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MYANMAR ENERGY POVERTY SURVEY

JANUARY 2011

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MSN Mangrove Service Network

ECOdev

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LIST OF ACRONYMS

ADB	Asian Development Bank
CBO	Community Based Organisation
CCT	Controlled Cooking Test
CSO	Civil Society Organisation
DM&E	Design, Monitoring and Evaluation
EGG	Ever Green Group
EPS	Energy Poverty Survey
EU	European Union
FAO	Food and Agriculture Organisation
FES	Fuel Efficient Stove
FGD	Focus Group Discussions
FREDA	Forest Resource Environmental Development Association
GRET	Groupe de Recherche et de Travail
GS	Green Stove
HEPA	Household Energy Poverty Analysis
IEC	Information, Education and Communication
MF	Metta Foundation
MSN	Mangrove Service Network
MSR	Myanmar Survey Research
NGO	Non Government Organisation
TSU	Technical Support Unit
UNDP	United Nations Development Programme
WBT	Water Boiling Test

PREFACE

Mercy Corps was awarded funding by the European Union through the Non State Actors & Local Authorities in Development budget line in March 2010 to work with Myanmar NGOs, Mangrove Service Network and EcoDev, on a project with the objective of promoting widespread use of fuel efficient stoves and social reforestation strategies to achieve sustainable reductions in household poverty and reversals in deforestation using a civil society and market-led approach. We would like to thank the European Union for its generous support to allow this work to happen. We would also like to thank the UNDP, GRET, FREDA, Ever Green Group, Malteser, and the Metta Foundation for sharing the valuable insights they gained from their experiences implementing similar projects throughout Myanmar. We hope that this document will contribute to the growing knowledge base for successful efforts in sustainable resource management and energy poverty reduction in Myanmar and elsewhere.

EXECUTIVE SUMMARY

The loss of livelihood assets following Cyclone Nargis in May 2008 has increased poverty levels and led to a severe lack of energy resources among affected communities from the low-lying Ayeyarwady Delta in Myanmar. The already stressed environment has been further damaged by the energy demands of poor households together with use of natural resources for reconstruction efforts. Mangrove forest reserves in Ayeyarwady division had already declined from 271,749 hectares in 1923 to 90,386 hectares in 2003, due to expansion of agricultural land and excessive cutting for wood-fuel. Due to Cyclone Nargis, some 17,000 hectares of natural forest (mostly mangrove) and 21,000 hectares of forest plantations were damaged, with an estimate cost of around $14 million. The loss and degradation of mangrove and forests has increased soil degradation and decreased fishery catches, which, if not reversed, will continue to exacerbate livelihood difficulties and poverty in the region.

With funding from the European Union, Mercy Corps partnered with Mangrove Service Network (MSN) and EcoDev to implement the project "Civil Society and Market Networks for Pro-Poor Sustainable Environmental Development in the Ayeyarwady Delta." Mercy Corps and partners, with the support of the local firm Myanmar Survey Research (MSR), conducted an Energy Poverty Survey (EPS) in Laputta Township with four foci: i) a Household Energy Poverty Analysis (HEPA); ii) a review of the experiences of previous community energy and reforestation projects; iii) a market analysis for fuel efficient stoves (FES) and saplings in Laputta Township, and iv) a fuel efficiency analysis for the different stoves marketed in Laputta Township. The findings are intended to help guide development of appropriate strategies for Mercy Corps, MSN and EcoDev, as well as any other organisations working on energy poverty reduction in the Ayeyarwady Delta.

The HEPA showed that **households in most villages lack market access to FES and would use them if they were available and affordable.** The majority of surveyed families currently use wood as the main fuel source for cooking, primarily using an open fire or "three-stone" method. Most households buy wood but many still collect it, spending an average of 233 hours per year on that task. Since Cyclone Nargis, the weight of each purchased wood-fuel bundle has decreased by around a third and the majority of households are now travelling greater distances to collect wood. When surveyed about energy needs for household lighting, the HEPA indicated **that most rural households lack access to power for good quality lighting**, and most would prefer electricity. The majority of adults would use additional lighting in the evenings for income generation activities, and around half of all children would spend evening time on homework, thus showing the significance of energy poverty reduction for socio-economic development.

A review of previous community-based energy projects provides many good lessons. The most important point to consider for successful programming is that **FES are not available in most rural areas of Myanmar, despite the high level of interest** from these communities. The irregular quality of stoves produced by decentralised community-led production systems can decrease consumer satisfaction and reduce demand, however, so quality control during the production, marketing, and at the user level is needed to ensure the quality of the product. Free distribution of FES further decreases the demand for stoves and impedes the development of market-oriented supply chains. To support sustainable FES production, marketing and usage, organisations should focus on training stove makers and stimulating demand through social marketing.

Similarly, community based projects working on sapling nursery development should consider several lessons learned through the experiences of previous reforestation projects. First**, nurseries cannot be developed as an income generation activity for vulnerable households** due to time investment requirements. Also, selection of freshwater tree nursery entrepreneurs should be based on entrepreneurial skills and investment capacity rather than vulnerability criteria. For mangrove trees, a nursery as a private business is not likely to be profitable due to lack of market demand for mangrove saplings, however, Community Based Organisations can successfully manage nurseries to supply reforestation projects. Encouraging wood-fuel collectors to become wood-fuel producers can also be a key strategy to reduce illegal deforestation. **Future reforestation projects in the Delta area should focus on creating sustainable demand for saplings** rather than engaging in free distribution. Intensive social marketing to support this market-led approach could include village lotteries, sensitisation on natural resource management, and distribution of saplings to traders to develop market channels.

The market analysis for FES showed that **87% of households are not using FES**, either because they could not afford one or had not heard of them. However, 100% of households indicated that they would buy an FES if it were available in their village at an affordable price. The fact that FES are readily available in Laputta town,

and widely used there, is a good indication of their acceptance at the household level. The market analysis also showed that although households in outlying villages of Laputta Township are interested in reducing wood-fuel consumption, **the majority could only spend between $1-$2 on a stove**. Current stove models available in Laputta Township range in price from $1-3. The market analysis points to the need to introduce a business model that supports entrepreneurs located close to the consumer in order to increase access, minimise transport costs, and keep the stove price within the consumer's budget. The best way to ensure sustainable consumer demand for FES is to facilitate market-oriented supply chains, not agency-funded free distributions.

Similar to the FES findings, the market analysis for sapling nurseries found that there is an **unmet demand for saplings in Laputta villages.** The majority of respondents indicated a clear preference for freshwater tree replanting, with 83% choosing these over mangrove trees. Clear preferences also emerged in terms of the types of freshwater trees and mangroves that households favoured. At this time, however, the market for mangrove saplings in Laputta is not good for entrepreneurs because several ongoing reforestation projects currently provide free mangrove saplings and there are access issues related to mangrove areas. **Many households indicated that they would buy saplings** for wood-fuel, windbreak or fruit production if these were provided affordably and if they had access to land for planting and sustainable utilisation of the forest products.

The stove efficiency analysis showed that the locally available FES are similar in their efficiency ratings and confirmed that **an upgrade from a three-stone method would result in a 30% fuel savings** per cooking cycle. Therefore, affordability and sustainable access are the principal factors in deciding which model to promote. In order to create local employment and provide low-cost stoves that are easy to repair and maintain and are primarily designed for wood-fuel use, Mercy Corps recommends that the project use a clay model that could be manufactured by local potters in the Delta area.

The project described in this EPS addresses energy poverty by supporting a civil society and market-led approach to reduce the need for fuel use and encourage reforestation. Household energy poverty and deforestation are targeted as the nexus at which Civil Society Organisations and entrepreneurs can work together with communities and local authorities to provide meaningful solutions for environmentally sustainable socio-economic development. The social and environmental benefits of properly managed forests and wooded areas are many, including biodiversity protection, improved farming and fisheries, soil erosion control, and disaster risk reduction. The benefits of energy poverty reduction strategies range from reduced deforestation and improved public health by using fuel efficient stoves, to improved income generation potential with access to better forms of lighting energy. Agencies and institutions in Myanmar interested in promoting energy poverty reduction, and poverty alleviation in general, should consider conducting household energy poverty analyses in other parts of Myanmar.

