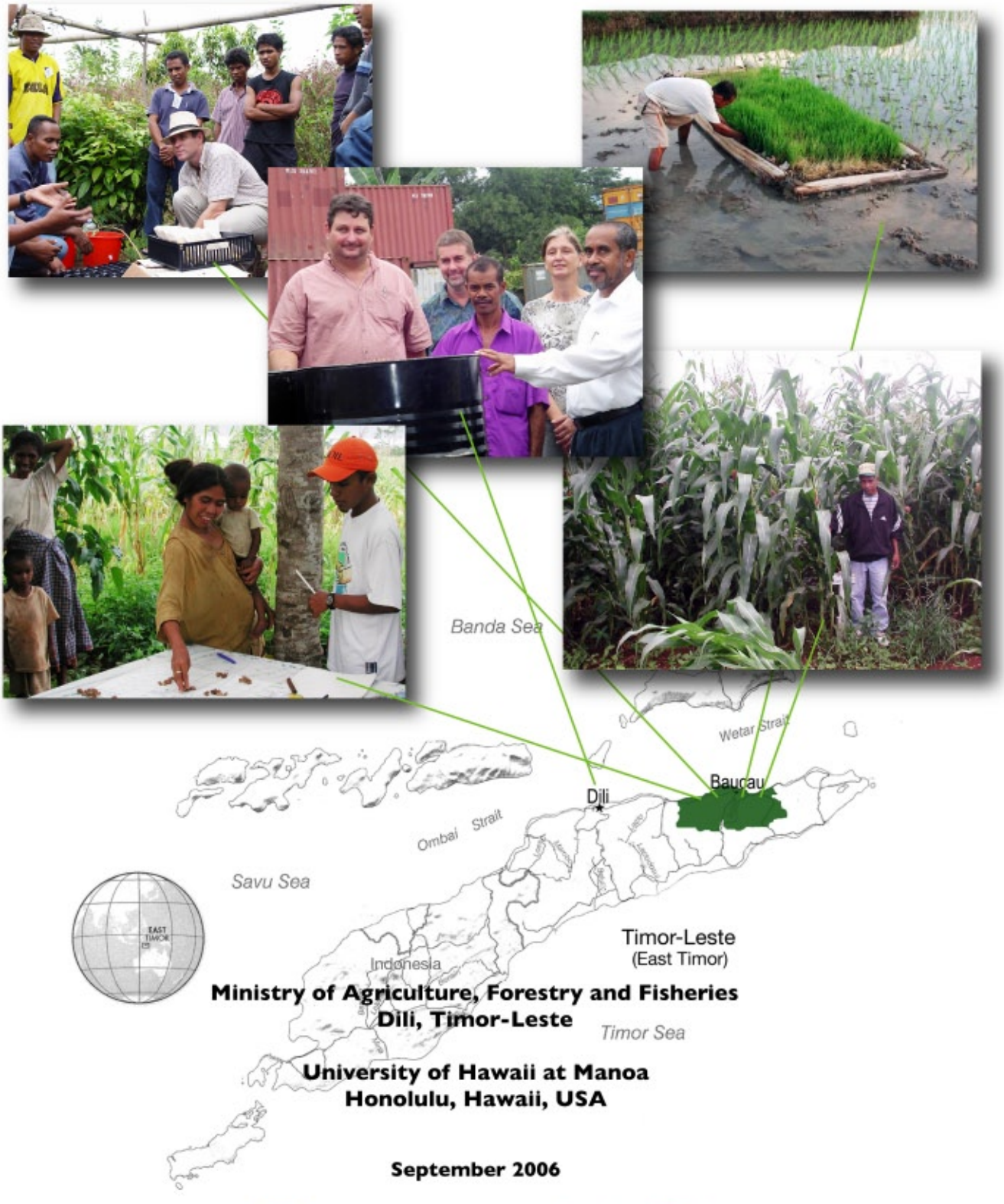
TIMOR-LESTE
AGRICULTURAL REHABILITATION, ECONOMIC GROWTH AND NATURAL RESOURCES MANAGEMENT

FINAL REPORT
(JULY 2003 TO DECEMBER 2005)



Ministry of Agriculture, Forestry and Fisheries
Dili, Timor-Leste

University of Hawaii at Manoa
Honolulu, Hawaii, USA

September 2006

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Andre S. du Toit
(1962-2004)

