A Palm Oil Mill in Oyo State
A Draft Proposal for a Private Venture

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Prepared for:
The Executive Governor of Oyo State
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Through the Commissioner for Agriculture
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12 January 2002

Executive Summary

We are proposing to develop a small-to-medium scale palm oil plantation and mill in Oyo State, Nigeria. The vision includes a 1000 hectare (2500 acre) plantation of Tenera-type hybrid palm nut trees, planted approximately 150 trees per hectare (ha). These trees, when mature, should produce between 8 and 10 million kg of fresh fruit bunches (FFB) of palm fruit per year. When processed, this is expected to yield 1.5-2 million liters of cooking grade palm oil annually, and will generate roughly from $0.8-1.0$ million U.S. per year in revenue. Most of this income is to remain in Oyo State through direct wages, other operating expenses, grants to the Good Samaritan Society of Nigeria, or further investments in local industrial development.

1 Background

1.1 Motivation

On a recent visit to Nigeria, the author had the opportunity to observe rural women involved in the production of cooking grade palm oil in Oyo State. After some further investigation, it became clear that the demand for palm oil in Oyo state must greatly exceed the supply available through these small-scale village production methods. On returning to the United States, a committee of those interested in developing and financing this kind of project formed to study the possibilities. We have come to the conclusion that the development of a palm oil plantation and mill in Oyo State is economically viable.

But the deeper motivation for this project comes from the vision of the Good Samaritan Society of America, and its Nigerian counterpart, to make a positive impact in the lives of Nigerians living in rural areas. This project would seek to support that vision through financial support for the Society in its mission and through the development of jobs for local residents. The project would also increase the opportunities for interaction between Americans involved in the project and the Nigerian people in Oyo State, hopefully resulting in additional benefits to both groups as they share their lives and different cultural perspectives.

1.2 Opportunity

The economic opportunity comes from three main areas: the demand for palm oil, the availability of palm nut trees and suitable climate, and the availability of labor. Each will be discussed briefly.

The local demand for palm oil is substantial. It is estimated that for every five people in Nigeria, perhaps two liters of palm oil or more are consumed each month for cooking. There are probably probably between 5 and 10 million people living in or near Ibadan, so that possibly 50 million liters of oil or more are needed to supply this market per year. It is not known how much of this demand is supplied by local palm oil producers, but it seems likely that much of this oil must be brought in from outside Oyo state. It has been reported that, although once a significant exporter of palm oil, Nigeria is now an importer, and it is possible the some of this demand may be currently supplied by foreign imports. In any case, it does not seem likely that the introduction of two million liters per year or less into the local market will have significant adverse effects on either the existing local producers or the local wholesale price.

Although only a fraction of the local demand would seem to be met by locally produced palm oil, there is clearly the potential to produce much more. Palm nut trees are grown in a number of tropical areas around the world, but they are native only to the tropical ares of West Africa. In the vicinity of Ibadan are large numbers of palm nut trees, although it seems that the fruit is harvested from only a relatively small number of them. Clearly the local soil and climate is well suited to the palm nut tree, and there seems to be enough land that is not currently productive that would be suitable for establishing a plantation.

In addition to a good potential supply of palm fruit and a ready market for the oil, it is important that there be a good supply of affordable labor. This clearly is present, as the only requirements are a general education and a willingness to be trained in the specifics of the plantation care and harvesting or machine operation. There will also be a need for a few management level people, with advanced skills and background in areas such as agronomy, industrial engineering, and perhaps chemical engineering. We expect to identify Americans supportive of the project who would be interested in filling some of these positions. Some Nigerians would also be needed fill the management needs.

2 Technical Details

There is much work remaining to be done to answer all the technical questions that need to be addressed. However, research done so far suggests that the challenges can be met. The technical information supporting this conclusion is broken down into sections describing the proposals for the plantation, the mill, distribution & marketing, organization, and statutory requirements.

2.1 Plantation

There are three main varieties of the West African oil palm: Dura, Pisifera, and Tenera. The Tenera palm produces the highest oil content of the three, but is actually a hybrid between the Dura and Pisifera. Modern Tenera or variant hybrids are usually planted when establishing a plantation, due to the high oil yield. Over 40% of an individual palm fruit, and over 20% of a fruit bunch from a typical Tenera palm can be extracted as palm oil.

Tree densities as high as 300 trees per hectare have been reported, but it is generally agreed that approximately 150 trees per hectare is recommended. The trees typically start producing in the third year after transplantation from nursery stock, and reach peak production by perhaps the fifth year. In southeast Asia, where the extensive plantations are all descended from a small number of transplanted West African palms, trees are generally cut down and replaced when they reach about twenty years old. However, it is not clear if that is the best strategy for the local Nigerian climate and soil conditions.