1. INTRODUCTION

Myanmar – Poverty, Energy Poverty, and Sustainable Resource Management

Myanmar is the second poorest country in Asia on the UNDP Human Development Index, lagging far behind other countries on a host of indicators. Fully 30 percent of its population live in acute poverty according to some estimates. The average household monthly income in the Ayeyarwady Delta township of Laputta is around US $80/month, but for around 40% of the population who work as casual labourers, the average monthly income is only around $44. In addition, Cyclone Nargis destroyed the livelihoods of entire families and killed wage earners in nearly half of all families. Although there has been significant recovery since the cyclone struck in May 2008, many households are still worse off now than they were before the cyclone.

One of the most far-reaching dimensions of this widespread poverty is the severe lack of energy resources, otherwise known as energy poverty, among rural communities of Myanmar. Households need fuel for cooking, for lighting, and if possible to power value-adding livelihoods activities. In rural Myanmar, cooking fuel comes in the form of wood-fuel, the use of which has negative impacts on households and on the environment.

In many rural communities, the traditional method of cooking is with a three-stone cooking fire. It is the simplest and least expensive stove to produce; all that is needed are three suitable stones of roughly the same size, arranged with space for firewood in the middle. The three-stone cooking method has several major drawbacks:

1) It is very inefficient with fuel. Because so much heat escapes into the surrounding air and not into the cooking pot, more wood-fuel is required for each meal.

2) There is no exhaust pipe for ventilation, so smoke stays in the room, causing health problems after repeated exposure. The World Health Organisation states that indoor air pollution is responsible for the death of 1.6 million people every year.

Generally speaking, the collection of wood-fuel from nearby mangrove areas has been done unsustainably in all of the low-lying Ayeyarwady Delta communities[1]. The ongoing deforestation has slowly decreased the availability of wood-fuel, increasing rural communities' energy poverty. Cyclone Nargis only added to this. Since that event, the price of a bundle of wood-fuel has remained the same but the size of the bundle has decreased by around one third[2]. The rural poor pay more for energy usage than those who are able to connect to electricity networks or afford more efficient stoves, adding to the challenges that the poorest rural households face in their struggle against poverty.

The higher real cost for this form of energy is made worse by the opportunity cost of collecting wood-fuel. In Laputta, many households spend significant time collecting wood, reducing the amount of time available for other income generating activities. Additionally, agriculture, food processing, craft production, and trading can be made more productive with access to safe, affordable and reliable energy, not to mention study time for children to enhance the effectiveness of education and put households on a better economic trajectory.

Greenhouse gases unleashed through widespread wood-fuel use may not be as high as other sources, but aggregated globally they are significant. Furthermore, the reduction of forest area decreases the potential for carbon sequestration in forests, further exacerbating the cycle of greenhouse gas build-up in the atmosphere. At the local level, unsustainable wood-fuel collection degrades ecosystem functioning, and the loss of mangroves in the Delta has contributed significantly to shore erosion and decreased fish catches[3]. Additionally, mangroves have a proven ability to help reduce the impact of severe weather events. The destructive fury of Cyclone Nargis was lessened in some villages thanks to the protective cover of mangrove and other forested areas. This is especially important in Myanmar. In the overall region of Southeast Asia,

[1] Mercy Corps, Stove and Saplings Market Analysis, May 2010.
[2] Ibid.
[3] In August 2010, Mercy Corps conducted focus group discussions with farmer and fisher groups in Laputta Township to evaluate the impact of mangrove deforestation. The five main consequences of mangrove deforestation mentioned by the community groups are: increased exposure to bad weather hazards (100% of the respondents); decreased fishery catch (75%); increased shore erosion rate (75%; increased salinity in the river (75%); and destruction of farming land (75%).

temperatures rose 0.1 – 0.3 °C per decade from 1951 and 2000 and sea levels rose by 1-3 millimetres per year[4]. The GermanWatch Global Climate Risk Index ranks Myanmar among the top three countries worldwide to be affected by extreme weather events[5]. The Asian Development Bank (ADB) reported that Southeast Asia (and Myanmar particularly) is among the regions with the greatest need for climate adaptation[6]. According to the ADB, the priority is to enhance climate change resilience by building adaptive capacity and promoting sustainable natural resource management.

Historically, wood-fuel for charcoal production was the largest contributor to the destruction of mangrove forests. Following the banning of this practice in the early 1990s, the destruction of forests for agricultural land (principally paddy expansion for rice cultivation), wood-fuel collection (for home consumption and trading), and the illegal extension of prawn ponds are respectively the three major causes of deforestation. Mangrove forest reserves in the Ayeyarwady Delta had already declined from 271,749 hectares in 1923 to 90,386 hectares in 2003, due to expansion of agricultural land and excessive cutting for wood-fuel[7].

Cyclone Nargis was the worst natural disaster ever in Myanmar and one of the most devastating weather events anywhere in the past 20 years. It wiped out entire communities and it also devastated the low-lying Ayeyarwady Delta's fragile and intricate ecosystem of mangrove swamps and tidal estuaries. Due to Cyclone Nargis, some 17,000 hectares of natural forest (mostly mangrove) and 21,000 hectares of forest plantations were damaged, with an estimated cost of around $14 million[8].

The protection supplied by mangroves against extreme hazards like tsunamis and cyclonic storm swells is well documented. Restoring forest cover increases the natural protection of low-lying Ayeyarwady communities from future shocks, whether they are of a historically typical nature or brought about by the growing impact of global climate change. However, employing a strategy of reforestation alone does not address the social and economic factors that drive unsustainable resource use. It is necessary to ensure that households are able to access the energy resources required for cooking at the very least, and ideally also for poverty alleviation and income generation, and that it be linked with market forces to ensure sustainability. This paper attempts to outline the rationale for such a strategy.

Programme Intervention

The project "Civil Society and Market Networks for Pro-Poor Sustainable Environmental Development in the Ayeyarwady Delta" addresses energy poverty by supporting a civil society and market-led approach to reduce the need for fuel use (through the introduction of fuel efficient stoves, or FES) and to encourage reforestation for sustainable wood-fuel sources. The project will achieve this objective in part by conducting a baseline Energy Poverty Survey (EPS) and by disseminating 14,000 FES and 140,000 saplings. The results are expected to stimulate community-driven and market-led sustainable resource management practices to reduce energy poverty for the poor. By triggering a process of replication and expansion through civil society and market actors, the action is expected to have an impact beyond its duration. The action targets: Civil Society Organisations (CSOs), which includes local Non Government Organisations (NGOs) and Community Based Organisations (CBOs)[9]; professionals such as traders and entrepreneurs; and women and youth.

To accomplish the action, the EPS team: reviewed the proposed strategy based on an analysis of the constraints and opportunities regarding market development of energy-efficient stoves and sapling nursery promotion; analysed the experiences of previous community stove and reforestation projects in Myanmar; and assessed energy poverty in Laputta Township. Efforts to address energy poverty have been undertaken by

[4] ADB, The Economics of Climate Change in Southeast Asia: A Regional Review, April 2009.
[5] Global Climate Risk Index 2010, Germanwatch
[6] ADB, The Economics of Climate Change in Southeast Asia: A Regional Review, April 2009.
[7] Myanmar Forestry Department, "Coastal Forest Rehabilitation and Management in Myanmar", Nature and Wildlife Conservation Division.
[8] ASEAN, Post Nargis Joint Assessment (PONJA) report, 2008.
[9] A CBO is a membership organisation aimed at furthering the interests of its own members, an NGO has a broader scope of activities that might assist CBOs and pursue commitments that do not directly benefit NGO members. CBOs differ from elected local governments in that they are voluntary, and choose their own objectives. CBOs may interface closely with local government, with other levels of government such as local representatives of central ministries, with the private sector, and with NGOs. (Community-Driven Development, The World Bank)

government, international organisations and NGOs, yet not all have brought about a self-sustaining model that survives after the project cycle ends. This EPS intends to put forth a sustainable market-led approach for energy poverty reduction in Laputta Township.

