation purposes, but creates little to no stream pollution as irrigation water is absorbed into the plants. Finally, many byproducts of mechanical processing (such as fibers, etc) are used as fuel, kernel cake, and composting materials.

The introduction of *tenera* seedlings is encouraging increased agricultural land use in Bong, Nimba, and Lofa counties. Replacing old trees and secondary growth with *tenera* seedlings is contributing incrementally, albeit slowly, to land cover change. Some landowners are choosing to reserve more of their land for *tenera* planting. This reduces agricultural land available for other annual and tree crops. At this time, the surface used for planting of *tenera* seedlings is relatively small and distributed across several counties compared to the amount of land available for cultivation and does not pose an immediate threat to other forms of agriculture.

A potentially contentious issue linked to the planting of *tenera* oil palms is land tenure. Conflicts surrounding land tenure in Liberia are notoriously complex and long-standing, many of them dating to the period prior to the Liberian civil war. Investing in, and planting tree crops establishes a long-term claim to land. If ownership disputes emerge, this could negatively affect or destroy the investments farmers have made in establishing trees. Thus far, SHOPS has consistently encouraged planters to discuss land tenure issues with local authorities to prevent land disputes.

VI. Recommendations

Building on the feedback provided directly from the survey participants, the following recommendations suggest ways that SHOPS and future development projects in the oil palm sector could enhance performance and extend outreach.

1. Measure the increased number of hectares of palm trees harvested when the mills are in use.

Measuring the increase in palm tree harvesting will assist in generating more precise calculations of the overall increase in palm oil production with the use of the promoted technologies. The estimates provided in this report are conservative and likely much less than the actual increases generated by technology usage.

2. Provide enhanced and continuing technical support to nursery operators and oil palm farmers.

For most of the nursery owners, the production of *tenera* seedlings is still a very new activity. Further support through extension services will ensure quality control and help to improve survival rates. In addition, oil palm farmers and outplanters will need further technical support as the trees mature. Future project activities should also focus on commercialization, sales tracking, and market research. The nurseries need to develop viable business models to increase the scale and technical capacity of activities to meet market demand.

3. Increase the loan repayment period, lower interest rates, and ensure that loan dispersal correlates with agricultural calendars.

According to the majority of the loan recipients, the average repayment periods, timing, and interest rates were not appropriate to the needs of rural entrepreneurs and farmers. The lending institutions should conduct further stakeholder analyses in order to offer financial products more suited to the needs of this target group. LEAD may need to more thoroughly and accurately assess the management structure and capability of the cooperatives before providing loans. In addition, both the cooperatives and LEAD should strengthen security of collateral before loan approval. Alternatively, future project interventions should focus on loans for actors and activities specifically in the oil palm sector rather than mediating the loan process for cooperatives engaging in diverse economic pursuits.