

DECENTRALIZED RURAL ELECTRIFICATION, HUMAN DEVELOPMENT AND
EQUALITY: A CASE STUDY OF TWO VILLAGES IN THE DRY ZONE AREA OF
MYANMAR

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พม่าในฐานะที่เป็นประเทศประชาธิปไตยใหม่และประเทศกำลังพัฒนา มีระดับการใช้พลังงานไฟฟ้าต่ำสุดในภูมิภาคอาเซียน อัตราการใช้พลังงานไฟฟ้าทั้งประเทศเป็น 11% ในปี 2005 ซึ่งเพิ่มขึ้นถึง 13% ในปี 2008 ที่มีอัตราการใช้ไฟฟ้าในเขตเมือง 19% และในชนบทเพียง 10% ตัวเลขเหล่านี้แสดงให้เห็นชัดเจนถึงการขาดการเข้าถึงการใช้พลังงานไฟฟ้าในชนบทระบบการกระจายการจ่ายไฟฟ้าแบบสามารถให้แหล่งพลังงานในทางปฏิบัติสำหรับคนในชนบทแม้ว่าระบบดังกล่าวยังไม่ได้เป็นที่รู้จักมากนักและยังมีการศึกษาที่ไม่มากนักในประโยชน์ของระบบนี้

ดังนั้นวัตถุประสงค์หลักของการวิจัยนี้คือการวิเคราะห์ผลกระทบของการกระจายการจ่ายไฟฟ้าในชนบทเกี่ยวกับการพัฒนามนุษย์และส่วนได้ส่วนเสียในบริเวณพื้นที่แห้งแล้งจากประเทศพม่าเพื่อให้เข้าใจถึงประเด็นดังกล่าว การศึกษาวิจัยนี้จึงมุ่งเน้นไปที่สองหมู่บ้านคือ Mone Taw และ Pay Khwinit Pin ของโครงการ โดยองค์กรพัฒนาเอกชนในท้องถิ่นที่เรียกว่าสมาคมพลังงานทดแทนพม่าวิธีการเชิงคุณภาพถูกนำมาใช้โดยนำรูปแบบของการอภิปรายในเชิงลึกการสังเกตมุมมองกลุ่มชาติพันธุ์และการสนทนากลุ่มในการสัมภาษณ์เชิงลึกได้ดำเนินการกับข้าราชการ 5 คน และเจ้าหน้าที่ท้องถิ่น 2 คน ผู้นำชุมชน 47 คน ครัวเรือนในชุมชนที่ได้เลือกแล้ว เจ้าหน้าที่องค์กรพัฒนาเอกชน 4 คน และนักวิชาการและตัวแทนจากสามผู้ประกอบการขนาดเล็กและขนาดใหญ่ในภาคเอกชน นอกจากนี้การสนทนากลุ่มได้ดำเนินการกับคณะกรรมการหมู่บ้านพลังงานแสงอาทิตย์และครัวเรือนที่มีและไม่มีไฟฟ้าเข้าถึงการกระจายการจ่ายไฟฟ้าจากหมู่บ้านทั้งสองวังให้ความสนใจโดยเฉพาะในมุมมองของผู้หญิง

โดยสรุป หลักการของงานวิจัยนี้เป็นของตัววัดทั้งสามของการพัฒนามนุษย์ คือ รายได้ที่เพิ่มขึ้น , การศึกษาที่สูงขึ้นและสุขภาพที่ดีขึ้นซึ่งเหตุผลสำคัญที่บ่งชี้ว่าทำไมชุมชนต้องการเข้าถึงแสงสว่าง ในเวลากลางคืนที่ผ่านการผลิตไฟฟ้าในการกระจายอำนาจ (พลังงานแสงอาทิตย์ในกรณีนี้) เป็นเพราะชุมชนส่วนใหญ่ ต้องการแสงไฟในเวลากลางคืนเพื่อให้เด็กสามารถเรียนได้นอกเหนือจากนี้ยังมีผู้คนทำงานในเวลากลางคืน และยังคงไม่มีมีการเชื่อมโยงระหว่างสุขภาพที่ดีขึ้นและสถานะปัจจุบันของการกระจายการจ่ายไฟฟ้า

อย่างไรก็ตามชุมชนที่ต้องการเงินขนาดใหญ่ของพลังงานจากการกระจายการจ่ายไฟฟ้าในการปรุงอาหารประจำวันและสำหรับธุรกิจขนาดเล็กและขนาดกลางในระดับท้องถิ่นนอกโดยเฉพาะแสงสว่างในเวลา กลางคืน ในที่สุดด้วยความเคารพต่อการเข้าถึงที่เท่าเทียมกันในหมู่บ้าน Mone Taw ตัวอย่างเช่น ครัวเรือนและพระอารามที่สามารถเข้าถึงพลังงานแสงอาทิตย์ได้มีการแบ่งปันการใช้กระแสไฟฟ้ากับผู้ที่ไม่สามารถเข้าถึงได้เหล่านี้มีผลในการเข้าถึงการกระจายการจ่ายไฟฟ้าอย่างเท่าเทียมกัน และความสามัคคีของชุมชนซึ่งไม่เหมือนในกรณีที่เกิดในหมู่บ้านตัวอย่างที่สอง และเป็นสิ่งที่ไม่สามารถวัดได้โดยตัวชี้วัดของการพัฒนามนุษย์ในที่อื่นๆ

สาขาวิชา: การพัฒนาระหว่างประเทศ.....ลายมือชื่อนิติศ.....

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Myanmar, a newly democratic and developing country has the lowest electrification level among the ASEAN region. The electrification rate for the whole country was 11% in 2005, which improved to 13% in 2008, with the rate in urban areas being 19% and rural areas just 10%. These figures clearly show the lack of access to electrification in rural areas. Decentralized electrification systems could provide practical energy sources for rural people, although such systems are not yet well known and their usefulness has been little studied.

Therefore, the main objective of this paper is to analyze the impacts of decentralized rural electrification on human development and equity in the Dry Zone Area of Myanmar. To understand the issues this research study focuses on two villages, namely Mone Taw and Pay Khwinit Pin, under a project by a local NGO called the Renewable Energy Association Myanmar. A qualitative method was used, taking the form of in-depth discussions, observations, ethnographic views, and focus group discussions. An in-depth interview was conducted with five government officers and local officials, two community leaders, 47 households in the selected communities, four NGO staff and academics, and three representatives from small-scale and large-scale enterprises in the private sector. In addition, focus group discussions were carried out in both villages with the village solar committee and households that have and do not have access to decentralized electricity, paying particular attention to the perspective of women.

The main conclusion of this paper is that of the three measurements of human development, increased income, higher education and better health, the key reason why communities wish to access lighting at night through decentralized electrification (solar energy in this case) is because communities largely need light at night so children can study. Other than this, few people work at night and there is no link yet between better health and the current status of decentralized electrification.

However, communities would like a larger amount of power from decentralized electrification for daily cooking as well as for small and medium-sized businesses at the local level, in addition to lighting at night. Finally, with respect to equal access, in Mone Taw village, for example, the households and the local monastery, which do have access to solar energy, share it with those who do not. This has resulted in equal access to decentralized electrification and the unity of the community, which is not the case in the second village and is something that has not been measured by human development indicators elsewhere.

Field of Study: International Development Studies Student's Signature

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LIST OF ABBREVIATION

ASEAN	:	Association of South East Asian Nations
REAM	:	Renewable Energy Association Myanmar
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
HD	:	Human Development
HDI	:	Human Development Index
DE	:	Decentralized Electrification
INGO	:	International Non-Governmental Organization
NGO	:	Non-Governmental Organization
UN	:	United Nations
UNDP	:	United Nations Development Program
MT	:	Mone Taw
PKP	:	Pay Khwinit Pin

CHAPTER I

INTRODUCTION

1.1 Statement of Research Problem

Even though rural electrification is globally acknowledged as being a basic need for rural communities, Myanmar, one of the world's least developed countries, still lingers at the bottom of the list when it comes to rural electrification. The government still faces significant challenges to provide nationwide access to electricity on a large scale due to high costs and geographic barriers. Efforts to promote decentralized rural electrification are being hampered at the moment by the fact that consumers lack basic awareness of the subject, as well as by insufficient technical knowledge by providers of electricity services and a lack of sufficient support from the government (Myint, 2012).

However, as the new democratic government's priority is to reduce poverty and raise people's standard of living, providing electricity will be one of the key requirements of infrastructure development to improve livelihoods in rural areas. Currently, the Renewable Energy Association of Myanmar (REAM) helps communities with decentralized rural electrification projects. REAM is a local non-governmental organization that has been working since 1993 to promote conservation, renewable energy technologies and reduce fuel wood use as aspects of rural development. REAM's agenda is to help the poor and protect the environment through the use of "green" alternatives in local development. In addition, REAM has concentrated its efforts on using renewable energy technologies to assist the development of the grassroots population through practical projects that bring immediate benefits, such as night light, and to reduce the need for fuel wood for cooking. REAM's projects include the "Rural Renewable Energy Revolving Fund Trial" and the "Candle Substitute Solar Lighting System Trial Program", which aim to demonstrate the potential of rural electrification to generate income as well as to integrate renewable energy into rural development in Magwe Division.

Magwe Division is located in Myanmar's central dry zone, which is a region that suffers from drought and desertification and which also has a higher incidence of malnourishment than in other parts of the country. The area consists of hilly areas and extends to the central plains. Dry zone communities are particularly underserved by the national power system partially due to their geographic location.

To date, there has not been any academic research in Myanmar on the extent to which the provision of rural electrification can bring development to rural people from the perspective of human development. Moreover, even though some areas have access to electricity, it is not accessible for all on an equal basis, so equal access to electricity is a topic needing more research. Thus, an analysis of the advantages of decentralized rural electrification is fundamental in order to evaluate its importance in the Dry Zone Area of Myanmar.

This study focuses on two rural villages: Mone Taw and Pay Khwinit Pin, both in Pauk Township. The ultimate aim of this thesis is that it can serve as a tool to help inform public policy on the supply of electricity as a means of fulfilling the basic needs of the poorest of the poor in Myanmar.

1.2 Background of the Study

Amidst an era during which the world is becoming increasingly hungry for energy, universal access to reliable and clean energy is central to sustainable and equitable development. There has been an increased focus on energy access and energy poverty over the last few years, culminating in the United Nations (UN) declaring 2012 as the "International Year of Sustainable Energy for All". By 2040, global electricity demand will be about 80 percent higher than today and electricity generation will account for more than 40 percent of global energy consumption (Exxon Mobil Corporation, 2012).

The UNDP states that energy is central to sustainable development and poverty reduction as modern energy services are directly linked to achieving the Millennium Development Goals (UNDP, 2012). Therefore, a nation cannot develop without

energy security. Access to electrification that provides lighting, refrigeration and power for appliances is one of the important needs in people's everyday lives. Moreover, electricity increases productivity by reducing labor-intensive and time consuming tasks and also promotes health and education. Access to electricity is essential for human development and is a prerequisite for economic development. However, in most developing countries, such as in Myanmar, electricity is supplied through a national grid that does not cover the whole country. In Myanmar there is a huge gap between access to electricity in urban and rural areas. Although understanding about the importance of rural electrification for national development has increased, incorrect assumptions and misunderstandings over the actual benefits still arise in both the literature and dialogues.

1.3 Objectives and Research Questions of the Study

1.3.1 Objectives

The main research objective of this thesis is to analyze the impacts of decentralized rural electrification on human development and equity in the Dry Zone Area of Myanmar.

The sub-objectives of this thesis are:

1. To outline the level of human development in the Dry Zone Area of Myanmar
2. To evaluate equity of access to electrification in the Dry Zone Area of Myanmar
3. To analyze the ways in which rural electrification is linked to human development in the Dry Zone Area of Myanmar
4. To determine how rural electrification could further promote rural development in Myanmar.

1.3.2 Main Research Question

These objectives translate into a set of research questions that guided the research process. The main research question therefore is:

- ▶ What are the impacts of decentralized rural electrification on human development and equity in Myanmar?