The EPS includes the following components:

1) Household Energy Poverty Analysis (HEPA)
2) Review of previous FES projects
3) Market analysis for FES in Laputta Township
4) Stove efficiency analysis
5) Review of previous reforestation projects
6) Market analysis for sapling nurseries in Laputta Township
7) Analysis of findings
8) Conclusions

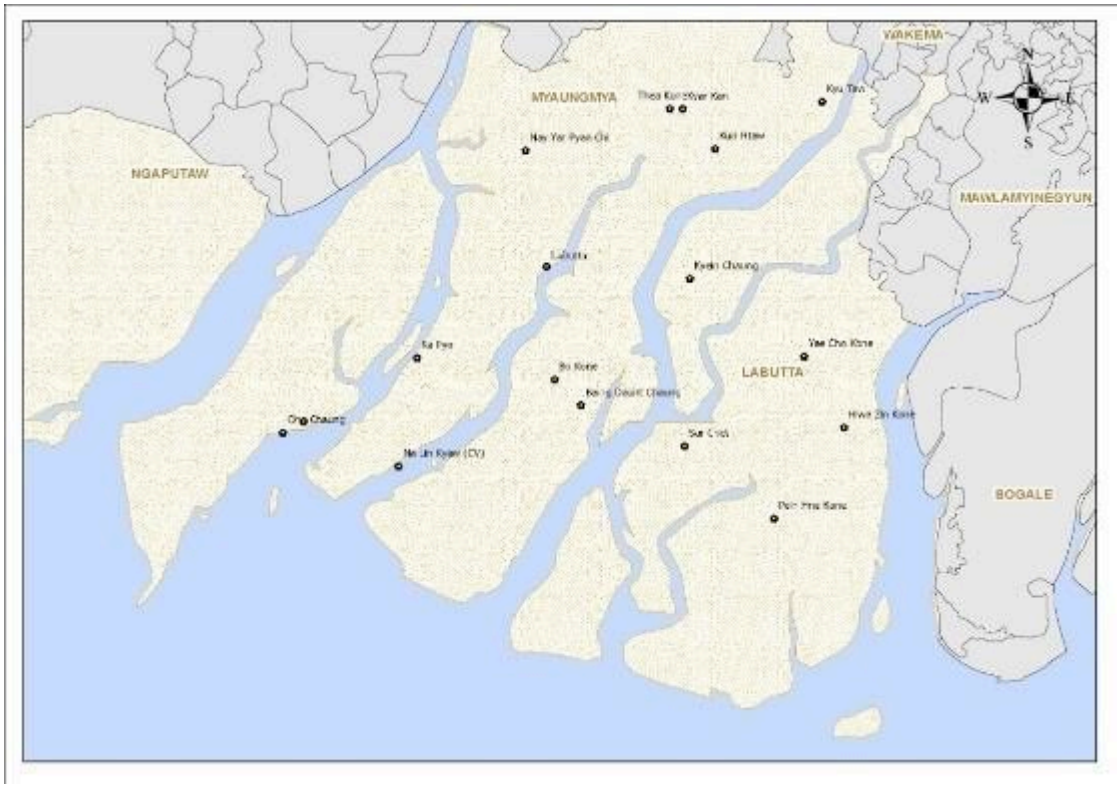
2. Energy Poverty Survey Methodology

Mercy Corps' Myanmar country team compiled the EPS, led by the Programme and Design, Monitoring and Evaluation (DM&E) Units and with the support of Mercy Corps' Environment and Climate Change Technical Support Unit (TSU) and DM&E TSU.

Methodology for Household Energy Poverty Analysis

- Sample frame: 70 villages in 22 village tracts of Laputta Township
- Sample size taken: 396 households (margin of error: 5%)
- Number of villages (clusters): 18 villages (selection of sample villages by PPS method)
- Households per village (cluster): 22 households
- Quantitative method

Map 1: HEPA Surveyed Area



Methodology for the Review of Previous Energy Poverty Reduction Projects

Mercy Corps analysed the lessons learned and best practices of 16 previous energy poverty reduction projects through key staff interviews as well as focus group discussions (FGD) and field observation in four project areas. Mercy Corps reviewed projects implemented by EcoDev, United Nations Development Programme (UNDP), Groupe de Recherche et de Travail (GRET), Forest Resource Environmental Development Association (FREDA), Ever Green Group (EGG), Metta Foundation (MF), Mangrove Service Network (MSN), and Malteser.