We dedicate this report in memory of Andre S. du Toit, who provided initiative, support, hope and energy to many in Timor-Leste

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cover top left Agroforestry nursery training of MAFF staff in Triloka *(Photographer: John Powley, UH)*
cover bottom left PRA exercise with women farmers in Venilale *(Photographer: Harold McArthur, UH)*
cover bottom right Improved crop performance with soil testing in Fatumaca *(Photographer: Richard Ogoshi, UH)*
cover top right Rice seedlings using ICM techniques in Seical *(Photographer: Richard Ogoshi, UH)*
center First candlenut oil shipment leaving Dili for Hawaii *(Photographer: Sildonia Sarmento, DAI/Dili)*

map on cover page and page 13 from Map Design Unit of The World Bank, April 2000

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EXECUTIVE SUMMARY

Participating farmers in three agro-ecological zones within the Seical watershed in Timor-Leste were able to increase maize yields from 1.5 tonnes/ha to 4.8 tonnes/ha and rice yields from 2.0 tonnes/ha to 4.9 tonnes/ha. These increases were achieved not simply by adding fertilizer, but by enabling the T-L Ministry staff to diagnose nutrient deficiencies with soil test kits and eliminate the cause for the low crop yields.

The project recognized that the entrepreneurial spirit is alive and well in Timor-Leste, yet this human quality must be linked to the ecological characteristics of the land in order to exploit its resourcefulness. Aquaculture near the coastal zone, poultry and animal husbandry in the middle elevation and vegetable production in the cooler, upper elevations are income- and job-generating enterprises that can be developed in one watershed and replicated in other watersheds throughout the country.

The importance of matching the biological requirements of an enterprise to the physical characteristics of the land was never more evident then with candlenut. The candlenut tree grows virtually everywhere in Timor-Leste, but more abundantly at the middle elevations. When the Timorese farmer deems the price is right, the nut is sold for export to Indonesia where it is used as a food condiment. The project was able to help identify a different export market. Now oil is extracted from candlenut and marketed internationally as an ingredient in cosmetics. This new market adds value to a local product, enabling businesses to generate new income and jobs. More importantly, rural households in Baucau can now earn new income by harvesting, processing and selling nut from trees that grow in and around their villages.

The importance of participatory stewardship was a lesson that can be learned by all. People who live by farming often fail to see the slow degradation of their land and surrounding environment and do not support efforts by outsiders to reverse the process. The project made the assumption that villagers and their leaders would support land conservation practices and policies if they had a voice in the design and implementation of activities, and especially if the people benefited from the outcomes. These conservation practices, such as growing privately owned teak trees that produce valuable timber or candlenut trees that produce marketable nuts, have a better chance of succeeding than large scale government-owned tree plantings, for example. Moreover, fast growing nitrogen fixing trees that provide fodder, fuel wood and income to households and at the same time improve soil quality by sequestering nitrogen-rich organic carbon in soils offer a way to protect and preserve the land for future generations.

This report also lists opportunities for future development, for in the end, the principal lesson learned is that agricultural rehabilitation is about enabling customers, whether they be farmers, Ministry of Agriculture personnel or policy makers to make better choices for themselves and for the society in which they live.

SUMARIU EZEKUTIVU

Agrikultor sira nebe'e partisipa iha zona tolu agro-ecological nian iha area dalan mota Seical, iha Timor-Leste, aumenta rezultadu batar hosi tonelada 1.5/ha to'o tonelada 4.8/ha; no hare hosi tonelada 2.0/ha to'o 4.9 tonelada/ha. Resultadu diak ne'e la'os liu hosi aumenta deit fertilizante, maibe Hawaii mos suporta Ministerio Agricultura Floresta e Pescas, atu uza material koko rai hodi halo diagnostika ba nutriente nebe'e menus no rezolve problema nebe'e uluk halo rezultadu ki'ik.

Projetu ne'e rekonhese katak ema Timor iha duni espíritu atu sai hanesan emprezario, maibe ita tenki halo ligasaun diak ba karakteristiku ekolojiku ho kapasidade rai nian atu bele realiza posibilidade diak. Hakiak ikan besik tasi, manu ho animal ki'ik iha foho lolon, i modo iha foho leten nebe'e malirin; ne'e hotu aktividade nebe'e bele kria rendimentu ho servisu diak iha area ida, depois bele replika iha dalan mota seluk iha rai Timor tomak.