Sub-Questions

1. What is the level of human development in Myanmar, especially in the Dry Zone?
2. Can all people access decentralized rural electrification equally?
3. Has decentralized rural electrification improved human development in the Dry Zone Area of Myanmar? If so, how?
4. How could rural electrification further promote rural development in Myanmar?

1.3.3 Research Hypothesis

Decentralized rural electrification strengthens the community in terms of income, education and health, which are indicators of human development and thus decentralized electrification can contribute to improving the level of human development in the community. Access to electrification is not equal within communities and therefore its benefits are also not shared equally in terms of human development. Access to electrification depends on a number of factors, including the following: favorable government policy, the availability of funds, existing options and their related costs along with the ability of households to pay for electrification, access to information, knowledge and understanding of technology, and last but not least community participation.

1.4 Conceptual Framework

To analyze the connection between decentralized rural electrification, human development and equity, three main concepts are used as a framework for the study: human development; the relationship between decentralized electricity and human

development; and equity in access to decentralized electrification. These concepts are expanded upon in more detail below.

1.4.1 Human Development

In 1990, human development was given a firmer conceptual, quantitative and policy grounding through the publication of the first global Human Development Report (HDR). The concept of human development is a normative approach to social transformation rather than focusing on GDP growth alone and has become the goal of development, as defined by the UNDP. The four main pillars of human development are (1) Equity – equal opportunities and fairness for global citizens, (2) Sustainability – the next generation should enjoy the same level of human development as the present generation, (3) Productivity – investing in people to enable macroeconomic growth, and (4) Empowerment – reducing the widening gap between the rich and the poor.

Human development is a process of enlarging people's choices by expanding human capabilities. Therefore, the Human Development Index (HDI), which is used in HDRs as a composite measure of achievements, has three essential capabilities for human development, which are that people should lead long and healthy lives, be knowledgeable and have a decent standard of living. If these basic capabilities are not achieved, many choices will simply not be available and many opportunities will remain inaccessible.

In this study, the key measures of human development are:

- **Income:** Linking income and human development helps support countries to adopt policies that encourage equal opportunities to participate in economic life.
- **Education:** Education and improved knowledge assist in human resource development by promoting the intellectual growth of the country and the achievement of universal primary education is the goal of MDG2.
- **Health:** Human development also emphasizes an improvement in the health sector through better nutrition and health services as part of a long and healthy life.

1.4.2 The Relationship Between Human Development and Decentralized Electricity

Small-scale decentralized rural electrification can play a significant role not only in providing local electrification but also in enhancing local prosperity. It can boost a local community's activities to improve productivity, and can improve the local economy in terms of equity, better living standards, health, education and knowledge about sustainability, all of which contribute to human development. Therefore, the relationship between the three chosen measurements of human development and decentralized rural electrification are as follows below.

1.4.2.1 Increasing Income and Decentralized Electrification

Increased personal prosperity and wellbeing are critical for economic growth and human development. In addition, electricity and mechanical power are needed for preparing food, grinding grain, pumping water, and running equipment in households and businesses. Decentralized rural electricity systems are essential for relieving the burdens of drudgery and expanding economic opportunities in rural areas, and are a prerequisite for information services such as television, radio and the Internet. This in turn fosters productivity since electricity also enables irrigation, crop processing, food preservation, water pumping, agro-processing, ice making, etc., which can increase income for a community and thus also improve human development.

Therefore, increased income can be measured by looking at the community through:

- 1) Comparing the average time spent by men and women on activities for generating income between those who have access to electricity and those who do not.
- 2) The average increase in household income attributable to access to electricity.

- 3) The distribution of energy expenditure in non-electrified and electrified sample households.
- 4) The collection of qualitative case studies on the income benefits of decentralized electrification.

1.4.2.2. Education and Decentralized Electrification

In a developing country like Myanmar, the time and physical effort expended in gathering fuel and carrying water seriously limits the ability of people to engage in education. Access to information and knowledge is also limited if there is no electricity to power televisions or radios. Moreover, a community's level of education and knowledge can be enhanced if people can study beyond daylight hours and better learning conditions are available. Reducing isolation and marginalization by improving communication and information channels will help improve the knowledge level of the community.

Therefore, improved education after accessing decentralized electrification will be measured in this study as:

- 1) The average enrollment in school per household of girls and boys aged between 4 and 16,
- 2) The ability of children to be able to study more at night,
- 3) A greater amount of household income devoted to education,
- 4) The collection of qualitative case studies that identify the benefits of decentralized electrification for education.

1.4.2.3 Better Health and Decentralized Electrification

Decentralized electrification allows for the implementation of safety measures such as street lighting, security lighting, remote alarm systems, road signs, railway

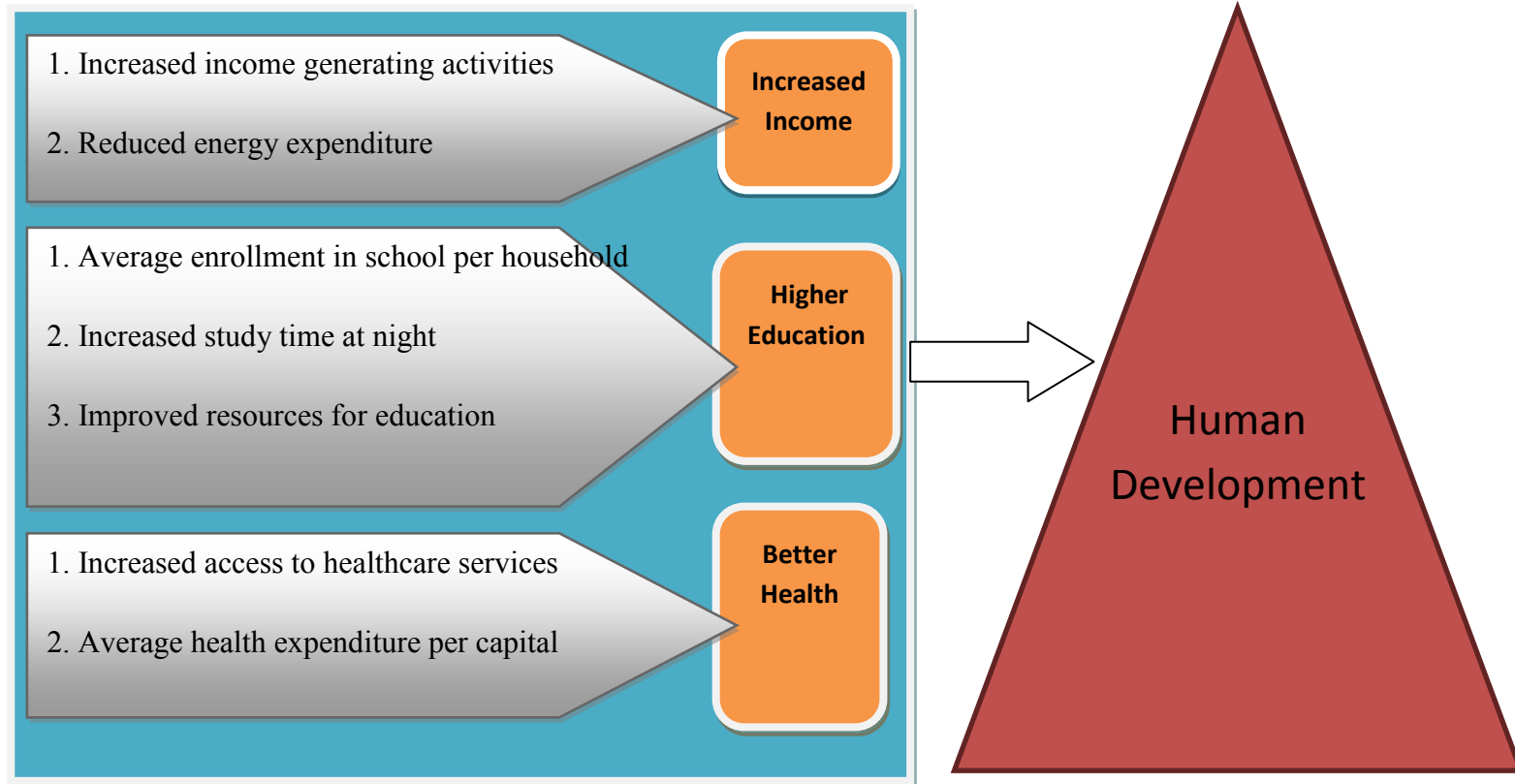
crossings and signals, as well as warning lights, etc. Access to electricity would also enable the provision of drinking water and lighting in rural clinics where vaccines along with blood and medicines could also be stored in refrigerators. Rural electrification could assist in natural disasters by making it possible to install radio repeaters and receivers, remote weather measuring systems, data acquisition and transmission systems (for example river levels), earthquake monitoring systems, emergency power for disaster relief, etc. All of these would contribute to improving the community's health system and thus also human development.

Furthermore, there are health problems related to using traditional fuels including household air pollution. Access to decentralized electrification for daily cooking can help improve sanitation conditions and prevent air pollution. People will also have more time than before to visit health centers.

Thus, in this study measuring health improvement will be undertaken by examining the following:

- 1) Increased access to healthcare services,
- 2) Average health expenditure per capita,
- 3) Collecting qualitative case studies that identify the benefits of decentralized electrification for health.

Figure 1.1 Conceptual Framework for Human Development and Its Measurement



1.4.3 Access to Decentralized Electrification (DE) and Equality

Equity is an important concept that lies at the heart of the human development paradigm. Since human development is about looking at enlarging people's choices, it must include equitable access to opportunities. What people do with their opportunities is their own concern as equity in opportunities may not always lead to similar choices or to similar results (Haq 1995).

Here, equity can be understood according to the meaning given in the Oxford Dictionary as "*the quality of being fair and impartial*". Similarly, the word "equality" is defined in the Oxford Dictionary as "the state of being equal, especially in status, rights, or opportunities". While it was known at the outset of this study that access to grid electricity is unequal, this study will analyze whether there is fair and impartial access to decentralized rural electrification. Unequal access to electrification means a restriction of choices for many individuals in a community. Thus, the questions that need further study are 1) How equitably or inequitably is decentralized rural electrification accessed or distributed in a community? 2) In what ways do people have access to electrification in the community? 3) Who is left without electrification in the same community or within different communities, and why?

In Myanmar, the development of rural energy is one of the seven tasks of the newly elected democratic government's policy on rural development and poverty alleviation (President, 2011). The country possesses technology and resources that could be used to provide electricity to rural areas using decentralized renewable energy such as biomass, biogas, mini hydro and tidal power as well as diesel generators for decentralized electrification. In addition, since rural micro-credit financing is provided by the government at present, villages have the potential to form power co-ops and set up mini power stations for their own village electrification and development through the one village one product program. Therefore, it is worth studying equality of access as a result of the policy changes in the country.

There are different types of financial resources available for decentralized electrification that are available to communities from government bodies, the private sector, as well as non-governmental organizations and international organizations such as the FAO and UNDP. Some agencies use a revolving fund system so that the fund can be used to help wider communities. However, there are villagers who still do

not have access to electrification and who depend on candle use. Since there are choices available, the reason for choosing a particular resource for generating electricity may depend on certain factors such as income or the nature of the family's occupation.