Map 2: Location of Stove and Reforestation Projects in Myanmar

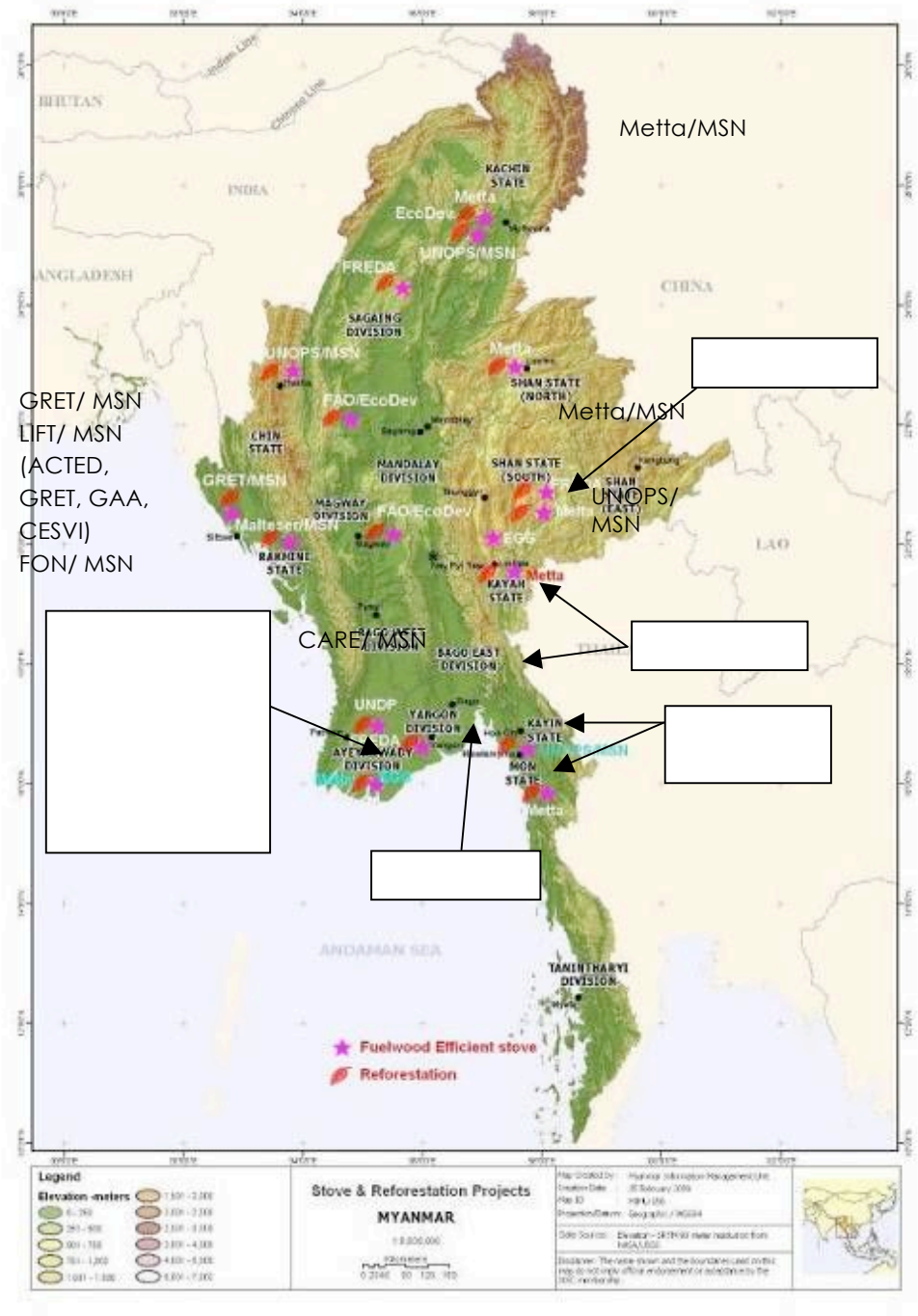


Table 1: Myanmar Project Review

Organisation	Project place	Duration	Project goal	Analysis of lessons learned / best practices
EcoDev	Kachin State	2008-present	Joint with WFP in 'Food for Work' in establishment community forestry	Key staff interview
EcoDev	Sagaing Division	1997-2001	FES as women-focused income generation, community forestry and soil conservation project	Key staff interview
EcoDev	Magwe Division	1997-2002	FES, reforestation project	Key staff interview, FGD, field observation
EGG	Shan State (South)	2007-2009	FES project	Key staff interview
EGG	Ayeyarwady Division	2008-2009	FES project	Key staff interview, FGD, field observation
FREDA	Sagaing Division	2000-Present	Wildlife conservation, natural forest conservation, stoves	Key staff interview
FREDA	Shan State (South)	2004-Present	FES, reforestation project	Key staff interview
FREDA	Ayeyarwady Division	2004-Present	FES, reforestation project	Key staff interview
GRET/MSN	Rakhine State	2007	FES, reforestation project	Key staff interview
Malteser/ MSN	Rakhine State	2009	FES, reforestation project	Key staff interview
MSN	Kachin State	2005-2006	Training of Trainers (TOT) for FES making	Key staff interview
MF	Kachin State	2008-Present	FES, reforestation project	Key staff interview
MF	Shan State (North)	2008-Present	FES, reforestation project	Key staff interview
MF	Shan State (South)	2008-Present	FES, reforestation project	Key staff interview
MF	Kayah State	2008-Present	FES, reforestation project	Key staff interview
MF	Ayeyarwady Division	2008-Present	Reforestation project	Key staff interview, FGD, field observation
MF	Mon State	2008-Present	FES, reforestation project	Key staff interview
MSN	Chin State	2006-07	TOT for FES	Key staff interview
MSN	Mon State	2006-2007	TOT FES making	Key staff interview
UNDP	Ayeyarwady Division	2000-Present	FES, reforestation project	Key staff interview, FGD, field observation

Methodology for Fuel Efficient Stoves and Saplings Market Analysis

Myanmar Survey Research (MSR), an independent research agency, together with staff members of Mercy Corps conducted a market study in Laputta interviewing stove producers, retailers, and users, and sapling producers and retailers. Interviews were conducted with the households currently using the traditional three-stone method to find out if they are interested in using FES and analyse the potential for households to switch to FES if they are available at a good price. Interviews were also conducted with households to gauge their interest in buying saplings. The main objective of this research was to find out whether it is feasible to disseminate FES and saplings in Laputta through a market-led approach.

Methodology for the Fuel Efficiency Analysis

Mercy Corps, MSN and EcoDev carried out baseline emission testing over a one-month period during July 2010. A technical specialist from Mercy Corps' Environment and Climate Change TSU led this analysis using testing methods accepted by Gold Standard, a carbon market company that is an industry leader in setting standards for carbon trading. This method used a combination of Water Boiling Tests (WBT) and Controlled Cooking Tests (CCT) to compare the thermal and fuel efficiency of traditional three-stone fires with fuel efficient stoves – the Pathein, the A1, and the Green Stove (GS).

3. HOUSEHOLD ENERGY POVERTY ANALYSIS

Mercy Corps conducted the HEPA in September 2010, in 18 village tracts in Laputta Township, Ayeyarwady Division. The purpose of the HEPA is to understand household and community level energy needs and opportunities, and challenges to meeting those needs. While the focus of the European Commission (EC)-funded project is on energy poverty in relation to cooking fuel and sustainable resource management, the HEPA also gathered information on energy needs for household lighting to gain a better understanding of the overall energy requirements. Following are the main findings of the study.

HEPA Main Findings

Energy Needs for Cooking

- In the surveyed area, the majority of households (88%) use wood, either with open fire or "three-stone" method (69%) or with a fuel efficient stove (19%), as the main fuel sources for cooking and heating water.
- 10% use plain rice husk (not compressed into bricks) as the main fuel source for cooking and heating water.
- Other fuel types used by some households are charcoal (1%) and electricity grid (1%).
- The most preferred type of fuel for cooking is wood with FES (42% of total respondent households), followed by wood with open fire (22%), electricity grid (18%), charcoal (11%), and rice husk (5%).
- The reasons, stated by the households, for preferring wood-burning FES are as follows:
    - Convenient and easy to use
    - Wood is easier to buy and more affordable than charcoal
    - FES are less of a fire hazard and are safer for children
    - FES can reduce deforestation
- The average weekly cost of household fuel consumption for cooking and heating water is $3.20 for firewood using a three-stone cooking method, $3.08 for firewood with a fuel efficient stove and $1.18 to use a rice husk stove.

Firewood Collection

- The average weight of each wood bundle is currently one viss (1.7 kg), down by 1/3 from before Cyclone Nargis.
- Overall, 61% of wood-fuel is purchased and 38% is collected.

- Significantly, 43% of the respondents buy 100% of firewood because there is no longer any wood collector in the household. Unlike most other parts of Myanmar, adult males are the only firewood collectors in 35.9% of the households collecting firewood.
- Households spend an average of 233 hours per year to collect the firewood.
- A significant number of households (74%) need to travel further than before Nargis to collect firewood, taking an average of one hour on foot, when possible, or four hours by boat when necessary to use boat travel, which is common in the Delta.
- Households get the firewood mainly from state land resources (reserve areas) (49%) and personal forest resources (29%). Some get it from community forest resources (12%) and privately held forest resources[10] (4%).

Energy Needs for Household Lighting

- In the surveyed area, the majority of households (56%) use diesel lamps, followed by 29% using power from the electricity grid[11] as the main fuel sources for lighting. Other fuel types used by some households are candle (9%), and battery (6%).
- The most preferred type of fuel for lighting is electricity grid (55% of total respondent households), followed by diesel lamps (25%), and battery-powered lamps (18%). The rest prefer solar (1%) and candle (0.3%).
- The common reasons, stated by the households, for preferring the electricity grid, diesel and battery are as follows:
  - Good quality lighting power
  - More affordable
  - Convenient and easy to use
  - Can use anytime
  - More suitable for business and income generating work
  - Reduced fire hazard
  - Can use for any social activities
  - Can use for education (studying at night)
- The average weekly cost of household fuel consumption for lighting in the survey area is $2.02 for diesel, $2.17 for grid electricity, $1.79 for candles, $1.53 for small batteries and $1.10 for large batteries.
- Lighting is mostly used for general household use (31%), religious purposes (30%), income generation activities (24%), homework (21%), and education (10%).
- Households can afford an average of 3.8 hours of light per night although they would like 5 hours on average.
- If they had extra hours of light at night, adults would prefer to do income generation activities (52% of respondents), household chores (32%), and social activities (11%), while children would prefer to do school-related homework (48%).

4. REVIEW OF PREVIOUS FES PROJECTS

UNDP, FAO, GRET, EcoDev, MSN, FREDA, Ever Green Group, CARE, and Metta Foundation have implemented community energy projects in Kachin State, Chin State, Rakhine State, Dry Zone, Shan State, Delta Region, and Mon State over the last 15 years. The objectives of these projects (ongoing or completed) were to reduce wood-fuel usage through the use of FES. Many of these projects faced challenges in establishing sustainable stove production and marketing systems, however, they achieved significant successes in developing training for fuel efficient stove making and facilitating private sector-led stove markets.

[10] Respondents identify the wood-fuel coming from land of private ownership (fish ponds, and salt production field) as private company resources.
[11] Electrical grids are privately owned or government owned.

Lessons Learned

Creating a Sustainable Market for FES

- Sustainable stove production and market chains should be developed as the life span of the stove varies from one to two years. Projects that focus on building awareness about FES and stimulating consumer demand may not be successful at establishing a sustainable market if they do not also consider a market chain analysis and help potential vendors to see a market incentive to remain engaged after project completion.
- FES are not available in most rural areas despite high level of interest in many rural communities.
- Free distributions of FES impede the development of a market chain by decreasing the incentive to pay for stoves. To develop sustainable FES production, marketing and usage, organisations should focus on training stove makers and stimulating demand through social marketing.
- The introduction of a decentralised production system supports the use of FES in some areas. However, irregular quality of stoves produced by decentralised community-led production systems can decrease consumer satisfaction and reduce demand. Quality control during the production, marketing, and at the user level is needed to ensure the quality of the product.
- Technical and marketing training should be adapted to the needs of the stove makers and retailers.
- The durability of FES models varies due to the different types of clay from different geographical areas.
- In some areas, especially in Kayah State, the demand for FES is high due to the scarcity of wood-fuel, however in some areas, households are reluctant to use them as some FES emit smoke. Consumers should be given a good choice of designs.
- In some areas the stove making trainees were able to make FES stoves and sell them at a lower price, thus raising household income.