Once trees reach maturity and produce fruit, 9,000-10,000 kg of fresh fruit bunches (FFB) per hectare (ha) can be expected from a well-managed plantation. Assuming Tenera palms and good extraction efficiencies in the mill, this will yield approximately 2,000 liters of oil/year/ha.

There are a number of technical details that still need to be worked out with respect to the plantation. These include identifying the appropriate use of fertilizers (if any), general tree care, ground cover/management, possible mixing of other crops, pest control, harvesting methods and equipment, and transport of the harvested bunches. Our intention is to enlist the services of an expert in oil palm agronomy to settle the final details of the operation of the plantation.

2.2 Mill

The capacity of the proposed mill is based on a number of factors:

- availability of capital;
- availability of land;
- availability of equipment;
- production costs per liter;
- anticipated impact on local economy, both positive and negative;
- environmental impact; and
- experience and expertise.

All of these factors have significant uncertainty at this time. Although production costs per liter tend to decrease as the size of the mill is increased, other factors motivate us to consider the medium sized plant that is being proposed. Theses factors include the availability of capital, the desire to minimize any possible negative impact on the environment and the local economy, and the limited experience and expertise of the present group. Due to these factors, it seems prudent to start more conservatively with the size mill that is being proposed, and to consider further expansion after demonstrating initial success.

The proposed mill capacity is targeted in the vicinity of 10,000 kg/hr of fresh fruit bunches (FFB) of palm fruit. Given the seasonal nature of the palm fruit harvest in Nigeria, it is expected that the plant will only operate near capacity for perhaps four months of the year, and at less than half capacity for the remainder. An annual average of half the maximum capacity, or 5000 kg FFB/hr processing throughput is estimated.

Although there are a variety of processing methods available, the appropriate processing technology is one that produces the highest quality oil with the highest extraction rate and lowest cost given the available capital. Very large mills use solvent extraction methods to obtain over 99% of the available oil from the palm fruit. For the smaller scale plant proposed here, mechanical methods are used that can extract perhaps 90% of the available oil. At an average annual throughput rate of 5000 kg (FFB)/hr, this would be expected to produce about 2 million liters/oil per year.

The exact processing details depend on the kind of equipment to be used. Typical processing steps are as follows.

1. Transport the harvested bunches to the mill with minimum bruising for processing within 24 hours. This minimizes the fermentation of the oil, and makes it possible to produce a final product with low (¡3.5%) free fatty acids.

2. Sterilize/cook the bunches with steam under pressure. The sterilization destroys the enzymes that cause the oil to ferment.

3. Strip the fruit from the bunches. This will likely be done with a mechanical bunch stripper.

4. Process the individual fruit-lets in a digester that releases the oil.

5. Press the oil out of the digested fruit in a mechanical screw press.

6. Remove water, dust, and fibers from the oil by filtering and boiling and/or using a centrifuge.

In addition to obtaining appropriate equipment for the processing just described, a facility will be needed. It is estimated that a simple building of about 300-500 square meters would be sufficient to house the equipment, and to provide room for both an office and limited storage. Reliable sources of both water (not necessary potable) and electricity will also be required. Documentation and record-keeping would be best facilitated with a computer and printer.

One challenge that will need to be addressed is the handling of by-products. The primary by-products are listed below, with estimated quantities based on an average annual throughput rate of 5000 kg (FFB)/hr, or a total of 10 million kg (FFB) processed per year.

- 3,500,000 kg of empty fruit bunches. Although these can be burned, they do not typically make a very good fuel, as they have a high water content. One idea is to chop them up for use as mulch for the palm trees.

- 2,250,000 kg of oil-pressed fibers. Local producers form these into small cakes to be used as cooking fuel. With a goal of extracting more oil from the fruit, the fuel value of the fibrous residue is uncertain.

- 1,750,000 kg of palm kernel nuts. Ideally, there will be sufficient capital and space to process the nuts into palm kernel oil, which accounts for about 50% of each nut by weight. The 875,000 kg/year of left-over shells might be sold as animal feed.

In addition, there will likely be a significant quantity of waste water from the sterilization and other processing steps.

2.3 Distribution & Marketing

Not much research has been invested yet into the plans for distribution of the palm oil. In general, the local wholesale market is targeted, meaning primarily people living within 50 km of Ibadan. Traditional distribution channels and methods will be employed if possible. The market for the palm kernel oil has not yet been explored.

2.4 Organization

Several important details are yet to be worked out with regard to the organization of the project. The proposals listed here are preliminary ideas.

The money for start-up capital expenses and initial operating expenses is expected to be raised from both American and Nigerian investors who support the project's goals. An American for-profit corporation, with a Nigerian affiliate or subsidiary, will be organized with the investors owning shares in the corporation.