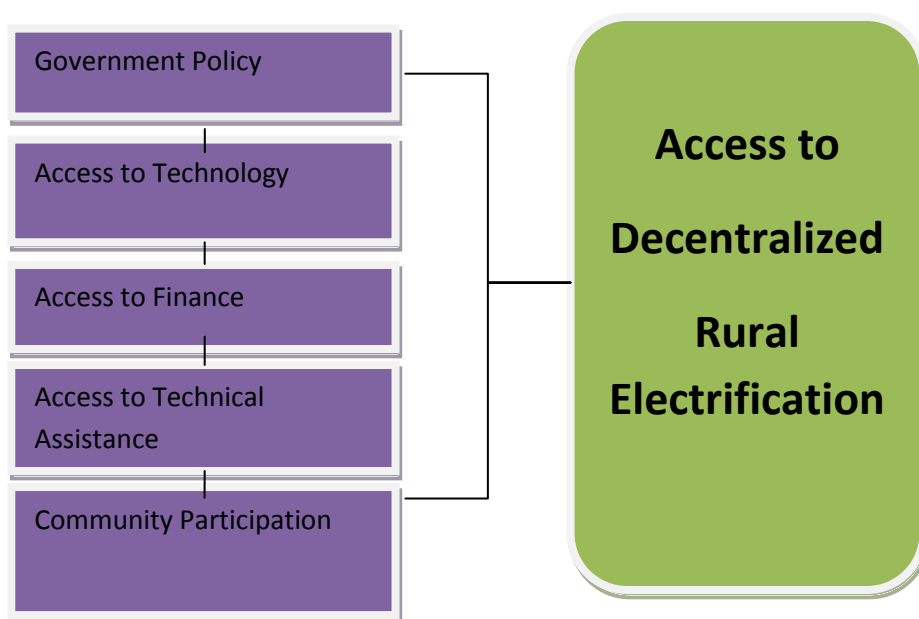
To facilitate access to electricity, effective communication and collaboration among stakeholders of potential electrification projects is needed so that they share information, exchange their experiences and knowledge, and strengthen their relationships in order to be able to access funds and technology for rural electrification provided by either government, the UN, international organizations or NGOs. In addition, non-profit organizations and government agencies that are involved in renewable energy electrification projects also collaborate with large-scale private sector actors, for example to buy the necessary equipment. However, the main stakeholder is the community because these types of project require the community's commitment and participation to maintain the equipment and manage the revolving fund. Moreover, the community's participation in certain types of electrification projects will vary depending on their affordability. A comparison between the costs and benefits will influence the community's decision-making in deciding whether to choose a certain resource to generate electricity or to remain without electricity.

Therefore, the key issues in equitable access to decentralized electrification are:

1. **Enabling government policy:** If the government's strategy and plan for rural energy development is made a priority in terms of rural development and poverty alleviation, it is more likely to include decentralized rural electrification projects or facilitate such projects by other stakeholders, such as NGOs or the private sector.
2. **Availability of technology and resources for electricity:** Renewable energy resources, such as solar, micro- or pico-hydro and biomass, are the most suitable for communities to use for generating electricity.
3. **Access to finance:** There is a need for a revolving fund to help communities with the initial installation costs.
4. **Technical Assistance:** The government and private or non-governmental organizations need to provide communities with the technical skills to maintain and use the systems adopted.

5. Community participation: The participation and commitment of the community to maintaining and having access to decentralized electricity is key to the successful implementation of decentralized rural electrification projects. In addition, the affordability of the system considered for implementation also influences the participation of the community.

Figure 1.2 Conceptual Framework for Access to Decentralized Rural Electrification



1.5 Research Method

This thesis is the result of a combination of field research and desk study. In attempting to understand equity, access to decentralized electricity and the relationship between decentralized rural electrification and human development, a qualitative method was mainly used. Data was collected through literature reviews, field interviews and discussions mainly in Yangon and Pauk Township.

All the desk-based research for collecting literature and the communication and planning for the field trips (from 12 to 20 June and 9 to 17 July) was carried out in Yangon. In-depth interviews were conducted with two main private sector actors, Ye Mon and Sun Power Company, which are partners in REAM's solar projects. For the

NGO sector, in-depth discussions were held with REAM and RDE (Rural Development Enterprises).

The period from 21 June to 8 July was the field trip spent in Pauk Township. Focus group discussions were carried out with team members of REAM and in-depth interviews with local authorities and government officers. Observations were made of the three main shops selling solar panels. A field visit to REAM's project areas aimed to examine changes in human development and focused on income, education and health in Mone Taw and Pay Khwinit Pin, the two local communities selected for the study. These two villages were chosen as case studies due to the different locations and livelihoods of the residents.

Mone Taw village is situated in the east part of Pauk Township and is one of the villages in Kan Pyo village tract and has a total of 154 households. The village has 744 people who earn their living mainly from farming, toddy farming, casual labor and as migrant workers. The major farming crops are pigeon pea, sesame and groundnut. In terms of seasonal work, the villagers mainly make hand-made mats. There is no community health worker apart from one public health worker in the nearby village of Kan Pyo. There is also a primary school with three teachers.

Pay Khwinit Pin village, situated in the south east of Pauk Township, is included in the Phoe Phyu Lone Kan village tract and has a total of 236 households. The village has a total population of 1,412 and half the households are in the village and the rest are farming households. The main livelihoods of the people in the village are farming, animal husbandry, toddy farming, casual labor and working as migrant workers. The villagers also make palm sugar as seasonal work. There are no health facilities but there is a midwife in the village. There is a single primary school in the village that has six teachers.

During the fieldwork in Myanmar from June 12 to July 17 2012, the researcher met and interviewed the following informants.

Table1.1 Informants Interviewed in the Study

Informant Information and Organization	Number of selected Informants	Types of Interviews, Data Collection and Purpose
Local authority (government)	Two in total (one from the General Township Authority and one from the Ministry of Electricity in Pauk)	In-depth interview To understand their perspectives on Decentralized Electrification
NGOs: REAM and Rural Development Enterprises (RDE)	9 persons (staff from REAM's Yangon office and REAM's Pauk Office and 2 persons from RDE)	In-depth interview, focus group discussion To get data and information on human development and DE-related projects, personal experience, and case studies
Local government (Education Sector)	Two headmasters from each village (Mone Taw and Pay Khwinit Pin)	In-depth interview To gain an understanding of the relationship between DE and education, case studies
Officer in charge at government health clinic (Health Sector)	One officer from Mon Taw Village	In-depth interview To gain an understanding of the relationship between health and DE, case studies
Community leaders from each community	Two persons from each village (Mone Taw and Pay Khwinit Pin)	In-depth interview To gain an understanding of how to access DE, the strengths and weaknesses of DE
Private sector	Three persons (two from a solar company in Yangon, one from Paya Taung village)	In-depth interview and observations of three solar shops in Pauk Township To gain an understanding of how to access DE, the successes and failures of DE and case studies

Committee for DE Management from each community	20 persons (15 from Mone Taw and 5 from Pay Khwinit Pin)	Focus group discussion with each community To gain an understanding of how to access DE, case studies
Households with access to electricity in two communities	22 in Total (15 persons in Mone Taw and seven persons in Pay Khwinit Pin)	Focus group discussion To gain an overall understanding of how to access DE, the strengths and weaknesses of DE, the relationship between DE and human development, and case studies
Households with no access to electricity in two communities	20 in Total (15 persons in Mone Taw and five persons in Pay Khwinit Pin)	Focus group discussion To gain an overall understanding of how to access DE, the strengths and weaknesses of DE, the relationship between DE and human development, and case studies
Individuals with access to electricity in two communities	10 in Mone Taw and 13 in Pay Khwinit Pin (23 in total)	In-depth interview and survey questionnaire To gain an overall understanding of why it is possible to access DE, the strengths and weaknesses of DE, the relationship between DE and human development, and case studies
Individuals with no access to electricity in two communities	10 in Mone Taw and 14 in Pay Khwinit Pin (24 in total)	In-depth interview and survey questionnaire To gain an in-depth understanding of why it is not possible to access DE, the strengths and weaknesses of DE, the relationship between DE and human development, and case studies

The study focused on qualitative methods such as in-depth discussions on theory and implementation, interviews, observations, ethnographic views, and focus group discussions. For comparison purposes, information from communities without access to electricity was collected and analyzed. In selecting the households, the researcher chose households representing diverse backgrounds and different livelihoods. The researcher paid particular attention to the perspective of women by asking specific questions addressing women's issues during the group discussions and during the house visits for in-depth interviews.

1.6 Research Limitations

Human development is quite a dynamic concept that has evolved over time and there are now many ways to measure it. In this study, the most relevant indicators chosen are income, education and health. However, even measurements of these indicators produced a wide range of data and information that is difficult to evaluate using a quantitative method in the short period of time available. For this reason, qualitative research from only two communities was selected for the in-depth analysis for this research.

In addition, township-level data on health was not available due to the transfer of the medical officer in charge during the period the researcher was in the field. However, some useful information on the health sector was obtained from observations and from in-depth interviews with local communities.

Although the UNDP is carrying out an assessment of rural electrification, it has not released any information yet and therefore no information on this can be included. However, overall the data and information collected are sufficient for analysis and can be used to formulate conclusions and recommendations.

1.7 Significance of the Research

This study evaluates the significant contribution decentralized electrification can have on human development in Myanmar. At present, investments are being made in electrifying the country but mainly in terms of non-renewable resources, which are costly and cannot be sustained in the long run. Therefore, although this research focuses on rural areas, in the future a long-term national plan could be drawn up in a sustainable way to electrify the country through decentralized electrification both in rural and urban areas.

In addition, this study defines the key aspects in accessing decentralized rural electrification and this will be helpful in creating a future strategy for supporting more projects. The peaceful demonstrations on regular access to electricity, which took place in Myanmar in May 2012, show that the lack of access to electricity has the

potential to become a political issue and increase instability. Therefore, this study can be used to inform the relevant stakeholders on implementing the findings.

1.8 Structure of the Thesis

This study is structured into six main chapters. Chapter 2 is the literature review of the thesis and Chapter 3 describes and analyses human development in the two communities. Chapter 4 sets out a description of the link between human development and decentralized electrification and describes the specific case studies in the two communities, which form the core of this research study. In Chapter 5, equal access to decentralized electrification is analyzed by comparing the two communities. Chapter 6 is the final chapter and contains the main conclusions and recommendations for project developers, the private sector and policymakers, and discusses issues requiring further study.

CHAPTER II

LITERATURE REVIEW

Amidst an era during which the world is hungry for energy, universal access to energy is one of the goals of the United Nations Development Programme (UNDP, 2012). Access to modern energy services is a priority development agenda with the overall goal being “universal access to affordable, clean and modern energy services for sustainable human development” (UNDP, 2012). There has been an increased focus on energy access and energy poverty over the last few years, culminating in the United Nations declaring 2012 as the “International Year of Sustainable Energy for All”.

The UNDP states that energy is central to sustainable development and poverty reduction as modern energy services are directly linked to achieving the Millennium Development Goals (UNDP, 2012). Therefore, a nation cannot develop without energy security. Access to electrification that provides lighting, refrigeration and power for appliances is one of the important needs in people’s everyday lives. Moreover, electricity increases productivity by reducing labor-intensive and time consuming tasks and also promotes health and education. Access to electricity is essential for human development and is a prerequisite for economic development. However, in most developing countries, such as in Myanmar, the main electricity supply comes from the national grid, which is under the control of the government but does not cover the whole country. In Myanmar there is a huge gap between urban and rural access to electricity. Although understanding of the importance of rural electrification to national development has increased, incorrect assumptions and misunderstandings over the actual benefits still arise in both the literature and dialogues.

This thesis will focus on the link between decentralized rural electrification, human development, and equity in Pauk Township in the Dry Zone Area of Myanmar. This section will look at the significant amount of academic work that has been compiled on decentralized rural electrification and human development both in the broader context and in the context of Myanmar. This section also considers the

gaps that exist in the literature and how the research of this study differs from previous literature.

2.1 Defining Decentralized Electrification

Electrification is the process of establishing an electricity system fueled by primary energy sources, e.g., wind or fossil fuel, and transferring the electricity generated to end-users through transmission and distribution lines.

In an urban context, grid extension as part of a centralized system where power plants are operated on a centralized basis is a logical choice and in this respect electrification approaches are very similar around the world. During the process from transmission to distribution, electricity must be stepped down so it can be distributed to homes and businesses. Transformers are needed to convert high voltage electricity to the lower voltages so it can be distributed down to end-users through distribution lines (International Energy Agency, 2011). Under this system, there is a tendency to invest in large-scale power projects in order to supply electricity to the entire country through an electrical grid that constitutes a vast, interconnected network for delivering electricity from suppliers to consumers (International Energy Agency, 2011).