Best Practices

Fuel

- Wood-fuel should be promoted as a more sustainable fuel than charcoal:
  - Wood-fuel production does not require chopping down an entire tree; instead branches are chopped and dead logs are collected. Charcoal production almost always requires cutting down trees to stump level. So, the impact on forests is much larger for charcoal.
  - Wood-fuel should not be extracted from small endangered trees like Kanazo and Madama (Acacia Catechu).
  - Most of the potential energy contained in firewood is used up to heat the end product, while only a fraction of the energy contained in wood that is converted to charcoal is ever utilised in the final end-use. This is because wood-fuel is used directly, while charcoal must first be processed from wood before it is applied as a source of heat. Depending on kiln efficiencies, 100 kg of wood produces 8 – 23 kg of charcoal.
  - It must be noted that wood-fuel is not a perfect source of heat either. There are many variations in quality, the smoke is damaging to health, and inefficient cooking methods allow too much heat to escape.

Stove Models

Three stoves can be found in Laputta:

- The **carved stone stove** produced in two villages of Laputta Township;
- The **Green Stove** designed by the Myanmar NGO MSN;
- The **Pathein stove**, produced and marketed in the Ayeyarwady division. The private sector developed the market chain for these stoves, without support from development organisations.

Development organisations have successfully introduced the **A1 stove** in the Central Dry Zone, however, it is not yet marketed in the Delta.

Carved stone stove (Didu Ko Laputta)

A1 stove

Gree

- The price of one Green Stove is approximately $1. A1 and Pathein stoves cost around $2-3. MSN successfully introduced the GS in Nargis-affected areas. The Pathein stove is marketed in main towns. The A1 stove has not been yet introduced in Ayeyarwady division.
- The producer makes the GS with clay, and does not need to bake the stoves (unlike A1 and Pathein stoves), reducing the production cost.
- Although there is considerable use throughout the target area of the carved stone stove, it would be inappropriate to promote the use of this model as extraction involves quarrying from the local hill territory of the base limestone material. The hill offered protection to the population during Cyclone Nargis and further quarrying degrades its protective potential in the event of future storms or tsunamis.

Creating a Sustainable Demand for FES

EcoDev's Social Marketing Approach for the A1 Stove

Since 1998, EcoDev has been working to disseminate FES in the Dry Zone in order to combat the rampant deforestation in the region. EcoDev used a social marketing approach to introduce the A1 stove, a type of FES developed by Forest Research Institute of Myanmar for greater user satisfaction and acceptance. EcoDev's social marketing approach included the following steps.

Step 1: Promoting private sector investment in large scale production of FES

To disseminate FES largely to rural household users for greater impact on protecting remaining forests, it was deemed that large scale production of the A1 stove was required. EcoDev undertook a consultation process with a potential private company for commercial scale production of the A1 stove within the Dry Zone area.

The Myanmar Myay Company, experienced in manufacturing ceramic products, collaborated with EcoDev to explore the possibility of a market-led approach in promoting FES among rural households in the Dry Zone area, particularly in Kyauk Pa Daung, Magwe, and Chaung U Townships. The company conducted a feasibility study to examine the technical, social, and economic potential of manufacturing the A1 stove in the Dry Zone. The company then built a stove factory in Minbu Township and innovated the new manufacturing process for producing the A1 stove in large quantities while maintaining the stove quality for energy efficiency. EcoDev facilitated the purchasing of 30,000 A1 stoves from the factory at the initial stage.

Step 2: Township advocacy and planning on environmental conservation and FES

In collaboration with township authorities, EcoDev conducted advocacy workshops in the Dry Zone townships to raise stakeholders' awareness on the importance of combating deforestation through FES. Village tract leaders were mainly invited to the advocacy workshops and EcoDev provided a stove demonstration to show the comparative advantages of the A1 stove for household use. As part of the advocacy workshop, EcoDev made plans with attending village leaders for organising village level awareness raising activities.

Step 3: Village level awareness campaign

Based on the township advocacy workshop, EcoDev field staff conducted village level awareness campaigns. At each campaign, two village women groups were brought together to observe the efficiency of the A1 stove compared with the common three-stone method that is used by villagers. After the stove demonstration, village women participated in analysis of the stoves, drawing their interest in the use of the A1 stove. These village campaigns were conducted in both of FAO's project villages and in non-FAO project villages in the Dry Zone. For the former villages, the A1 stoves were given as a grant by FAO but small fees were collected to cover some logistics costs and for use as a women's revolving fund. For the latter villages, the village women group decided on the price of the A1 stoves to be sold within the village. Stoves were transported to these women groups, who handled stove dissemination at village level.

Step 4: Development of supply chain

While village level stove campaigns were conducted, EcoDev's field staff identified the potential retailers and wholesalers in the village and townships. This was linked with the factory for direct delivery of stoves and for further marketing of the stoves within the area. It took almost two years for EcoDev to develop a supply chain and more than 200 sources were able to link with the factory. The factory also conducted meetings with dealers to understand the pros and cons of selling the stove at the local level.

Step 5: Dissemination of information materials

EcoDev and the factory jointly developed information materials such as posters and an advertising pamphlet to provide information needed by users. They also made an exhibition at Shwe Set Taw Pagoda festival, where more than 500,000 pilgrims visit annually. Good Information, Education and Communication (IEC) materials are useful to promote FES, as the benefits of using FES are not well known in many rural areas. An FES maintenance and usage booklet should be developed and attached to the stoves for clients to know how to maintain stoves and how to reduce wood-fuel consumption.

Step 6: Evaluation of customer satisfaction

In 2001, EcoDev conducted a customer satisfaction survey and 3000 users were interviewed to share their experiences in using the stove. Based on the findings, EcoDev made suggestions to the factory for improving the quality and performance of the A1 stove.

Step 7: Cash flow assistance

Owing to the fact that the market threshold was not well established in the beginning, EcoDev had to provide financial assistance to the factory for continuing the manufacturing process and market promotion. This was done periodically on a loan basic and it took at least five years for the factory to be able to stand alone, without a cash flow gap in the marketing of the stove.

At present, the factory has been independently running its production and marketing functions on a commercial scale and monthly sales range from 3000 to 5000 stoves per month. Within the last decade (2000 - 2010), over 300,000 stoves have been produced and sold to rural users, particularly in Dry Zone townships. The factory itself employs 100 villagers in year-round jobs and contributes to the local economy.

5. MARKET ANALYSIS FOR FES IN LAPUTTA TOWNSHIP

Mercy Corps commissioned MSR to conduct a market analysis[12] to determine whether it is feasible to use a market-led approach to disseminate FES in Laputta Township. This research showed that **87% of households in rural areas still used traditional three-stone fires**. Of the **13%** of rural households using an FES, all were totally reliant on wood-fuel[13] since charcoal was not available for sale. **75%** of households in urban and peri-urban areas used FES with **35%** using charcoal as their fuel source and **40%** using wood. The average cost of wood-fuel for a five-member family was estimated at **$9–$15**[14] per month and the majority of households (90%) collect wood-fuel for about six months of the year and buy it for the remaining six months. The cost of charcoal for a similar size family in an urban setting was estimated to be **$10** per month.

Demand for FES

Map 3: Villages using Fuel Efficient Stoves in Laputta Township

The two principal reasons given for not using an FES were that households could not afford one **(49%)** or that they had not heard about FES **(38%)**. Others indicated that there are "no sellers in their area". **100% of households indicated that they would buy an FES if it was available in their village at an affordable price**. Substantiation of this is reflected by the fact that 80% of households in the area surrounding the production of the carved limestone stoves (see below) have converted to using an FES.