Liu hosi aktividade Kamii ita hare katak importente tebes se atu halo biznis, rai nia fisik tenke pas ho buat nebe'e biznis tenke hetan hosi rai. Ai kamii moris diak iha Timor tomak, maibe barak liu moris iha foho lolon, iha rai as natoon. Wainhira agrikultor sira haree katak folin diak, sira fa'an kamii ba ema nebe'e halo esporta ba Indonesia, nebe'e ema uza hanesan temperus. Projetu ne'e ajuda hodi identifika merkadu exporta oin seluk. Agora dadauk, emprezario hasai mina hosi kamii nia musan depois fa'an ba merkadu internasional hodi sai henasan ingrediente ba kozmétiku. Merkadu foun ne'e aumenta valor ba produtu lokal, fasilita biznis kria rendimentu no servisu. Liu-liu, uma kain iha Baucau agora bele hetan rendimentu foun liu husi koleta, prosesu, i fa'an musan hosi ai nebe'e moris iha sira nia aldea laran.

Lisaun ida nebe'e ema hotu bele aprende katak importante servisu hamutuk Ema nebe'e hela ho agricultor dala barak la repara katak sira nia rai no ambiente hetan degradasaun no sira la fo tulun ema hosi liur nebe'e hadia fali rai. Projetu ne'e foti asumsaun katak ema iha aldeia no sira nia lider sira, sei suporta aktividade kuandu sira iha influensia hodi dezenu no implementa aktividade sira ne'e, liuliu kuandu ema sira hetan benefisio husi aktividade hirak ne'e. Practis konservasaun hirak ne'e – hanesan kuda ai teka nebe'e produz ai kabelak nebe'e iha valor diak, ka ai kamii nebe'e fo musan ho folin diak – bele hetan resultadu diak liu duke aktividade bo'ot governu nian atu kuda ai. Diak liu tan, kuda ai balun nebe'e moris lalais no kaer nitrojéniu, nebe'e bele fo hahan ba animal sira, ai sunu, no rendimentu ba uma kain, iha tempu hanesan ai ne'e aumenta rai nia bokur liu prosesu hatama karbon nebe'e riku ho nitrojen, fo dalan atu fo proteksaun no preserve rai diak ba jerasaun sira iha futuru.

Relatoriu ne'e mos lista oportunidade ba desenvolvimento futuru nian, tanba, ikus liu, lisaun prinsipal nebe'e ami foti katak rehabilitasaun agrikotoral konaba fo capacidade ba consumador – ema nebe'e deit, hanesan agricultor, ema hosi MAFP, ka lei nain sira – hodi sira bele hili diak liu ba sira nia an no ba sira nia sosiedade tomak.

INTRODUCTION

This report summarizes both the lessons learned and the accomplishments of a field-support project developed in Timor-Leste at the request and support of the U.S. Agency for International Development (USAID) Mission/Dili. The project was specifically designed to enable the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Timor-Leste (T-L) to revitalize agriculture and sustainably manage the nation's natural resources. Three objectives were jointly developed by the project team that included MAFF and the supporting U.S. institution consisting of the Soil Management Collaborative Research Support Program (SM CRSP) and the University of Hawaii at Manoa (UHM).

The three project objectives were:
1. Increase agricultural productivity and food security.
2. Increase household income and create new employment opportunities.
3. Foster adoption of farming practices that protect and preserve the environment for future generations.

To enable MAFF to revitalize Timor-Leste's agriculture and manage the nation's natural resources in a sustainable manner, the University of Hawaii worked hand-in-hand with the research and extension staff of MAFF to achieve all three project objectives. By involving MAFF in project activities, capacity building of the MAFF staff and their ability to continue to perform at a high level after the conclusion of this project became an important aim.

The role of the University of Hawaii and the SM CRSP was to enable the research and extension staff of MAFF to replace costly and time consuming trial-and-error methods with more efficient and cost-effective, science-based approaches to attain project objectives. Another important role of the supporting SM CRSP institution was to encourage MAFF staff to shift from a top-down technology transfer to a bottom-up approach that allows clients to exercise choice and to participate in the process of changing the farming system for the better, not only in the eyes of the extension staff, but for the clients themselves. This combination of science-based methodology and participatory approaches is reflected in the project accomplishments summarized in the following sections.