In the rural context, there is a broader range of options including the following: stand-alone installations, micro-grids and grid extensions (International Energy Agency, 2011). Decentralized electrification or stand-alone small power generation is one option that is not connected to the national grid where electricity is generated in areas near to the point of use. This off-the-grid (OTG) or off-grid approach refers to living in a self-sufficient manner without reliance on one or more public utilities. Thus, a decentralized energy system has two key characteristics: 1) it enables buildings to become power stations using technologies such as solar panels, wind turbines, and micro-hydro power, and 2) local energy networks proliferate in order to distribute heat and power locally. In a decentralized (distributed) power system, the closer the distance between the place where electricity is produced and consumed, the less is lost through transmission lines (Mekong Energy and Ecological Network, 2012).

Therefore, I define “decentralized rural electrification” as the “*generation and distribution of electricity near to where it is used.*”

The following diagram represents the two different power generation systems (Greacen, 2011).

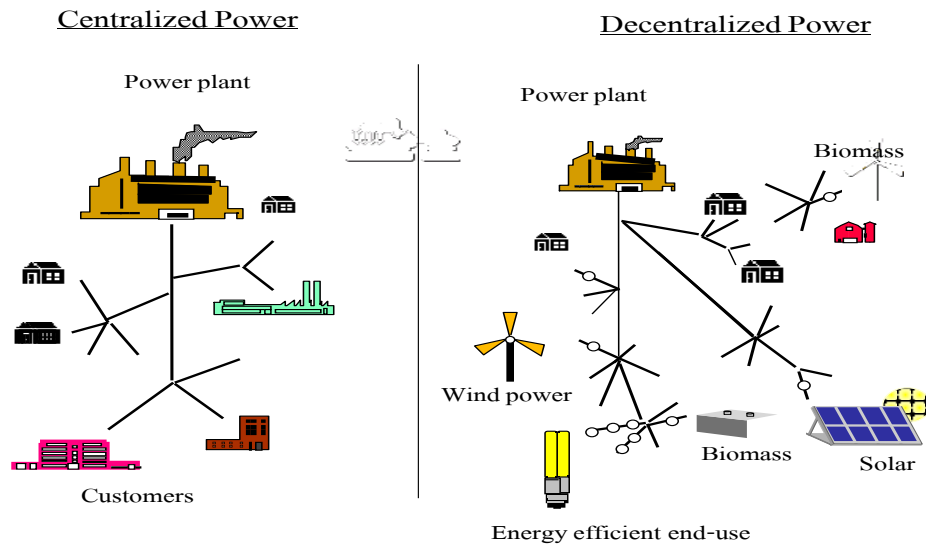


Figure2.1: Electricity Distribution Pattern of Centralized Power Vs Decentralized Power

2.2 Background Information on the Energy Sector in Myanmar

The electricity system in Myanmar is primarily centralized and under the control and management of the government and state-owned enterprises such as the MOGE (Myanmar Oil and Gas Enterprises). The main state actors in the power sector are (1) the Ministry of Electric Power 1, which is responsible for hydropower and coal-fired thermal power, (2) the Ministry of Electric Power 2, which manages gas-fired thermal power, power transmission and distribution, (3) the Ministry of Energy, which responsible for oil & gas, (4) the Ministry of Mines, which has responsibility for extracting and using coal, and (5) the Ministry of Forestry, which takes care of biomass and fuel wood and (6) the Ministry of Science and Technology, which is responsible for renewable energy technology (Ministry of Energy, 2012).

Myanmar is rich in natural resources, including an abundance of gas and oil reserves and has considerable potential for hydropower. In Myanmar hydropower, gas

and steam turbines are the main sources of power generation, which accounted for more than 95% of installed capacity in 2008–2009. Myanmar has no resources in diesel, the import of which only accounts for 0.60% of electricity generation. Myanmar Electric Power Enterprise (MEPE), a state-owned enterprise, distributes electricity generated by major hydropower and gas turbine stations. The national grid supplies 94% of the nation's power while another 6% comes from off-grid isolated energy sources (Ministry of Energy, 2012, JICA, 2003). Therefore, electricity generation in the country is still largely dependent on fossil fuel rather than DE.

2.2.1 Definition of Electrification in Myanmar

According to MEPE's statistics, households that receive their power supply from MEPE through a watt-hour meter are counted as electrified households. MEPE's guidelines state that electrified households mean those that can receive electricity through distribution lines from MEPE, independent power producers (IPP), a village electrification committee (VEC), or directly from generators. The government's minimum rural electrification (RE) target is defined as receiving a power supply throughout the year for three hours a day in the evening time and in terms of quantity to be able to use three 20 W fluorescent lamps and one electric appliance, totaling 80 W including distribution losses (Ministry of Energy, 2012, JICA, 2003). Although battery-powered lighting using 4–8 W fluorescent lamps uses electricity, it is merely substituting a kerosene lamp and is, therefore, not specifically counted as an electrified household by the government as it does not reach the actual level of the government's defined lighting standard.

However, in Myanmar, a newly democratic and developing country in Southeast Asia, there is a large difference in the electrification rate between urban areas and rural areas. In 2005, the rate of electrification was 11% for the whole country, which later improved to 13% in 2008, with the urban electrification rate being 19% and rural level 10%, which is the lowest among the ASEAN region (World Energy Outlook, 2008). Similarly, according to the UNDP, 42.8 million of the country's 58.82 million population lived without electricity in 2008. The data from the Ministry of Labor on human resource development indicators revealed that the number of electrified villages in rural areas is 1,750 out of 65,148 villages, which equates to less than 10% of the villages in Myanmar (Ministry of Labor, 2011).

Although there are several other slightly different figures on the electrification rate in Myanmar, it can be concluded that the population living in rural areas of the country with no access to electricity is relatively high in Myanmar.

2.2.2 Myanmar Power Policy and Planning

Myanmar's economic development strategies, especially for the energy sector, are driven by centralized government decision-making. The MEPE's list of power development objectives for the country include developing hydropower for base load power and gas turbines for peak load; optimizing the use of natural gas for cogeneration power plants; expanding the national grid; studying alternative means of producing electricity by using waste products; meeting local energy requirements without using the main power grid; reducing electricity losses incurred from transmission and distribution; and generating and distributing electricity using diesel generating sets as well as wind and solar facilities in remote areas where there is no access to the national grid (Ministry of Energy, 2012).

According to the Ministry of Energy, the government's policies on the energy sector are 1) to maintain the status of energy independence, 2) to employ hydroelectric power as one vital source of energy sufficiency, 3) to generate and distribute more electricity for economic development, 4) to promote wider use of new and renewable sources of energy, 5) to promote energy efficiency and conservation and 6) to promote the use of alternative fuels in households. Therefore, it can be concluded that among renewable energy sources, hydropower is the only one that has been given priority as a source of energy sufficiency to date, although there are plans to promote the wider use of new renewable energy sources. The policy on alternative fuels in households does not really focus on decentralized electrification in rural areas (Ya, 2010).

In May 2011, the eight most important proposals were discussed and planned at the first national level workshop on rural development and poverty alleviation to reduce the poverty headcount rate in Myanmar from 26% to 16% by 2015. Those priorities are: (1) the development of agricultural productivity, (2) the development of livestock breeding and fisheries, the development of rural small-scale productivity, (4) the development of micro savings and credit associations, (5) the development of

cooperative tasks, (6) the development of the rural socio-economy, (7) the development of rural energy, and (8) environmental conservation. The importance of rural energy is highlighted as a priority and since the workshop the development of rural energy has been assigned to the Ministry of Industry. Moreover, Article 45 of the National Sustainable Development Strategy for Myanmar states that renewable resources can be used to maintain non-renewable energy resources in a resource-rich country like Myanmar. Article 46 also states that a high dependence on non-renewable energy cannot sustain energy sources in the long-run for the next generations (NCEA/MOF/AIT/UNEP RRC.AP, 2009). However, no specific types of energy are mentioned in the Article and the role of DE still requires further study.

Moreover, in order to achieve its economic and social development plans of 12% annual GDP growth, Myanmar's Fourth Short-Term Five-Year Plan (2006/2007-2010/2011) was formulated to meet this stated target. One of the power-related objectives in the five year plan is „to develop electric power and the energy sector to be in conformity with developing trend industries“. At present, there are plans to continue oil and gas pipeline construction, oil and gas extraction, hydroelectric power development, and transmission line construction both for domestic use and as part of regional interconnection plans during the time period of 2010–2020 (Greacen, 2011).

However, while the government claims that energy sector development is vital for meeting the population's basic needs and overall development strategy, Myanmar's electrification rate is very low, even after years of resource exploitation. Countries looking for energy resources, such as Thailand, China, South Asian countries, South Korea, and the GMS countries, are also involved in extractive industries in Myanmar, and thus the benefits from the country's resources do not remain entirely in the country itself. Therefore, further research is needed on the government's rural electrification policy in general as well as the plans of the government to meet rural electrification targets.

2.2.3 Decentralized Electrification in Myanmar

The level of access to DE in Myanmar is still very low although the available technology and resources do exist. A study from the JICA in 2003 revealed that depending on the geographical location, different DE options are available and suitable for communities in Myanmar. Firstly, small hydro is the most suitable

solution for rural electrification in those remote and hilly areas that are a long way from the grid but which have potential for hydro. Secondly, biomass gas engines are the most suitable option in those villages and towns that have access to the necessary volume of rice husk or wood chips from rice mills or sawmills and at an affordable price or preferably free of charge. Thirdly, solar power is best suitable for the dry zone region. Last but not least, wind power is also suitable for certain sites with high wind potential.

However, the use of candles has been the most useful rural power source, which is not an electrified power source but they are used merely for lighting purposes. Moreover, Myanmar is fundamentally an agriculture-based country, with more than 75 percent of the total population engaged in agriculture. At present, 64 percent of primary energy in rural areas is supplied from fuel wood, charcoal and biomass. Wood fuel is the main source of domestic energy in Myanmar, which is mainly used for cooking. In 1988–89, wood fuel consumption was about 80% of the total primary energy consumption and it is directly proportional to population growth and indirectly proportional to the availability of other energy sources such as crude oil, natural gas, hydropower and coal. About one million acres of forest have been clear-felled to meet the energy need of rural areas. The types of fuel used for cooking in rural households breaks down as follows: firewood 93%, charcoal 4%, and electricity 1%. Lighting is provided by grid electricity 18%, battery 32% and others 50% (Ministry of Energy, 2012, JICA, 2003). Therefore, it shows that fuel wood is the main energy source for cooking and lighting in rural areas.

In addition, there are other forms of DE although they are not in much use in rural communities. Firstly, there are small diesel generators for household consumption and village hydro systems producing less than 50 kW (with technical assistance provided by private sector experts). There are also some 300 W to 1 kW Chinese turbine generators available in the local market. Secondly, Solar Home Systems (SHS) are also available with solar PV panels from India, and solar-wind battery charging stations, which have been donated by NGOs and donors. Finally, some rice husk gas engines have been installed to power rice mills, which also generate some electric power that can be fed to neighboring households. Nevertheless, the use of non-DE, i.e. candles and fuel wood, is much higher compared to other forms of DE in Myanmar.

Therefore, the increased use of DE is an important solution to overcome those communities' energy needs. At the moment, a number of bodies including government agencies, international organizations, international non-government organizations, bilateral aid agencies, and local organizations are working on renewable energy as DE projects in order to reduce fuel wood consumption and substitute candle use in Myanmar (Ministry of Energy, 2012, JICA, 2003). For instance, the Ministry of Industry 2 plans to electrify 5,000 villages over the next five years at a rate of 1,000 each year using solar panels, wind turbines, biogas, hydro turbines and diesel generators depending on the available resources and the most suitable means of providing electricity for the village. The initial projects will be in Chin State and Mon State. The projects are intended to provide electricity for an additional 3.5 million people by 2016. The ministry has been allocated K 147.971 billion (about US\$ 185 million) for the 2011–2012 fiscal year, a rise from only K 1.089 billion in 2010–11.