[12] Mercy Corps, Stove and Saplings Market Analysis, May 2010.
[13] Wood fuel is used to denote all fuels derived from woody biomass including charcoal, as opposed to wood-fuel which is understood to mean wood in its original composition
[14] USD 1 = K 1,000 in July 2010.

FES Supply

The MSR market analysis identified three types of FES currently available on the local market – the iron band stove produced in Pathein **(Pathein stove)**, and two types of **carved limestone stoves** produced in rural areas of the township. The Pathein stove is made of clay with an iron frame around it and is designed to be mainly used for charcoal. Around 4,200 units are currently sold in Laputta town with the numbers increasing by around **10 percent** a year. The current production capacity of the carved limestone stove is around 28,000 stoves per year but a substantial number of these are either used locally or sold to other areas.

Table 2: Current sales of stoves in Laputta Township

Type	Durability	Fuel	Producer (Place)	Annual stove units available on market	Annual stove units sold in Laputta Township
IBS	One year	1 Charcoal (Main) 2 Wood-fuel	Pathein	4,200	4,200
CLS	3-5 years	1 Wood-fuel (Main) 2 Charcoal	Ahtet Pyun (Laputta)	6,000	4,200
CLS	3-5 years	1 Wood-fuel (Main) 2 Charcoal	Didu Kone (Hainggyi, Laputta	22,000	4,400
Total					**13,100**

The carved limestone stoves are produced in Didu Kone Village and Ahtet Pyun but stoves from the latter are unsuitable for transport because the stone is prone to cracking. Environmental concerns levied by the government led to limestone extraction being suspended for some time, but it was allowed to resume when production processes were altered. However, as mentioned above, Mercy Corps has discounted the use of carved limestone stoves because of environmental issues and the initial energy requirement to heat up the stone. Mercy Corps' baseline research on the fuel efficiency of various stoves[15] led to two other options being examined:

1) The **A1 stove**: a factory-manufactured baked clay stove designed by a USAID-funded project in Thailand. It has an interior cement panel for heat insulation, two iron bands around to strengthen, mid grate, two opposing air vents below, letter-box fuel entry above, and three risers to carry the cooking pot.
2) The **Green Stove**: a hand-moulded, non-baked clay stove designed by MSN. It has a mid grate and an air vent aligned with the fuel entry, two opposing vents in the firebox section, and three risers to carry the cooking pot.

[15] Mercy Corps, Efficiency of Fuel Efficient Stoves in Myanmar, July 2010.

Map 4: Main producers of FES in Laputta Township

Market Strategy for FES

FES Price

The indicators of affordability showed **31 percent** being able to afford an FES if it was sold at $1 or less. A further **22 percent** would be able to afford a stove if it was $1.5 or less while **27 percent** could purchase one if it cost $2. Therefore a total of **80 percent** of households would be able to afford an FES if the price was $2 or below.

Promotion Messages for FES

Reasons identified by households for using an FES were:

- Wood-fuel has become scarce after Nargis and more expensive, and using an FES is more fuel efficient.
- FES reduces fire hazard.
- FES reduces smoke in kitchen.

6. STOVE EFFICIENCY ANALYSIS

Mercy Corps conducted baseline emission testing using Gold Standard criteria over a one-month period during July 2010[16]. This used a combination of Water Boiling Tests and Controlled Cooking Tests to compare the thermal and fuel efficiency of traditional three-stone fires with three FES – the Pathein, the A1, and the Green Stove.

An upgrade from a traditional three-stone fire to an FES will result in a saving of 0.52kg wood-fuel (30 percent) per cooking cycle. Subject to verification of the traditional cooking regime by a comprehensive kitchen survey, over the intended range of 14,000 fuel efficient stoves disseminated under the project, around **7000 tonnes** per annum of mangrove wood-fuel would be conserved, with a corresponding carbon (as CO_2) emission reduction of around **11,000 tonnes per annum**.

Table 3: Cook-stove test data, averaged for each type of stove

Stove Performance by Stove Type						
Test		**3 stone**	FES Pathein	FES A1	FES Green	**Average FES**
WBT	Fuel kg WBT	**0.91**	0.59	0.65	0.67	**0.64**

[16] Ibid.

	% Efficiency WBT[17]	**7.36**	11.53	10.20	10.05	**10.59**
CCT	Fuel Kg CCT	**0.85**	0.57	0.62	0.61	**0.60**
	% Efficiency CCT[18]	**24.76**	37.90	40.03	35.17	**37.70**

Stove Types Selected for Laputta Township

In analysing the advantages and disadvantages of the various stoves options the following factors were taken into account:

- Principal fuel use of stoves (charcoal/wood)
- Ease and cost of transport
- Facility for local manufacture and job creation
- Ability to repair and maintain the stove
- Stove cost

The desirability of creating local employment together with having a low-cost stove primarily designed for wood-fuel use which could be easily repaired and maintained, led to the recommendation that the project should use a clay model that could be manufactured by local potters in the Delta area.

Since the quantitative test results reflect little difference between the FES models the recommendation would be for the project to use the Green Stove model based on the reasons outlined above.

7. REVIEW OF PREVIOUS REFORESTATION PROJECTS

Community forestry projects have been implemented by a number of agencies throughout Myanmar over the past 15 years (please see Table 1, Myanmar Project Review). The objectives of these projects (ongoing or completed) aimed to engage in reforestation by establishing nurseries and community forest user groups. Many of these projects faced challenges in establishing sustainable sapling production and marketing systems. However, significant successes were achieved in developing income generating activities from sales of saplings and other forest product.

[17] **% Efficiency WBT**
Theoretical heat Q supplied to the WBT from the burning wood is given by:
→Weight of wood burned (WBT) x 15.3 MJ/kg = Q-theory MJ (WBT)
Actual heat supplied to the 3 litres water is given by:
→Q-actual MJ (WBT) = mass kg x Cp MJ/kg (°C) x temp rise (°C) where
- Mass of 3 litres water = 3 x 0.997kg/litre @ 25 °C = 2.991 kg
- Cp = specific heat of water 4.1813 kJ/kg °C = 0.00418MJ/kg °C
- Temp rise deg C = as measured (for example 20 °C to 100 °C i.e. 80 °C)

Hence Stove WBT efficiency = (Q-actual MJ (WBT)/Q-theory MJ (WBT)) x 100%

[18] **% Efficiency CCT** :
Theoretical heat Q supplied to the CCT from the burning wood is given by:
→Weight of wood burned (CCT) x 15.3 MJ/kg = Q-theory MJ (CCT)
Actual heat supplied to the 3 litres water during simmering and vaporisation of a mass kg of the original 3 litres of water is given by:
→Q-actual MJ (CCT) = (mass kg x L MJ/kg) where:
- mass kg = weight (kg) of water vaporised (i.e. weight of 3 litres – weight remaining)
- L = specific latent heat of vaporisation of water at 100 °C, and 1 bar atmospheric pressure is 2.26 x 10(6) J/kg or 2.26 MJ/kg

Hence Stove CCT efficiency = (Q-actual MJ (CCT)/Q-theory MJ (CCT)) x 100%

Lessons Learned

Management and Ownership of Nurseries

- Nurseries cannot be developed as an income generation activity for vulnerable households due to time investment requirements (it takes around five months after the investment in inputs and labour cost to produce and grow saplings).

Creating a Sustainable Demand for Saplings

- Reforestation projects usually do not include the development and support of a market channel for saplings. Most projects provide free saplings to communities for vulnerable people, thus impeding the development of a sustainable market chain.
- Most of the species produced by nurseries are preferred species of key project staff and not always the target group's preferred species.
- Planting time does not always coincide with the best period for household incomes. For example, in the Delta area, November is the paddy harvest time and the period when households can invest in non-essential assets (such as trees), however the best time for freshwater tree plantation is June and September during the paddy cultivation season.