ACCOMPLISHMENTS BY OBJECTIVE

Objective 1. Increase Agricultural Productivity and Food Security

Maize (corn) and rice are the two staple crops in Timor-Leste. Rice is the preferred staple, but most families are unable to grow rice and cultivate maize instead. Grain yields of maize and rice are low, ranging from near 1.5 tonnes/ha for maize and 2.5 tonnes/ha for rice. Many households are able to produce grain to meet their food requirements for nine to ten months of the year and depend on purchased food or food aid for the remainder of the year. Under Objective 1, MAFF was introduced to current science-based diagnostic methods to identify the cause of problems associated with low grain yields and to conduct field trials in farmer fields to test and demonstrate the utility of this approach. Figures 1 and 2 illustrate the before and after outcomes of implementing science-based methods to improve performance of maize crops in Baucau, Timor-Leste. Figure 3 shows MAFF personnel learning to use a soil test kit to diagnose nutrient deficiencies in soil samples collected from various locations in the country.

Figure 1. Poor corn.

Figure 2. Good corn.

Figure 3. MAFF participants at the STK or soil test kit training.

By using this diagnostic tool, MAFF researchers have discovered that most of the soils of Timor-Leste as reported in the soil survey of the country are well-supplied with the nutrient potassium, and that this nutrient, which was recommended for application to all soils in the past, need not be applied in most instances. The test results also show that most soils are moderately high in phosphorus and this nutrient need not be applied at the rate previously recommended. In addition to these findings, MAFF researchers exposed the sale of adulterated fertilizers. They discovered that fertilizer sold as potassium chloride was in fact a cheap grade of table salt, sodium chloride. These findings have been conveyed to the Minister and should result in major changes in monitoring fertilizer quality and in fertilizer recommendations for the nation as a whole, and help farmers use fertilizers in a manner that is more cost-effective and environmentally safe.

How will MAFF take lessons learned in one watershed to all other watersheds in the country?

Watersheds are places where effects can be traced back to causes so that interactions that produce positive consequences can be promoted and negative ones eliminated. A watershed can be characterized by its biophysical and socioeconomic components. Understanding both components and their interactions will allow MAFF to predict potential outcomes related to our three objectives on food security, economic growth and natural resources management.

A first step would be identification of the kinds of soils in a watershed. Once identified and classified, the nomenclature associated with that classification provides MAFF access to a global data base on soil management information that can be used and interpreted for local use. Moreover, that nomenclature also includes climatic information for crop selection and management. Portuguese soil scientists produced a soil survey report of Timor-Leste in 1978, three years after Portugal terminated the colonial status of East Timor as it was then known.

The resulting soil map was determined to be reasonably accurate geomorphically by USDA soil scientist, Patrick Niemeyer, who was invited by the University of Hawaii to Timor-Leste to verify if the Portuguese mapping unit delineations were consistent with the geomorphology of the landscape. Since they were, the USDA/NRCS produced a digitized version of the soils map of Timor-Leste. The next step would then be for MAFF to corroborate the classification of soils reported in the soil survey report and to locate them onto to the digitized soils map. Once soils are identified, assessments of land use can be made on the relative similarity of soils, and hence climate and environment between and among watersheds that would accelerate the transfer process for site specific nutrient management. Lessons learned in Baucau or any other watershed or district could then be applied to other watersheds through a process referred to as transfer by analogy rather than by trial-and-error.

The ALGIS staff at MAFF and officers from the Land and Property Division of the Ministry of Justice participated in a training workshop on application of the digitized soil map for technology transfer by analogy (Figure 4).

Figure 5 shows a group of farmers and an extension agent learning about a new way of growing rice from a rice agronomist from the International Rice Research Institute (IRRI) in the Philippines.

Figure 4. Participants at a training workshop on the use of the T-L digitized soil map for transferring technology by analogy.

Figure 6 shows bundles of rice seedlings scattered in a field for subsequent transplanting. A clump of seedlings containing four to six plants will be transplanted randomly throughout the field. Figures 7a and 7b show the new way of planting seedlings. The seedbed foundation is formed by lining the base of the small bed with banana leaves and establishing borders bound by banana tree trunks. The banana leaf is covered with a layer of soil and the seeds are allowed to germinate and grow in this layer but the leaf mat acts as root barrier and enables the seedlings to be harvested easily without damaging the roots as shown in Figure 7c.