In short, the use of DE is an important part of the solution for meeting the energy needs of communities and it is likely that there will be increased use of DE in Myanmar as the government, private sector and non-profit organizations become more involved.

2.2.4 Cost Analysis of Rural Energy Use

According to a JICA study in 2003, the average monthly household expenditure on fuel and lighting was 4.9% of the total household expenditure. However, a recent study by International Development Enterprises stated that for most villages in rural areas candles are used for night light and the cost of candles is around 350 kyat per package or 50 kyat for each candle. People in the village use an average of two to six candles per night depending on the household's need, which cost around 100 kyats to 300 kyat per night and therefore between 3,000 to 9,000 kyat each month. As some villagers' income is less than 1,000 kyat a day, so for a family of three earning 1,000 kyat a day and an income of 90,000 per month, using candle light for a month accounts for 10% of the family's income (IDE, 2012). This shows that the current expenditure on using candles may be as much as double the average energy expenditure according to the calculation in 2003.

2.2.5 Level of Rural Electrification in Magway Division

The gap in the electrification rate is very large between urban and rural areas in Magway. According to a Household Income and Expenditure Survey undertaken by the Central Statistical Organization in 1997, Magway Division has the highest percentage (92.5%) of electrified urban households whereas in rural areas of Magway only 19.1% of households have access to electricity (JICA 2003). According to the data by the Central Statistical Organization, the general monthly household expenditure on fuel and light in Magway Division was 5.22% of expenditure in 1997 and this increased to 6.13% in 2001 and 6.20% in 2006.

The table below shows research done by the JICA in 2003 on electricity demand in relation to population increase in rural areas of the Magway Division.

Figure 2.2 Electricity Demand in Magway

No.	State/Division	Population 1983 Census			Population in 1997		Rural Households	Power Demand		
		Urban	Rural	Total	Total	Rural		Upon RE	After several years	
		1,000	1,000	1,000	1,000	1,000		1,000	MW	MW
		1	2	3	4	5		6	7	8
8	Magway Division	493	2,750	3,243	4,301	3,647	608	73	97	

The above data shows that there is increased demand as the population increases and the expenditure on fuel and lighting has also increased in Magway Division.

However, the current level of overall access to electrification is still low in Magway at 31% according to an IHLCA study for 2010. In addition, there is a gap in the electrification level between the urban and rural areas of Magway Division since 89% of urban areas have access to electrification, which is more than three times higher than in rural areas where the figure is 24.4% (IHLAC 2010). Therefore, it can be concluded that there is not enough supply to meet access to electrification in Magway Division.

2.3 Human Development

The concept of human development has changed over time and varied among international institutions, academic and policy groups. The preliminary conceptual framework on human development was established in 1990 when the UNDP launched its first Human Development Report (HDR), which included the use of a Human

Development Index (HDI). Since then, the HDR has been produced nearly every year. This section will discuss the definition of the concept of “Human Development” and its related literature review to gain a broader understanding of the core concept of the study.

2.3.1 Defining Human Development

The definitions of human development have evolved with the publication of HDRs since the term was first coined in 1990. The core fundamental literature on the concept of human development comes from the theoretical framework of capability approach, which is based on the freedom to achieve well-being and is understood to refer to people’s capabilities. In the first HDR, the concept of Human Development retained its fundamental philosophy of expanding people’s capabilities and is defined as follows:

“Human development is a process of enlarging people’s choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living. Additional choices include political freedom, guaranteed human rights and self-respect.”

Over the past twenty years, further features have been discussed, deliberated, advocated and clarified and in 2010 the revised concept of human development was stated as the following:

“Human Development aims to expand people’s freedoms – the worthwhile capabilities people value – and to empower people to engage actively in development processes, on a shared planet. And it seeks to do so in ways that appropriately advance equity, efficiency, sustainability and other key principles.”

The core understanding that is based on the definitions of human development over time have three main components: capabilities, process freedoms and principles of justice. Successful human development means people are able to enjoy activities and are in a state of being that they value and have reason to value. Moreover, people live long and healthy lives; enjoy education and a decent quality of life. They are able to be productive and creative either at home and/or at work, shape their own destiny and together advance shared objectives. In addition, people are able to enjoy human relationships and feel relatively secure. Thus, in human development, the „focal space“ is people’s lives. Resources, income, institutions and political or social guarantees are all vitally important means and policy goals, although ultimately

success is evaluated in terms of the lives people are able to lead and the capabilities they enjoy.

Therefore, the concept of human development is not merely looking at the rise or fall of national incomes and the development of the concept over time has resulted in better approaches for understanding the broader aspects of its core values for social well-being.

2.4 Human Development in Myanmar

Myanmar is ranked 149 out of 187 in terms of the UNDP's Human Development Index (HDI) (UNDP, 2011). Myanmar's HDI value for 2011 is 0.483, which puts it in the low human development category. However, between 1980 and 2011, Myanmar's HDI value increased from 0.279 to 0.483, an increase of 73.0 percent or an average annual increase of about 1.8 per cent.

Figure 1: Trends in Myanmar's HDI component indices 1980-2011

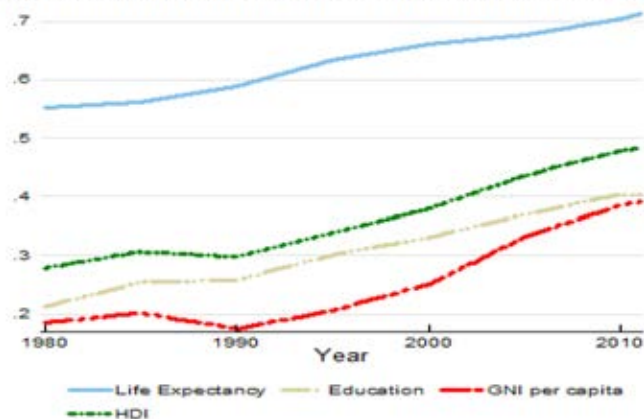


Figure 2.3 Trends in Myanmar's HDI Component Indies 1980-2011

The following figure compared Myanmar's combined HDI values verses individual income, education and health values.

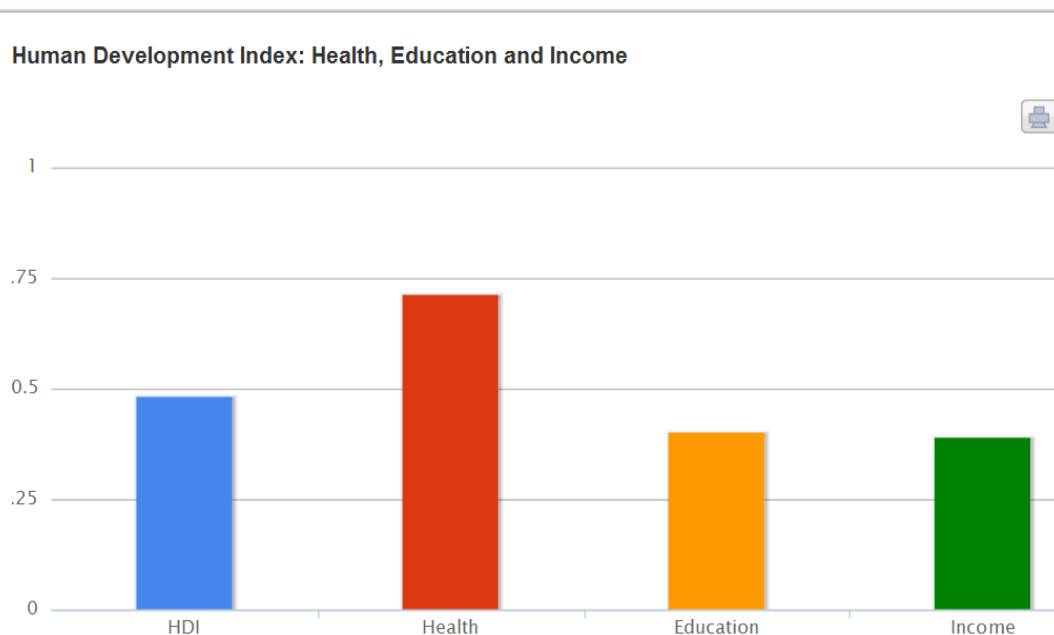


Figure 2.4 Human Development Index: Health, Education and Income

Of the three measurements, health values are ranked above the average HDI values and the other two values of education and income are slightly less than average. Therefore, it can be concluded that the Myanmar health sector is more developed than its education and income sectors. The following section will look in detail at the level of income, education and health values in section 2.4.1, 2.4.2 and 2.4.3 respectively.

2.4.1 Level of Income

The most up-to-date figure for the population of Myanmar (October 1 2009) is about 59 million in total (pg. 23, CSO, 2012). According to the integrated household living conditions assessment survey (IHLCA), which was conducted in Myanmar in 2005 and in 2010, around 25% of the population falls below the poverty line. The data also suggests that there is an improvement in basic consumption for the poorest 30% of the population in Myanmar with the remaining gaps between states/regions and in particular between rural and urban areas. The overall survey shows that the total rural poverty incidence, at 29%, is almost double that of urban poverty, at 15% (IHLCA, 2010). In addition, Myanmar's GNI per capita has increased by about 322 percent between 1980 and 2011. In 2009, Myanmar's economy accounted for 0.10 % of total global GDP, adjusted by Purchasing Power Parity. This figure is forecasted to rise to 0.11 % in 2015 (IMF, 2011).

Therefore, the data suggest that Myanmar has a high poverty level and that one fourth of the population was still below the poverty line in 2010. The rate of poverty is uneven as the rural poverty level is double urban poverty. However, in terms of the country's overall economy, this is expected to improve in the near future.

2.4.2 Level of Education

The education system in Myanmar takes the form of three levels: basic, higher, and vocational education. The basic level starts on entering kindergarten and ends with high school and lasts for a total of 11 years. This is often referred to as the 5-4-2 system. Those children who cannot attend primary school may get education from the private monastic school system, which is provided free of charge by monks at monasteries. Myanmar has preserved this education system over a long period of time. The Government sets the national examination called the BEHS (Basic Education High School) for students, which students must pass to enter university education (JICA, 2003).

In general, around two-thirds (65%) of household heads have attained only a primary education or less (2010). Only around 15% of household heads have completed secondary school or higher. There are significant differences between urban and rural areas as 75% of rural dwellers only have a primary education or less compared to 37% of urban residents. The level of educational attainment is low overall in Myanmar with large gaps between poor and non-poor households as well as between urban and rural dwellers.

Enrolment in primary education in Myanmar has slightly increased to 88% in 2010 from 85% in 2005, with the figures for urban and rural areas at 87% and 92%, respectively. Net enrolment in secondary education has seen a significant increase from 42% to 53% in 2010. Furthermore, access to primary school, which is defined in terms of physical distance, was 91% in 2010, which is unchanged from 2005. According to data from IHLAC, educational expenditure in 2009 provides information on the financial burden related to education costs and access to higher education. The overall expenditure on education in Myanmar was around 2% in 2010, down from the level of 2005 of around 3%. Expenditure on education by the poor is lower than for the non-poor, since the non-poor pay close to three times the amount of the poor on education to get higher quality education.

Therefore, the data on primary and secondary enrolment and access to schools show that there is a large gap between rural and urban populations in terms of education in Myanmar. The overall level of education in Myanmar has increased to some extent while the non-poor pay more than poor households.

2.4.3 Level of Health

In Myanmar, the Government provides medical and healthcare services at three levels. The primary level consists of state hospitals (SH), rural health centers (RHC), sub-centers (SC) under RHCs, and maternal and child health centers. The second level consists of district hospitals (DH) and township hospitals (TH). The tertiary level consists of general hospitals and specialized hospitals. The district hospitals and township hospitals are the centers of rural medical and healthcare services.