The company will be operated according to international standards for quality control, documentation and bookkeeping. Although this will probably require some extra money to be spent hiring someone with these skills, it is expected that the investment will be worth it in the long run.

2.5 Statutory Requirements

In order for this project to succeed, an excellent relationship with the government and community leaders is absolutely essential. Based on the relationships already being developed through the Good Samaritan Society Mission in Oyo State, we have every reason to expect cooperation and support for a project such as this. However, details about the kind of support the government in Ibadan might be able to supply, and what kinds of incentives might

be available, need to be worked out. We also need to understand the taxes that would be applicable to this kind of enterprise.

3 Financial Analysis

This financial analysis is based on very rough estimates, and could change considerably before the proposal is finalized. The assumptions are that tree planting could begin right away, and that the mill would become operational in 2003. Before the trees are fully mature, a smaller amount of nuts could be bought from local farmers who have mature trees producing fruit now. When the plantation is fully operational, the desire is to continue to work with local farmers in addition to processing fruit from the plantation.

Financial Projections
(All estimates in thousands of U.S. dollars)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Capital									
Mill Equipment	10	0	0	10	20	30	40	0	0
Building/Shelter	2	0	0	5	5	5	5	5	5
Trees	30	40	50	0	0	0	0	0	0
Misc. (computer, truck, etc.)	5	0	0	5	10	10	10	10	10
Total Capital	47	40	50	20	35	45	55	15	15
Operating Expenses									
Palm fruit bunches	3	30	40	30	10	0	0	0	0
Mill operators (5-30)	5	5	5	10	15	20	25	30	30
Plantation workers (10-60)	10	10	15	25	40	60	60	60	60
Management/Engineering	5	5	5	10	10	15	15	20	20
Travel	5	8	8	8	10	10	10	10	10
Plantation (transp., etc.)	2	3	4	5	5	5	5	5	5
Mill (water, electric, etc.)	1	2	2	3	5	5	7	8	10
Maintenance/Repair	0	1	2	2	3	5	5	5	5
Land (Lease)	0	0	0	0	0	0	0	0	0
Taxes	0	0	0	0	0	0	0	0	0
Contributions (TGSSA)	1	6	10	12	16	27	52	104	130
Other	2	2	3	5	5	10	15	20	20
Total Operating Expenses	34	72	94	110	119	157	194	262	290
Annual Income									
Palm Oil	5	45	70	90	120	200	400	800	1000
Palm Kernel Oil	0	10	17	22	30	50	100	200	250
Other Income	1	5	8	8	10	15	20	40	50
Total Income	6	60	95	120	160	265	520	1040	1300
Net Income/(Loss)	(75)	(52)	(49)	(10)	6	63	271	763	995

There are likely to be a number of additional expenses beyond what has been anticipated above, and as was already stated, some of the numbers are very rough estimates that are likely to change significantly when more information is known.

Note that, among the listed expenses, we are proposing to commit ten percent of all income to go directly to the Good Samaritan Society Mission Village in Oyo State.

4 Conclusion

Based on the projections above it seems that this project has a very good chance to be financially successful. More important than the economic opportunity, however, are the several important ways in which we envision this project making a positive impact in the lives of the people of Oyo State.

- We will bring good income to the rural people in Oyo State, improving the economic well-being of the rural areas.
- We anticipate important positive social impact both through opportunity for regular employment and through participation in organized industry. In this regard we wish to include interested Nigerians at every level of the project, from workers to investors and owners.
- We hope that these factors will lead to reduced population pressure on the cities, by helping to make rural life more attractive and productive.

We believe we will be able to succeed in each of these regards, and so bring improved hope and prosperity to the rural people in Oyo State.

Profile

Jeffrey Vogel is a Principal Engineer working in process development at Boston Scientific–Scimed, an international manufacturer of medical devices. Prior to joining Scimed, he spent six years as an Assistant Professor in the Mechanical Engineering Department at the University of Minnesota. He received his B.S. and M.S. degrees in Mechanical Engineering from the University of Minnesota, in 1984 and 1986, respectively, and his Ph.D. in Mechanical Engineering from Rensselaer (RPI) in 1989. His research interests are primarily in the areas of manufacturing processes and process modeling, and he has published over 20 scientific articles in the study of materials and material processing. He has also been awarded three patents.

In addition to his scientific and engineering experience, Dr. Vogel's association with the Good Samaritan Society of America and Grace Evangelical Free Church of Fridley, MN, USA also contribute to his qualification to undertake this project. He serves as an elder at Grace Evangelical Free Church, and has traveled to Nigeria twice in the past three years as a member of both the church's choir and orchestra.

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