With this new method, single seedlings, as opposed to four to six seedlings in the traditional method, are planted 20 to 25 cm apart in straight rows as shown in

Figure 5. Dr. Balasubramanian of IRRI with rice farmers in Aileu. Balasubramanian is the third person from the right and the extension agent, Joao Rodrigues, is on the extreme left. To the right of Balasubramanian is Chuck Attarzadeh, a former Peace Corps volunteer in Timor-Leste, serving as an interpreter and trainer of the new rice planting technique.

Figure 6. Traditional rice farming.

Figure 7a. Establishing the mat nursery.

Figure 7b. Mat nursery.

Figure 7c. Rice seedlings for transplant.

Figures 8a & b. This new rice planting method doubles rice yields, but what has impressed farmers most is the noticeable reduction in drudgery and time required for weeding. The straight rows not only ensure proper plant spacing, but they allow mechanical weeding to replace traditional hand weeding, thereby reducing two days of weeding time, under the previous planting scheme, to two hours with the new.

Under Objective 1, the research and extension staff of the Ministry has gained confidence that adoption of sci-

Figure 8a. Rice planting in rows.

Figure 8b. Rows of rice in Aileu.

ence-based methodology and a bottom-up, participatory approach to technology transfer to clients can result in rapid improvement in agricultural performance. Future efforts should focus on the value chain that leads to successful marketing of farm products. Most Timor-Leste households in rural areas are subsistence farmers and will need to link their production capability to markets beyond village borders to Dili and the outside world as

Objective 2. Increase Household Income and Create New Employment Opportunities

As a largely agrarian society, with most of its people still living in rural areas and dependent on agriculture for their livelihood, it is natural and logical that agriculture is the stimulus for a broad-based, rural-led economic growth in Timor-Leste. These rural agricultural areas can be found from sea level to mountain tops across the length and breadth of the country in watersheds that opened either north or south.

With 26 watersheds in 13 administrative districts, a watershed management approach was deemed to be the more appropriate and feasible mechanism by which the SM CRSP project could implement activities to minimize food insecurity and improve the social and economic well being of the rural poor. The challenge was to find ways to work at the watershed level where one must often deal with multiple stakeholders in multiple locations (differing in temperature, i.e., elevation, and rainfall) and competing interests.

The watershed is also a place where our three objectives (raising agricultural productivity, expanding export crops and achieving food security and economic growth through sustainable natural resource management) and their interactions, both good and bad, intersected. In addition to their many different physical attributes, watersheds also contain numerous social configurations, since watersheds are commonly transected by numerous villages and human management entities, be they political, ethnic or religious in nature. For these reasons, it made sense to take a participatory approach in the design and implementation of a watershed management project.

To understand why only a limited land area was used for growing food and cash crops, the project sought out farmer groups in villages across the watershed landscape to participate in a land use group study to utilize their ingenuity to generate income.

Prospects of increasing household income were listed in order of likely success as leafy vegetables and tomatoes, followed by fish and livestock and lastly by candlenut. The latter was considered a safety net of sorts as the nuts were sold to a candlenut trader for export to Indonesia when farmers needed cash.

Chromolaena ordata (Figure 9) is commonly recognized as an indicator plant associated with fertile soils. The abundant growth of this plant in the watershed was initially viewed by University of Hawaii, Manoa (UHM) researchers as a good sign. They quickly learned, however, that chromolaena was considered an invasive shrub by MAFF and was commonly identified by villagers as a constraint to increasing land for pasture and arable lands for food and cash crops at all elevations in the watershed. Although it would have been simple to defoliate the shrub with herbicides, this would not have been a sustainable solution, considering the prohibitively high cost of herbicides and the large extent of the invasion.

Figure 9. Chromalaena ordata *in Ostico, Gariuai.*

Since chromolaena is a plant that stores or accumulates nitrogen, it would make an excellent soil amendment, or a compost if used before it flowered (Figure 10). Thus, those who chose to plant leafy vegetables or tomatoes were asked to use chromolaena as a soil amendment, i.e., compost.

Intuitively, farmer groups in the higher elevations and cooler environments successfully grew leafy vegetables (Figure 11) while those in the lower elevations found greater success with tomatoes (Figure 12). Markets for these vegetables extended beyond the village borders to villages in the lower elevations and to the capital, Dili. These market links were established unexpectedly by drivers of buses using their transportation network (Figure 13).