The IHLAC data on physical access to health care is defined as those living within one hour's walking distance (1.23 miles) of a hospital (including township hospitals, public specialized hospitals and station hospitals) or a health center (including rural health centers, sub-rural health centers, maternal and child health centers). In Myanmar, the overall access to healthcare increased significantly from around 81% in 2010 compared to 65% in 2005. The difference in access between urban and rural areas is large with the figure being 75% in rural areas and 96% in urban areas.

In addition, expenditure on health according to data in the IHLAC highlights both the financial burden associated with healthcare costs and access to higher quality, but higher cost healthcare. The overall share of expenditure on health in Myanmar was around 5% in 2010, almost identical to the 2005 level. The breakdown in expenditure between rural vs. urban dwellers is 4.4% and 5.9%, respectively. The non-poor pay close to three times the amount of the poor on health, which shows better access to higher quality care.

In summary, access to healthcare has improved quite substantially since 2005, although there is a considerable difference between urban and rural dwellers. The burden of health expenditure on the poor is less than that of the non-poor, although the quality of health received by the latter is likely to be higher.

2.5 Human Development in Magway

The population of Magway Division as of October 1, 2009 was 5,564,000 in total, making it the sixth largest population in Myanmar's 14 states/divisions (CSO, 2012). According to the IHLCA Survey 2009-2010, Magway Division's share of national food poverty was 6.4% for Incidence, 7.1% for Intensity and 7.4% for Severity. In terms of poverty measures in 2010, Magway Division's share was 8.9% of National Poverty for Incidence, 8% for Intensity of National Poverty and 7.6% of National Poverty of Severity. These figures rank Magway Division as the fifth highest among the 14 states/divisions.

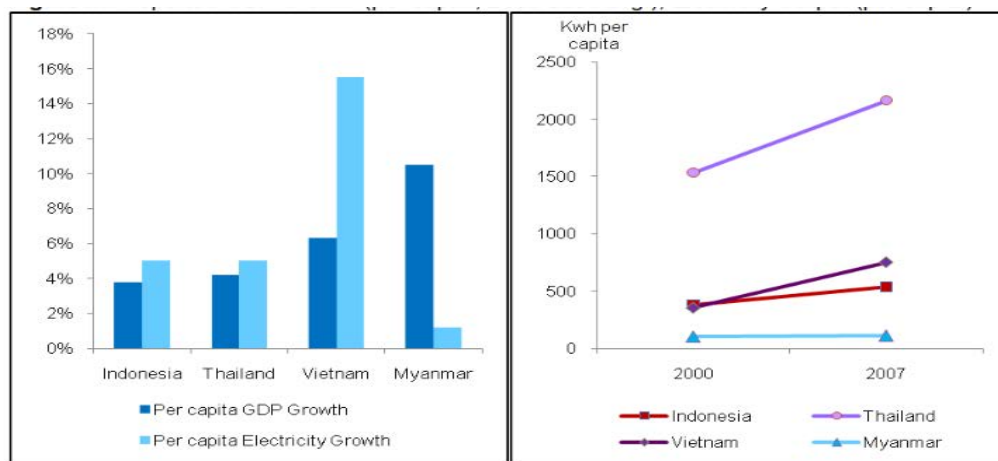
The data on education levels of the household head in Magway Division are as follows: 4.2% never attended school, 12.2% attended monastic school, 59.9% attended primary school, 15.6% attended middle school, 6.1% attended secondary school, and 2.5% attended post-secondary school. In addition, net enrolment in primary school has slightly increased to 91.7% in total in 2010 from 87.6% in 2005, whereas access to primary school has also increased from 86.5% in 2005 to 87.5% in 2010. Moreover, net enrolment in secondary school has increased from 39.5% in 2005 to 45% in 2010, and access to secondary school has increased significantly from 12.6% in 2005 to 22.3% in 2010. The share of expenditure on education for urban areas is 1.7% and for rural areas is 1.2%, and the total figure decreased from 1.5% in 2005 to 1.3% in 2010. The data suggest that there is an increase in access to education; however, expenditure on education is still a barrier.

In terms of health sector development, access to healthcare has increased in Magway Division from 49.7% in 2005 to 71.5% in 2010. Access to healthcare in urban areas was 93.1% in 2010 and in rural areas 69.1%, highlighting the gaps in accessing healthcare between urban and rural areas of Magway Division. In addition, the share of health expenditure in Magway Division was 4.5% of the total in 2010, up from 4.1 in 2005. There is only slight difference between the share of health expenditure in urban and rural areas, with the figures standing at 5.4% and 4.3%, respectively. Therefore, although there is an increase in access to healthcare, the data shows that health expenditure has not increased much and there may be unforeseen factors accounting for this.

2.6 Literature Gap

Three Harvard Kennedy School reports on Myanmar's economy have highlighted the importance of electrification for the development of Myanmar. One report shows that although Myanmar has seen growth in GDP, the rate of electrification is very low (David et al. 2009, 2010, 2012). The study even pointed out that without an improvement in access to electricity in Myanmar, GDP growth would mean nothing and therefore a policy change on the energy sector is needed. The link between GDP and electrification in Myanmar is compared in the figure below.

Figure 2.5 Reported GDP Growth (per capita, 2000-2008 avg.); Electricity Output (per capita)



Source: Asian Development Bank database; Myanmar data from *Statistical Yearbook 2008* (Naypidaw: Central Statistical Organization, 2009).

The report also highlighted that Myanmar will encounter great difficulty in improving the competitiveness of its economy relative to its major ASEAN neighbors without reliable and competitively priced electricity (David et al. 2010). However, this study only argued about the need for electrification in general, not specifically in rural areas, and called for a national grid rather than renewable energy and decentralized electrification.

The study, funded by Japan's International Co-operation Agency (JICA), was carried out by Nippon Koei and the Institute of Energy Economics, Japan, in collaboration with the Myanmar Electric Power Enterprise between 2001 and 2003. The findings of the study have been made available online in English and Japanese under the title "The Study on Introduction of Renewable Energies in Rural Areas in

Myanmar”. In spite of the many changes in the country, the study is still relevant although further research is needed to update the information.

Moreover, FAO workshops on renewable energy for rural development, which have been held in Myanmar, Lao PDR, Vietnam and Cambodia, have concluded that there is a need to promote more renewable energy in Myanmar through networking and cooperation.

However, no study has been carried out on the link between human development, decentralized rural electrification and equity in Myanmar, which is the subject of this research. The aim is that the results will contribute to the gap in the literature and that this will help support a better understanding of the issues.

CHAPTER III

HUMAN DEVELOPMENT OF THE TWO CASE STUDY COMMUNITIES

This chapter seeks to answer the first sub-question of the study, namely “What is the level of human development in Myanmar, especially in the Dry Zone?” by looking at the two selected communities as case studies. To understand the human development of the communities as discussed in the conceptual framework, three indicators have been chosen to measure this: income, education and health. However, some of the available data are out of date while some data show variation in different documents. Therefore, this paper only looks at the three indicators by examining the trends for past five years so as to gain an overall indication of the human development status of the two communities. This chapter will be structured such that an overview of the Dry Zone region, Magway Division and Pauk Township are presented in Section 3.1. Secondly, the overview of the two communities, Mone Tau and Pay Khwinit Pin villages, will be given in Section 3.2. This will be followed by a detailed discussion on the human development of the two selected communities divided into the three indicators of income, education and health in sections 3.3, 3.4 and 3.5, respectively. Finally, Section 3.6 offers a summary of the findings and an analysis of this chapter.

3.1 Overview of the Region: Pauk Township, Magway Division, Dry Zone Area

The Dry Zone is one of seven natural regions of Myanmar. The landscape in the Dry Zone is vast semi-arid low-lying land between two higher regions – the Shan Highlands to the east and the Rakhine Yoma and the Chill Hills to the west. These higher regions form the sharp geographical as well as climatic boundaries of the Dry Zone, since the climate changes abruptly from dry to wet in the higher regions. The Dry Zone covers an area of about 19,000 square miles and uncultivated lands are covered with open forests of scattered small trees and bushes. There are 56 townships in the Dry Zone (Win, 2012).

The region is called the Dry Zone because the natural vegetation, agriculture and landscape within the Dry Zone rainfall boundary are all different from those outside it. Some of the significant vegetation indicators of the Dry Zone include taung, sha,

and Thanat khar¹, which are types of xerophytes that are common trees and plants in the region. In the Dry Zone, multi-crop cultivation is the traditional farming system and crops such as groundnut, sesame, cotton, beans and pulses, maize, and millet are the major crops grown in the region. Although rice is the traditional staple food in Myanmar, rainfed rice cultivation is not productive in this region because of the small amount and unreliability of rainfall within the Dry Zone boundary (Win, 2012).

The Dry Zone region of central Myanmar, which makes up much of Magway, Mandalay and lower Sagaing Divisions, is one of the most food insecure regions of the country. Irregular and scarce rainfall leads to extreme water shortages and is a constant threat to the viability of rural livelihoods. The Dry Zone's vulnerability is manifested in the poor agricultural yields resulting from limited access to water, inadequate levels of food consumption and high levels of indebtedness among the rural poor (FSWG, 2010).

Magway Division is located in the Dry Zone of Central Myanmar. The 25 townships and 1,696 wards and village tracts of Magway Division are also inhabited by Asho-Chins and Rakhines. The population of the area is about 3,241,103. The main crops grown in Magway Division are sesame and groundnut and thus this region has become the supplier of cooking oil for the country. Other crops grown include paddy, maize, cotton, pulses, Myanmar tobacco, Virginia tobacco and potatoes. Oil is also an important mineral resource in the region and it is being extracted in large quantities at the Yenangyaung Oil Field, Chauk Oil Field and Mann Oil Field in Minbu (Saku), which are major oil producing areas in the country. Other products from the area include cane, bamboo, charcoal, catch, teak and hardwoods. There are some state-owned industrial plants in Magway Division including the Thayet Cement Factory, Pakokku Cigarette Factory, Wazi Plant, Sale Fertilizer Plant, and Kyaunchaung Fertilizer Plant. The area also has a famous handicrafts industry and produces hand-woven cotton fabrics in the Pakokku, Gangaw and Swa Township (Myanmar's Net, 2012).

¹ The bark from this tree can be ground and used in a traditional beauty product which offers protection from the scorching heat of the sun and makes the skin feel smooth and free of acne.