Best practices

Management and Ownership of Nurseries

- For freshwater trees, a nursery as a private business can be sustainable and profitable, but private nursery development projects must coordinate with other projects providing saplings for free to avoid overlap. Projects distributing saplings for free impede the development of a sustainable sapling market chain in their target area.
- Selection of freshwater tree nursery entrepreneurs should not be based on vulnerability criteria but should be based on entrepreneur skills and investment capacity (including access to credit for business growth or risk management).
- For mangrove trees, a nursery as a private business can probably not be profitable due to lack of market demand for mangrove saplings. Nurseries can be managed by a CBO and trained to produce saplings demanded by reforestation projects. Linkages should be developed with other agencies and local authorities to keep the nursery active beyond the project duration. Projects should target wood-fuel collectors as a priority and provide technical skills that could reduce illegal deforestation by encouraging wood-fuel collectors to become wood-fuel producers.

Creating a Sustainable Demand for Saplings

- Social marketing should be intensive as the market channels do not exist at the moment. This could include village lotteries, sensitisation on natural resource management, and distribution of saplings to traders to develop market channels.
- For a nursery to generate incomes, the minimum production is about 10,000 saplings per nursery.

Maintenance of Reforested Land

- Community participation and buy-in to the project is essential. Without active and representative participation, reforestation efforts hold little chance of being respected by local communities, who can easily cut down trees if they see no reason for their growth. A strong education programme is also critical for success. Reforestation projects should include a village reforestation plan developed with the target groups, including the number of saplings, size and species planted, precise location for plantation, who should be participants, etc.
- Similarly, community residents must see that the local government is involved and supportive.

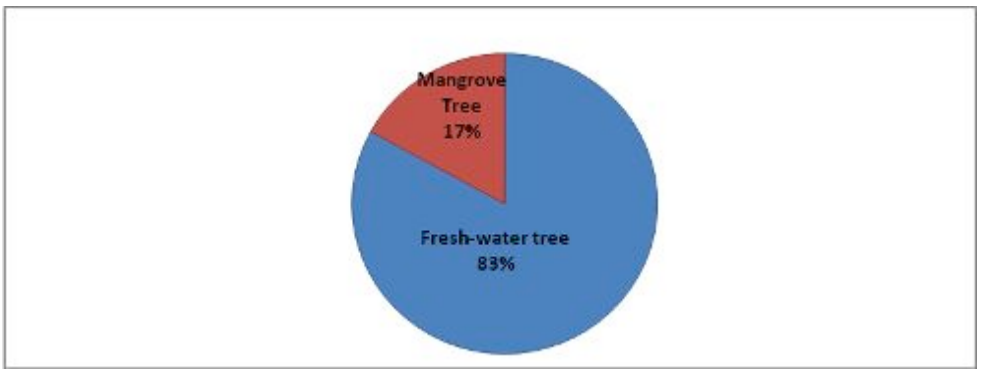
8. MARKET ANALYSIS FOR SAPLING NURSERIES IN LAPUTTA TOWNSHIP

MSR conducted a market analysis[19] to determine whether it is feasible to disseminate saplings in Laputta Township through a market-led approach.

Demand for Saplings

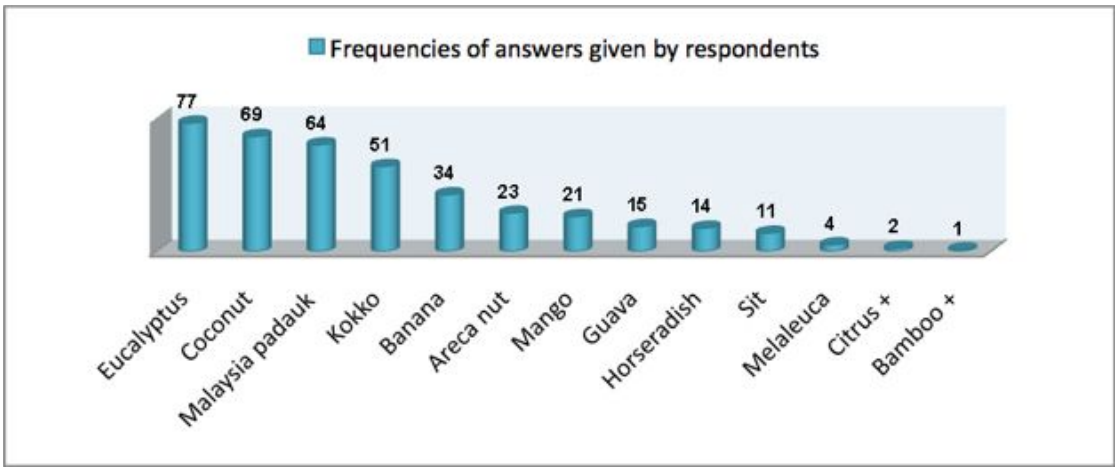
A clear preference was reflected for freshwater tree replanting with **83%** of respondents choosing these over mangrove trees (see Exhibit 1 below). Of those preferring freshwater trees, **54%** would prefer them for windbreak, wood-fuel or timber purposes while **46%** would prefer fruit trees. Of the remaining 13% that indicated that they would prefer to plant mangrove trees, **85%** said that this would be for windbreak purposes while **15%** said that this would be to limit erosion.

Exhibit 1: Sapling Preference



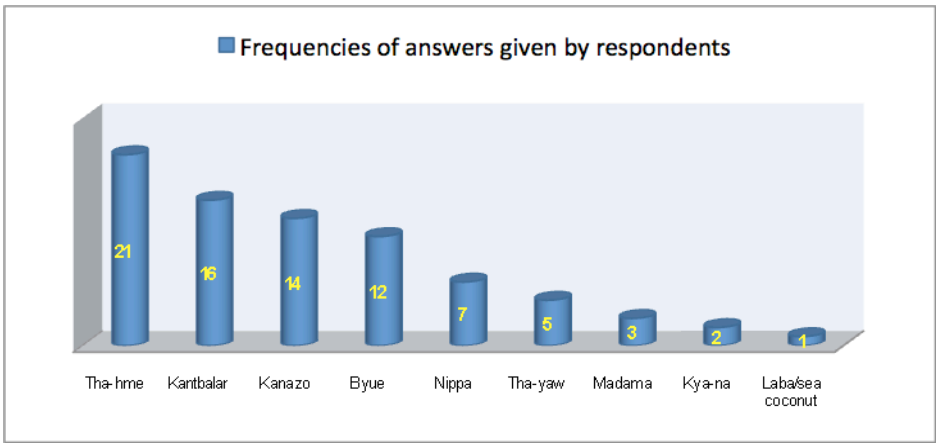
Clear preferences also emerged in terms of the types of freshwater trees and mangroves that households favoured. These are illustrated below in Exhibit 2 and 3.

Exhibit 2: Freshwater Preferences



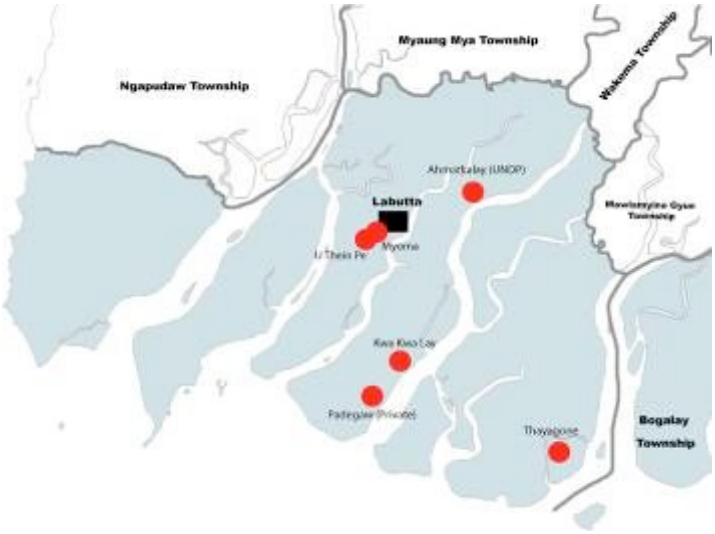
[19] Mercy Corps, Sapling Market Analysis, July 2010.

Exhibit 3 : Mangrove Preferences



Sapling Supply

Map 5: Nurseries in Laputta Township



Non market-led dissemination: There are currently three nurseries owned by the Government Forestry Department, one owned by UNDP, and one large-scale private nursery. In addition to this there are two small scale private nurseries and some traders who bring saplings by boat to the area. EcoDev is also planning to start up a mangrove nursery in 2010, which will supply mangrove saplings to 11 villages in Laputta Township.