Figure 10. Chromolaena *compost pit.*

With the exception of off shore gas and oil resources, the land area of Timor-Leste has few exploitable resources other than the natural resource base of land, water and biota. The coffee industry in Timor-Leste provides jobs and income for local people, but many more such enterprises would need to be developed to

Figure 11. Vegetable production in Venilale (high elevation).

Figure 12. Tomatoes growing in the Seical (low elevation).

Figure 13 . Roadside sale of vegetables to bus driver bound for Dili.

improve the employment and income-generating situation in rural areas of the country. The MAFF and the SM CRSP institution looked into several possibilities including marketing of black rice, honey, candlenut, virgin coconut oil and vanilla bean locally and in the international market. After discussions with MAFF,

GTZ and local community leaders in Triloka, Baucau District, the project agreed to concentrate on candlenut owing to the potential of increasing income for a large number of rural women and their households. They would benefit greatly from growing, harvesting and marketing this non-timber forest product. The candlenut tree or *Aleurites molucca* is a large tree (Figure 14) of the Euphorbiaceae family that produces an oil-bearing nut (Figure 15). The nut is minced or crushed and used in Indonesia in curry dishes during festivals and special occasions. A well-established network of collecting, bagging, storing and transporting the nuts had been in existence since Indonesian times. With Timor-Leste's independence from Indonesia, Indonesian buyers have favored Indonesian producers, resulting in a marginalized candlenut industry in Timor-Leste. This left T-L with two options: 1) increase its competitive advantage by marketing higher quality nut or 2) find a new market for candlenut.

When MAFF and the University of Hawaii looked into this matter, the price of candlenut offered to Timor-Leste villagers by Indonesian traders ranged from 30 to 50 cents per kilogram (kg) of candlenut kernel. At 30 cents/kg, villagers did not feel it worth their time to harvest candlenut, but at 50 cents/kg, villagers did not wait for buyers to come and collect the cracked kernels but took the nut to the buyer themselves.

With this information in hand, the University of Hawaii contacted Oils of Aloha, a small business in Hawaii that refines candlenut (referred to as kukui nut in Hawaii) oil for the cosmetic industry to learn if it would be interested in working with Timor-Leste businesses to establish a candlenut oil extracting plant there.

Oils of Aloha was already supplementing oil extracted from locally harvested nuts in Hawaii with candlenut oil imported from Indonesia. Owing to the high cost of locally harvested candlenut and the uncertain quality of oil imported from Indonesia, Oils of Aloha expressed interest in obtaining T-L oil, provided the price would be equal to that of Indonesian oil and the quality would match the Hawaiian variety. When an economic feasibility study funded by the USAID Mission and a biochemical analyses of oil from T-L candlenut by the University of Hawaii showed both to be the case, a Timor-Leste businessman, the local community in Baucau, MAFF and Oils of Aloha all agreed that investing in a candlenut oil extracting plant could generate stable income for many hundreds of villagers, particularly women who harvest and crack the nuts (Figure 16).

Several proposals to initiate the candlenut oil venture were submitted including a multimillion dollar effort from a Timor-Leste based NGO, but in the end a small loan from the USAID Mission was awarded to Oils of Aloha and the Pacific Business Center in the College of Business Administration at the University

Figure 14. Candlenut tree.

Figure 15. Oil-bearing candlenut.

Figure 16. Timor-Leste village woman cracking candlenuts.

of Hawaii to train local staff to establish, operate and manage a candlenut oil extracting plant in Timor-Leste. Based on a business plan prepared by the Pacific Business Center, the Timorese business partner, Acelda, was able to negotiate a commercial loan from a local bank to build the plant and purchase equipment such as electrical generators, ovens, and compressors (Figure 17). MAFF also contributed to the effort by awarding Acelda a small agri-business grant to help the rural community take the first step in transforming itself from a subsistence farming system to a market-based economy. For the first time, the community had a buyer who was willing to buy a village product in large volumes (Figure 18), hire its young men and women to process the product and maintain records (Figure 19) so losses could be avoided and profits maintained.