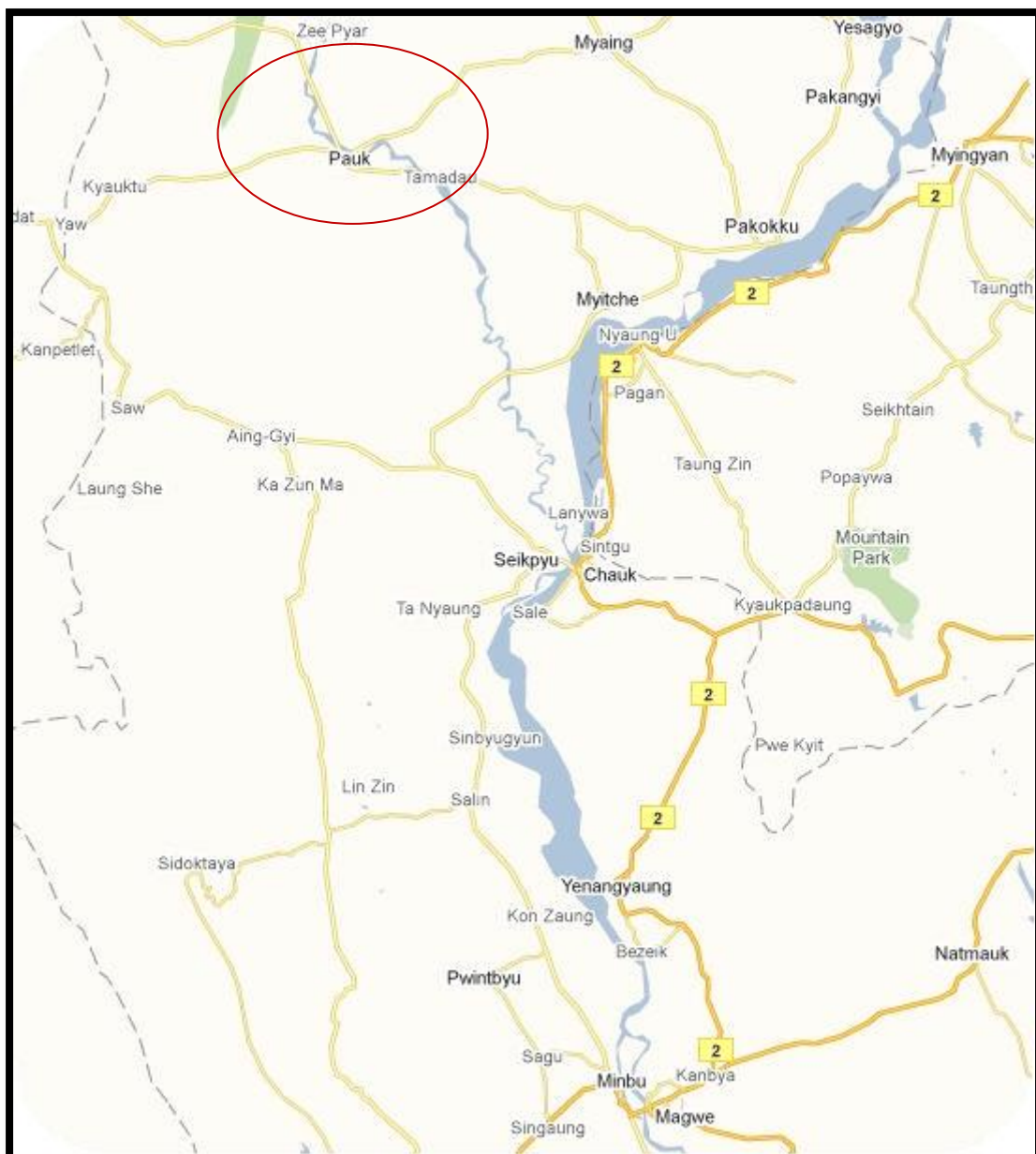


Figure 3.1 Map of Magway Division

Pauk Township is a township in the Pakoku District in the Magway Division of Myanmar. The principal town and administrative seat is Pauk. The township lies between $21^{\circ} 10'$ and $21^{\circ} 49'$ north latitude and $94^{\circ} 18'$ and $94^{\circ} 44'$ east longitude. It covers an area of 1,490 square miles. The principal river is the Kyaw River and rice is grown along its bank (Wikipedia, 2012).

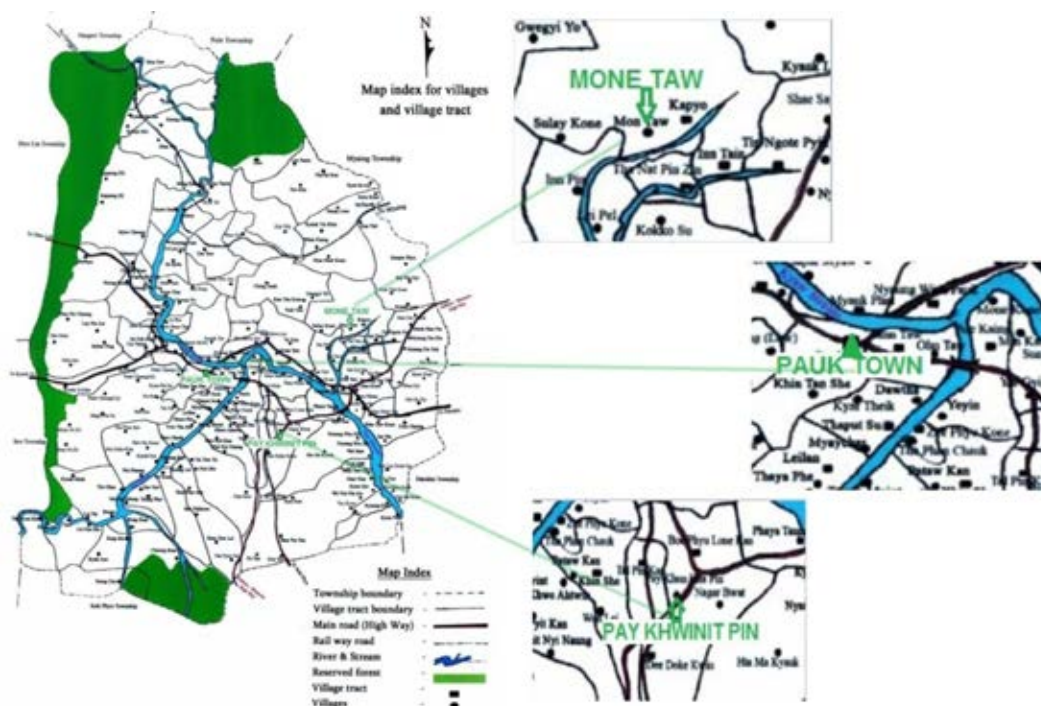


Figure 3.2 Map of Pauk Township and the two communities: Mone Taw and Pay Khwinit Pin

3.2 Overview of the villages

3.1.1 Mone Taw

The first community, Mone Taw village, is situated in the eastern part of Pauk Township and is one of the villages in the Kan Pyo village tract². Presently, there are 144 households with 154 families and a total of 744 villagers. The community has one monastery, one video house, two telephones, two grocery shops as well as 35 transportation vehicles. The river near the village is called the Chaung Chauk river. Transportation is the main problem for this village because it is 24 miles away from Pauk Township, which means a one hour trip by bicycle and the road is rough and bumpy. The most useful types of transport are mobile vehicles and motorbikes, although the community still uses bullock carts; however, these cannot be used in the rainy season when the road is muddy. The nearest markets from the village are in Kanma Township, which is one hour away by motorbike, and in Pakokku Township, which is six hours away by car (Village Profile, 2012).

² The village tract is the basic administrative unit in Myanmar and is made up of one or more villages depending upon the size of population in each village.

3.1.2 Pay Khwinit Pin

The second village, Pay Khwinit Pin, is situated to the southeast of Pauk Township and is included in the Phoe Phyu Lone Kan village tract. At present the village has a total of 236 households and a total population of 1,412 villagers. Half of the households are in the village and the rest are located near to farms in crop field areas. The community has one monastery, three phones, four mills, four grocery shops, 12 video houses, three transportation vehicles owned by a single household and one cooperative shop. There is no river near to the village. The village is located next to the asphalted Pathein - Moneywar road and is 9 miles away from Pauk Township. The most useful types of transport are mobile vehicles and motorbikes. The nearest market from the village is in Pauk Township, which takes one hour by car (Village Profile, 2012).

3.2 Income

First of all, it is important to define the word „Income“ to enable a deeper analysis of the income of the studied communities. The original meaning varies in different contexts. According to the Oxford Dictionary, the definition of “income” is *“money received, especially on a regular basis, for work or through investments”*. However, this paper is based on the concept of human development and one definition of „income share“ from the 1990 Human Development Report explained the term as *“The income both in cash and kind accruing to percentile groups of households ranked by total household income”* (UNDP, 1990). The focus of this paper is mainly on household-level income rather than individual income. In addition, as the study is at community level, in terms of assets it is also important to highlight the income level of the family because people in communities rarely save money in any kind of banking system but try to invest any surplus income in land and animals for farming (Interview, MT_FG1, 23.6.12). Therefore, for the purpose of this discussion, the term income is defined as *“the money that a household receives from regular work and the assets owned, especially land and animals.”*

In the conceptual framework, income is referred to as the first human development indicator and thus the following section will explore the income status of the two communities in order to gain a better understanding of this human development indicator of the two communities.

3.2.1 Mone Taw

The community comprises 276 acres of agricultural land, 350 acres of forest land and 250 acres of fallow land. Out of the 144 households in the village, two households (1%) own more than 10 acres of land and in REAM's village profile they are regarded as high income farmers. 39 households (27%) in the community own 5–10 acres of land and they are considered to be upper middle income farmers, and the 15 households (11%) that own less than five acres of land are considered lower middle income farmers. 61% of the households, 88 households, are landless and they are in the list of low income households. In total, the community's assets include 80 oxen, 51 cows, 18 goats, 473 chickens, and 31 pigs (village profile, 2012).

In the past, the main source of household income for the communities used to come from farm produce alone. Nowadays, the villagers' livelihoods in Mone Taw village have diversified and include more types of farming, including Thanat Khar plantations, as well as migrant working (MT_FG1, 23.6.12). In total, 56 households are engaged in farming and 88 households have work as casual labor. The crops that are cultivated include different kinds of beans, pigeon pea, sesame and groundnut, corn, cotton and toddy farming (Village Profile, 2012). Villagers also migrate to work in other areas of the country such as to Phar Kant as workers in the jade mining industry, or to nearby areas with oil reserves to dig new oil wells. Some migrate to other countries like Malaysia and Thailand to work as housemaids, construction workers and general workers in restaurants etc. For the landless, there are opportunities to work as casual labor or hawkers either in the village or in nearby villages. In terms of seasonal work, the villagers mainly make hand-made mats (MT_FG1, 23.6.12). There are also two masons and 11 carpenters in the village (Village Profile, 2012).

The overall trend observed from the in-depth discussions with experts and villagers is that during the last five years most of the households have seen their income increase. The reason given for the increase in income is put down to income from migrant working. The researcher also observed that when comparing the level of income from farming and migrant working, households with more income are those that have members who have jobs as migrant workers. Therefore, it is important to learn more about the current status of income sources in the community. In the

following section, the income of the villagers as classified under the four income categories of REAM's village profile is briefly discussed using case studies from the in-depth interviews.

- **High income household in Mone Taw**

U San Aung, who is known to be a descendent of the village founder, and his son-in-law, who is a local village official, own more than 10 acres of land in the community. Their family's main source of income is from a Thanat Khar plantation. The plantation is 10 acres, which generates 6,000,000³ kyat from sales every three to five years. The family can live off that money for many years. Thanat Khar plantation owners need to wait 10–15 years to get a good price for the plant. As the family also has enough land to plant cash crops for yearly consumption, the family can wait to get a good price for the Thanat Khar. U San Aung said, *“Our family can hold one grand ceremony for my sons for when they enter monkhood as a treat for relatives and the whole village with the income from selling Thanat Khar and I am really proud and glad about that every time I think about it”* (Interview, MT1, 24.6.12).

The Mya Pae family has a total of five family members (four men and one woman), two of whom are students and one is elderly. This household currently has 9 acres of cropland, two oxen, one bullock cart and five chickens.⁴ This family used to be wealthy from farming and had a yearly income of around 500,000 kyat, which is enough for the family's needs as well as for buying assets for the household. However, the income of the household decreased last year when changes in the weather affected their plantation and resulted in lower crop yields. As a result, the household income dropped by a half compared to the previous level and the family now has some debt. Therefore, U Mya Pae said, *“We wish to have good weather to improve our income again”* (Interview, MT20, 28.6.12).

- **Upper middle income household in Mone Taw**

U Paw and Daw Ehin Myaing's household has five family members including one middle school student. They have five acres of lands, two oxen and one bullock cart. Although they cultivate sesame, corn, cotton, groundnuts and beans and even

³ 1US\$ is equivalent to 845 kyat

⁴ This is the largest land-holding family interviewed in Mone Taw

farm other people's land in the community, they only earn enough for the family's needs and changes in weather patterns have meant that they have fewer crops as well. Therefore, the main family income comes from trading mats as seasonal work and buying textiles, as well as from sewing and selling clothes. The family's income has increased as a result of the greater opportunities from trading (Interview, MT1, 24.6.12).