In general, saplings supplied by the Forestry Department are distributed free but are primarily to government-supported projects. Similarly UNDP distributes free saplings to the projects that it is supporting (10 villages). All other nurseries and traders sell saplings. There are also variations in the types of saplings provided. Most Forestry Department nurseries supply mangrove saplings while none of the private nurseries/traders supply them. There are also variations in the availability of fruit trees and trees suitable for windbreak/wood-fuel.

Market-led dissemination (selling to consumers): Sometimes dealers from the upper areas of the Delta travel by boat to sell seeds and saplings. They sell mostly fruit trees such as coconut ($1 per sapling), areca nut, guava, jackfruit ($0.5) and mango ($0.3). But the frequency of their visits to lower villages is very low (about twice a year) and the quantities of saplings are small. Their main purpose in coming to these villages is to buy thatch.

Market Strategy for Saplings

The survey found that there is unmet demand for saplings in the villages. This finding indicates that there is opportunity for developing the sapling market in these rural villages.

Fruit trees: Fruit trees are the most feasible for market-led dissemination. Households are willing to buy fruit trees if they are available at affordable prices. It is reported that small-scale dealers on boats sold out all saplings they had brought.

Fresh-water trees: Villagers also wish to grow freshwater trees for windbreak /timber/ firewood and it is expected that some households will buy these saplings. However, they will pay lower prices for them, since they are sometimes available for free in some places.

***Mangrove*:** The least feasible type of tree for market-led dissemination in the rural villages is mangrove trees. Villagers usually obtain seeds/saplings free from mangroves in their village or neighbouring villages. Without cultivation, seeds grow into plants, which the farmers uproot and plant at desired locations. Some villages do not wish to grow mangrove trees because they are concerned about confiscation.

9. ANALYSIS OF FINDINGS

The results of the HEPA, the review of previous FES and reforestation projects, the FES and sapling market analysis, and the FES efficiency test confirm some of the assumptions and findings of preliminary assessments, while at times challenging other assumptions made by the programme team and by some other agencies working on these issues.

The EC-funded project was designed based on the assumption that there is an unsustainably high level of wood-fuel collection for household cooking needs. The reduced size of wood-fuel bundles being sold, and the greater distances required for households to travel to collect wood-fuel, confirm that **the reduction in forest cover reported by numerous sources has translated into relative scarcity at the household and market level.** Given that firewood-collecting households spend an average of 233 hours/year (the equivalent of nearly six 40-hour workweeks) collecting it implies a high opportunity cost in terms of educational study time or potential income generating activities.

The HEPA also showed that **the majority of families would be interested in using fuel efficient stoves if these were made available**. The fact that they are readily available in Laputta town, and widely used there, is good indication of their acceptance at the household level. However, the HEPA also indicated that the weekly cost of fuel consumption for cooking and heating water for households in the survey area using a three-stone cooking method was $3.20, compared to $3.08 for those using an FES. This minimal savings of only 3.75% contrasts sharply with the results shown in our controlled study (see Section 6), which showed that an upgrade from a traditional three-stone fire to an FES will result in a savings of 0.52 kg wood-fuel (30 percent) per cooking cycle. **This indicates the importance of educating consumers on the proper use of FES**, highlighting the efficiency and savings to be gained by conserving the amount of firewood used. This is confirmed by other agencies as an important best practice for successful FES projects.

The HEPA and the market analysis showed that households in outlying villages of Laputta township are interested in reducing wood-fuel consumption, but that **80% could only spend between 1000-2000 kyat ($1-2) on a stove.** They also indicated that they had not previously bought an FES because of lack of market access. This points to the need to introduce a business model that supports entrepreneurs located close to the consumer. **Having stove producers closer to the consumer increases access** while also minimising transportation costs, keeping the final stove price within the consumer's budget. Free distribution schemes within the consumer's area make potential consumers less willing to buy an FES if they believe that they too may receive a free stove. This eliminates the incentive for entrepreneurs to risk entering the market and prevents local producers/providers from supplying consumers with replacement stoves after 1-2 years, thereby impacting sustainability. **The best way to ensure sustainable consumer demand is to facilitate market-oriented supply chains, not agency-funded free distributions.**

Similarly, the market survey for nursery development found that **there is an unmet demand for saplings in Laputta villages, indicating that there is an opportunity for market-led dissemination of freshwater tree saplings.** This confirms the best practices reported by other agencies working in other areas of Myanmar, that a nursery as a private business can be sustainable and profitable, but private nursery development projects must coordinate with other projects providing saplings for free to avoid overlap. Projects distributing freshwater tree saplings for free impede the development of a sustainable sapling market chain in their target area.

Mangrove saplings would probably follow the same logic, but because there are several mangrove reforestation projects taking place that provide mangrove saplings for free, and because of access issues

related to mangrove areas, **the market for mangrove saplings at this time in Laputta is not good for entrepreneurs.** Agencies interested in supporting community driven demand for mangrove reforestation should either agree to end free distributions and switch to a market-led approach, or they should continue free distributions based on social and environmental justifications. **More research should be undertaken to ascertain the potential willingness of communities to invest in mangrove saplings within a market-oriented reforestation scenario**, and the policy changes needed to facilitate this potential.

This last point highlights the importance of a CSO-driven approach to complement a market-led strategy. Sustainable resource management and poverty alleviation are possible to achieve together when certain conditions are met:

1) Household awareness of the negative impact of resource over-use reaches a critical mass in the community.
2) Practical alternative solutions are offered.
3) Households are able to trust that individual efforts to conserve resources will be matched by others; i.e., that collective progress is realistically achievable.
4) Sufficient buy-in and support from relevant authorities takes place.

For these reasons, **NGOs and/or CBOs are key agents in effecting the desired outcomes of poverty alleviation with environmental sustainability.** This strategy is one of the best practices recognised by the organisations that have achieved successful reforestation or conservation results in other parts of Myanmar.

Finally, although the current project does not directly address household energy poverty as it relates to lighting requirements, it is worth addressing this dimension in the final analysis. **The HEPA found that the majority of households in the surveyed villages in the Delta had insufficient light for night time use.** Furthermore, respondents indicated that if they had more light, they would put their time to constructive use: half of all adults would work on income generation activities, one third on household chores, and half of children would spend more time on their homework. Strategies for bringing more families out of poverty should include attention to household energy needs along with other livelihoods-focused economic development strategies.

10. CONCLUSIONS

The EC-funded project described in this EPS promotes a civil society and market-led approach to provide solutions for sustainable environmental development in Laputta Township. Specifically, household energy poverty and deforestation are targeted as the nexus at which CSOs and entrepreneurs can work with communities and local authorities to provide meaningful solutions for environmentally sustainable socio-economic development. The HEPA showed that households in most villages lack market access to fuel efficient stoves and would use them if they were available and affordable. Similarly, many households would buy saplings for wood-fuel, windbreak or fruit production if these were provided affordably and if they had access to land for planting and sustainable utilisation of the forest products. Market-led dissemination is hampered in areas where agency-led (free) distribution of mangrove saplings takes place, so the approach must take into consideration the significant social and economic benefits of mangrove reforestation. Organisations working on these issues in the Delta should consider the pros and cons of market-led dissemination of stoves and saplings versus agency-led distribution, as there may be a significant impact on long-term sustainability depending on which approach is taken.

The social and environmental benefits of properly managed forests and wooded areas are many, including biodiversity protection, improved farming and fisheries, soil erosion control, and disaster risk reduction. The benefits of energy poverty reduction strategies range from reduced deforestation and improved public health by using fuel efficient stoves, to improved income generation potential with access to better forms of lighting energy. Agencies and institutions in Myanmar interested in promoting energy poverty reduction, and poverty alleviation in general, should consider conducting household energy poverty analyses in other parts of Myanmar. Also, more research is necessary on alternative fuel sources such as biogas, solar, jatropha, and small-scale rural electrification that is environmentally friendly, affordable, and complements the sustainable management of water resources for farming and household use. With most of these energy strategies, an analysis of the potential impact of land use changes on agriculture is necessary to mitigate against possible threats to household food security and well-being. As Myanmar moves forward with political and economic reforms, we anticipate that more progress will be made in this area in the near future.

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