As a cosmetic ingredient, candlenut, unlike palm fruit or coconut, produces very delicate oil that readily becomes rancid if exposed to air. To ensure receipt of a high quality product at its final destination in Hawaii, quality control is maintained by placing the oil in sturdy metal shipping containers (Figure 20) and bubbling nitrogen gas through the oil to displace dissolved oxygen before tightly sealing the container for sea shipment to Hawaii (Figure 21). When the candlenut plan was first proposed, many expressed the view that Timor-Leste and its people were not yet ready to undertake a project requiring this level of mechanical, entrepreneurial and managerial skills, and pointed to many failed projects to make their case. The candlenut story proves that good ideas, planned properly, can succeed when self-interest is combined with trust and commitment to create new wealth.

Figure 17. Interior of Acelda oil extraction plant.

Figure 18. Pile of candlenut in Acelda warehouse.

Figure 19. Timor-Leste women managing business records and accounts for candlenut extracting plant.

Objective 3. Adopt Farming Practices that Protect and Preserve the Environment for Future Generations

Wood became the primary fuel for heating and cooking in Timor-Leste when the kerosene supply was cut

Figure 20. Candlenut oil shipping containers in Acelda processing plant.

Figure 21. Candlenut oil delivery to Oils of Aloha.

off after independence from Indonesia. This shift from kerosene to wood compelled communities to depend on forests to provide the new energy source. The resulting consequence was the gradual deforestation of land near population centers (Figure 22) and increased harvest of wood from more distant forests (Figure 23a) for transport to cities and towns (Figure 23b).

Government reforestation programs were not particularly successful in reversing the land degradation problem owing to destruction of the young trees by grazing animals and seasonal burning of dry grasses (Figure 24). It was clear that a new approach would be needed by MAFF foresters to reverse the worsening situation. This approach required the foresters to involve the rural

Figure 23a. Trees harvested for firewood on roadside.

Figure 23b. Transporting firewood.

community in the reforestation program and to find ways that ensured newly planted trees were protected from animals and fires. Key elements of the new reforestation partnership are self-interest and ownership.

Figure 22. Deforestation and soil erosion in Timor-Leste.

Figure 24. Burning hillside in Timor-Leste.

In this partnership program, farmers have a say in which trees will be grown, where and for what farmer-specified purposes. The MAFF district foresters maintain nurseries (Figure 25), train farmers to plant and care for young trees of the farmer's choosing (Figure 26), invite others to visit their nurseries (Figure 27) and participate in the reforestation effort. This new approach to sustainable land management succeeds in two ways. First, the newly planted trees are protected from animals and fires by being interplanted with annual crops in a system known as taungya, as shown by the young teak trees planted in a fenced corn field (Figure 28), and second, farmers now grow fuel wood for sale and home use in their protected plots. As a result, wood harvesting in existing forests is minimized.

LESSONS LEARNED AND REMAINING OPPORTUNITIES

Like every country, Timor-Leste's greatest asset is its people, but unlike technically advanced countries, Timor-Leste's people lack options to apply their energies in actively productive and useful ways. One role of governments and technical assistance programs is to identify options to which people can respond in ways that benefit not only the responders but the larger community of which the respondents are a part. Thus the connection between a cosmetic user in France or Japan with a candlenut harvester in rural Timor-Leste energizes not only village households, but the banks that lend money to businesses that purchase equipment, goods and services from local shops that sell generators, compressors, ovens, computers and nitrogen gas, for example. The first lesson learned from this project was that if the value chain, beginning with a candlenut tree in Timor-Leste and ending in a cosmetic shop in Europe or Asia, can bring hope to people in rural Timor-Leste, than other similar opportunities are likely to exist. The second lesson learned was that to succeed, T-L cannot compete on the world market with products manufactured by mainstream providers, and should concentrate on products with narrowly defined groups

Figure 25. MAFF-maintained nursery.

Figure 26. UH scientist, JB Friday, teaching forestry to MAFF officers who in turn will train T-L farmers.

Figure 27. Visitors at the MAFF nursery.

Figure 28. A reforestation planting of teak trees (circled) in a corn field.

of "niche" customers. The third lesson learned was the entrepreneurial spirit is alive and well in Timor-Leste and can be channeled and utilized to drive the economic development of this new nation.

Outcomes from land use groups (Figure 29), established after completing the PRA with farmers, provide a glimpse into the entrepreneurial spirit of the Timor-Leste people. Preliminary analysis indicates those groups that were better organized, with common objectives for increasing household incomes and collective work experiences with selected commodities chosen by the group, tended to be more successful than others. Communal effort was important, if not the most important, factor in overcoming temperature and rainfall constraints associated with the location of farm sites in the watershed in order to achieve positive outcomes. That is, the spirit of the group to persevere was an overriding factor in achieving success.

Furthermore, groups that were formed spontaneously fared poorly compared to those that were previously established. Another lesson learned is the need for effective training of both individuals and farmer groups to learn of improved farming practices and entrepreneurial skills.

Figure 29. Land use group site where fish, chicken (in the thatched roof coop) and vegetables are grown. Chromolaena was removed and used as compost.

Figure 30. Baskets filled with black rice.

Figure 31. Prosopis *or mesquite trees are common in coastal areas.*

Based on lessons learned, the land use groups and expressions of interest by Timor-Leste farmers and businessmen, the following rural development options might be explored in the future.

- *Production, processing and marketing of certified, organic black rice* (Figure 30) for export to specialty gourmet restaurants in Hawaii and other locations in the US. Timor-Leste black rice has been restaurant-tested in Hawaii and appears to have a ready market there. Although black rice yields are relatively low, the high price offered for it virtually assures high profit for farmers who can grow it.

- *Production, processing and marketing of certified, organic "Kiawe" honey* for export to Hawaii and the US. The Kiawe or mesquite tree (*Prosopis*) (Figure 31) grows profusely in the dry coastal zones of Timor-Leste. The honey produced by bees collecting pollen from flowers of this tree is a high quality product which is marketed nationally in the US by a small firm in Hawaii. The firm also sells queen bees and is prepared to train local Timorese people in the production and processing of this specialty honey. As is the case with candlenut, local people already harvest wild honey, and sell the product in empty beer or water bottles locally, so collecting and selling honey will not be new to them.

- *Harvesting, processing and marketing of tamanu oil* for the international market. Tamanu oil is extracted from the nut of the tamanu tree (*Calophyllum inophyllum*) (Figures 32a and b). This green oil has anti-neuralgic, anti-inflammatory and antibiotic properties and can

be sold for a higher price than candlenut tree oil. The tamanu tree grows in the coastal zone of Timor-Leste and is planted as a shade tree in urban areas. When the press used to extract candlenut oil is not in use, it could be used to extract tamanu oil. The marketing arm of Oils of Aloha could be applied to market tamanu oil on the international market.

Figure 32a. Callophylum inophylum *or tamanu tree in Fatumaca.*

Figure 32b. Tamanu nut.

- *Import substitution of coconut oil for palm oil.* Many people of Timor-Leste prefer coconut oil over palm oil for cooking, but buy palm oil because coconut oil is too expensive or unavailable. Several grants have been awarded to local groups to produce coconut oil, but the manual oil extracting methods have failed to produce coconut oil on a commercial scale or profitably. A system of oil extraction similar to the one developed for candle nut can be installed to produce coconut oil for local markets. Virgin coconut oil is also now sold on the world market as a health food and sells for about $3/liter.

- *Shift from wood to charcoal for cooking* to increase energy efficiency, reduce pressure on forest resources, and lessen smoke-related health problems associated with wood burning. A new, fast and efficient method for converting wood and other forms of biomass into charcoal has been developed by the Hawaii Natural Energy Institute of the University of Hawaii. This method, called *flash carbonization*, is able to convert 1000 pounds of wood or other organic materials including organic waste into 300 to 350 pounds of charcoal in less than an hour. Changing from wood to charcoal has two advantages. First, family health is improved by reducing respiratory ailments from inhaling smoke from open air cooking (Figure 33). Second, pressure to cut forest for wood will be reduced because charcoal can be made out of bioresidue considered to be waste material. Coconut husks and shells, rice hulls, candle nut shells and other forms of biowaste and bioresidue can be converted into commercial grade charcoal (Figure 34). Carbon Diversion, a small energy company located in Honolulu, Hawaii is licensed to build flash carbonization units and can install and train local personnel to operate them.

The work carried out and the lessons learned under this USAID Mission supported project can be applied to enable people of rural Timor-Leste to explore the future with the above and other options to seek a better life for themselves and future generations.

Figure 33. Timor-Leste village woman cooking sago palm over an open fire.

Figure 34. Flash carbonization unit located on the UH campus.

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