Daw Daung Wai's family has three members and they own five acres of land. In the past, they had a single ox and bullock cart but due to financial difficulties over the past five years, they had to sell it. The family earns 150,000–200,000 kyat per year from farming. As seasonal work, they go around nearby villages and markets and sell mats, but only on a small scale. Currently, the family's income level has increased as one family member works in Phar Kant, and this has made it possible to buy a motorbike. However, as there is a state of civil war in Kachin State, the family is worried about their friends and family who work in Par Khant. Daw Daung Wai said, *"The family earns a good income from the one working in Phar Kant but the work is not regular and stops in the rainy season. The civil war in Kachin State also has an impact on the mining work in Phar Kant"* (Interview, MT14, 28.6.12).

- **Lower middle income household in Mone Taw**

The household of U Myo Thein and Daw Khin San Tint represents a lower middle income family. The family has three acres of crop land and owns their house. The produce from farming goes for home consumption but they also rent their land to others. They are a nuclear family and have a three-year-old son. U Myo Thein works in Phar Kant as a driver and operator of mining machinery. The job lasts for six to seven months a year and pays between 150,000-30,000 kyat per month although the job also stops in the rainy season. Daw Khin San Tint is a housewife and a school teacher in the high school of Kan Pyo village and has a monthly salary of 88,000 kyat. The housewife said, *"I am happy for the regular income and the recent increase in salary for teachers provides enough family income."* (Interview, MT13, 28.6.12).

- **Landless household in Mone Taw**

Ma Myint Kyi is divorced with one son. As she is landless, she earns her living by weaving mats as seasonal work. She is skillful in this occupation and can finish two

mats in a day and the income she earns is between 48,000 and 72,000 kyat per month. As it is seasonal work, the income is not regular, especially in summer because there is no raw material available. Therefore, when she is unable to weave mats, she works as a general worker on cropland of other households for a rate of 1000 kyat per half day. In addition, she also received a 50,000 kyat loan from Oxfam's micro finance program and she can use that money to buy raw materials for mats and put galvanized iron sheets on the roof of her house instead of thatching. She owns the land in the house compound where she lives and has three chickens as assets. She said, *"I am a good example for the Oxfam loan program and the village head also praised me for earning well although I am landless and divorced. I try hard so I can give my son an education"* (Interview, MT9, 28.6.12).

U Kyaw Aung's family has seven members and three chickens. The main source of income for this family is from family members who work as migrant workers: two work in Pyin Oo Lwin Township as general workers in the tea shop and one works in Phar Kant in jade mining and the rest of the family weave mats. Although the family does not own any cropland, they have enough sources of income and the household's income is around 1,000,000 kyat per year (Interview, MT15, 28.6.12).

3.2.2 Pay Khwinit Pin

The community has 940 acres of cropland, 89 acres of rice land, 7 acres of forest land and 10 acres of fallow land. Out of the 236 households in the village, seven households (3%) own more than 10 acres of land and according to REAM's village profile, they are considered high income farmers. 88 households (37%) in the community own 5–10 acres of land and they are considered upper middle income farmers, and the 25 households (11%) with less than five acres of land are classed as lower middle income farmers. 116 households (49%) are landless and they are included in the list of low income households. In total, the community's assets also include 475 oxen, 1506 goats, 1379 chickens, and 158 pigs (village profile, 2012).

Similarly to Mone Taw, the villagers' main livelihoods are farming, animal husbandry, toddy farming, casual labor and some work as migrant workers. The villagers also make palm sugar as seasonal work (PKP_FG1, 30.6.12). A total of 120 households are engaged in farm work, 50 households in toddy farming and 66 households have jobs as casual labor. The crops that are farmed include different

kinds of beans, pigeon pea, sesame and groundnut, green gram (mung bean), millet, cotton and toddy farming (Village Profile, 2012). Some villagers have also migrated to work in other areas of the country such as to Phar Kant to work in the jade and mining industry, or to Mandalay to work as housemaids or workers in restaurants and shops. Another industry that attracts migrant workers is the oil industry, which requires people to work on digging new oil wells. Alternatively, some villagers migrate to other countries such as China to work as housemaids, construction workers and general workers in restaurants etc. For the landless, there are opportunities to work and earn a daily wage as casual labor or hawkers either in the village or nearby villages (PKP_FG1, 30.6.12). There are also four masons and four carpenters and six hawkers in the village (Village Profile, 2012).

As an overall observation after conducting interviews with the experts and villagers, it can be stated that most of the households have seen an increase in their income during the last five years (PKP_FG1, 30.6.12). The reason given for the increased income was due to the income from migrant working and goat breeding. The researcher also observed that when comparing income from farming and goat breeding, the households that had more income were those that were successful in goat breeding. The following section will briefly discuss the income of the villagers under the classification of the four income categories using case studies from the in-depth interviews.

- **High income household**

U Saw Aung has two acres of rice paddies and 25 acres of crop fields. He also has six oxen, one bullock cart, six pigs, 15 goats and 14 cows. The household consists of 22 family members. They also have a mill that is used by other villagers for grinding their crops. The family charges 30,000 kyat for grinding 1000 maize plants and on average the family earns 250,000 to 300,000 kyat per year from the mill. Although crop yields have decreased through drought and climate change, as they have enough land all the family's expenditure has been covered by farming up until now. In addition, the family breeds goats, which produces an income of around 300,000 kyat per year. One of the family members is also a carpenter (Interview, PKP, 1.7.12).

- **Upper middle income household**

The U Shwe Maung and Daw Than Yin family has 10 family members and own 8 acres of land, 23 chickens and one pig. Two of their children now have separate houses. Three of the children work in Mu Hser, near to the Chinese border, and both earn 100,000 kyat per month. Two of the family members are students and one family member stays at home to help the parents. The family's income comes both from farming and from migrant working. However, farming produces only enough for the family's consumption and the family's other costs are covered by those working in Mu Hser Township. Since the three elder children are working, the family can continue to pay for the education of the two young children, one of whom is in the 8th grade in Yae Pyar boarding school and the other is in the fourth grade of the village school. If the children show they are interested in gaining an education, the family will continue as much as it can to fund their education (Interview, PKP15, 1.7.12).

- **Lower middle income household**

The family of Daw Hla Kyin has two daughters and two sons. Their assets include five acres of land, one pig and two goats. The two daughters work in Mandalay and their total income is 70,000 kyat per month. The two sons work in Shwe Li, which is near the Chinese border, and earn 100,000 kyat per month. Daw Hla Kyin usually takes care of pig breeding and she will buy a pig for 20,000 kyat and will sell it for 150,000 kyat after eight months. As there is no one in the family who works on the farm, she rents the land for either half of the crop as payment type or at the rate of 30,000 kyat for one year. Therefore, there is enough income for the whole family (Interview, PKP5, 1.7.12).

- **Landless household**

U Pay Ye and Daw Wine Sein, a family of 11 members, owns neither any land nor has any other assets. The entire household income is mainly earned from migrant working. Three family members work in Mandalay as general workers, one in road construction in a nearby village, one in the oil industry, and one in China working for a paper factory. The salary levels are between 15,000–40,000 kyat for the two working in Mandalay; 2000–2500 kyat per day for the family member working in road construction; the oil industry job pays around 100,000 kyat per season; and the

last family member in China earns around 10,000 kyat per day. There is one son left at home and he sometimes works seasonally picking tamarind for an income of 3500 kyat per day. The head of the family, U Pay Ye, is a professional in traditional medicine and receives income from that although on an irregular basis. U Pay Ye said *“Unlike in the past, the family’s income is enough due to the availability of migrant work”* (Interview, PKP1, 30.6.2012).

3.3 Education

Education is the foundation of human resource development of a nation and education is also one of the human development indicators. In Myanmar, access to education is playing a key role in the country’s overall development. Therefore, the education status of the two communities will be discussed in detail in order to help gain an understanding of the human development of the communities.

3.3.1 Mone Taw

The community has a primary school (grades 0-4) with three teachers: one female headmistress as well as one male and one female teacher. Out of a total of 75 students, 36 are boys and 39 are girls. In the past, the community had difficulty finding sufficient resources to pay for the school furniture and facilities. However, currently thanks to the help of the World Food Program’s (WFP) food for work program, the school has enough blackboards, benches, drinking water as well as a proper toilet (Village Profile, 2012). In addition, when the researcher visited the community it had just received 1,000,000 kyat from the government to build two toilets. It was among the 10 villages chosen from among the villages in the entire Pauk Township (Interview, FG_3, 24.6.12). This school also gets assistance from UNICEF for all the students’ stationery needs such as bags and pencils (Village Profile, 2012).

Post-elementary education is provided by the middle school (grades 5-8) in Kan Pyo village, which is 30 minutes away from the village on foot. The nearest high school (grades 9 and 10) is two hours away on foot or 45 minutes by motorbike in Yae Pyar Township (Village Profile, 2012). As the high school is far away from most villages in Pauk Township, boarding services are provided by the private sector. Furthermore, students wanting a university education have to go to a township further away such as Pakkoku, depending on the major subject they want to study. For some subjects like

medicine, these can only be studied at certain universities such as in Magway Township. The further the education is from the community, the more the household has to pay.

Regarding primary school education in the village, 100% of primary school age pupils attend the school. The middle school has 51 pupils, which represents 27% of the pupils in the village, while the high school has 44 students (24%). One student attends day university and 22 students are taking distance learning education making a total of 12% of students who are in university level education.

In total, the community has 34 members who have graduated from university and 20 people from the village work in government services, which the villagers are proud about. However, the costs for boarding and university education are too high for the community's level of income and not all households are able to afford it. However, most of the households in the community are trying to invest in their children's education especially since farming does not generate enough income due to climate change and drought. Parents would also prefer their children to work in government services or become nurses and teachers (Interview, MT_FG2, 24.6.12). The following case studies highlights the status of families in Mone Taw village who can continue to pay for their children's education and those who cannot.

- **Case study of a household whose children continue in education**

The family of U Myint Kyi has nine family members, of which two are high school students and one is in middle school and a further child studies through distance learning university. They are in the lower middle income category and the household owns four acres of land, two oxen, one bullock cart and two chickens. The family's main source of income comes from migrant working as two family members work in Thailand and another works in Phar Kant. The farm produces sesame and beans, which are sold to buy cooking oil and rice for the family's consumption. The cost of attending the middle school is 20,000–30,000 kyat per year for stationery, and the children go to school on foot. One child is at the high school and is in the 10th grade and the total costs are 450,000 kyat for one year's boarding in Yae Pyar. The other family member studying at the high school stays as a boarder and the costs for the education are 150,000 kyat per year. In addition, the family has to send rice and dry curry, which incurs costs of 2,000 kyat per month for cooking the rice. The family

member who attends distance learning university needs to go to the township for one month in a year and this costs around 150,000–200,000 kyat for tuition fees, food and hostel accommodation. The money to pay for all the family's education costs comes from the income earned by migrant working as well as the family business. For example the family loans out their tractor at a daily rate of 4000 kyat per hour (Interview, MT18, 28.6.12).

- **Case study of a household whose children cannot continue in education**

U Kyaw Aung's family is landless (as mentioned above) and the family income is mainly earned from migrant working. The family's children explained that they cannot continue in education because the family has financial difficulties. One son dropped out of school after failing his 9th grade. The other two children only studied up to the end of the 5th grade. However, the family is planning to send the youngest children to primary school because the WFP will help with a rice ration and attending primary school education does not currently incur high fees. The housewife said, *"Although we know education is good for our children, we have no other choice but to let them work so we can make ends meet"* (Interview, MT15, 28.6.12).

3.3.2 Pay Khwinit Pin

The community has a primary school (grade 0–4) with six teachers: one headmistress and five other female teachers. Out of a total of 243 pupils, 121 are boys and 122 are girls. The WFP's food for work program also supported this school so it can provide adequate school facilities (Village Profile, 2012). The school was also selected to receive 1,000,000 kyat from the government to build two toilets. They are among the 10 villages chosen out of all the villages in the entire Pauk Township (Interview, FG_3, 24.6.12). This school also gets the assistance from UNICEF for all the students' stationery needs such as bags and pencils (Village Profile, 2012).

In terms of post-elementary education, both the nearest middle school (grades 5–8) and high school (grades 9 and 10) are in Yae Pyar, which is four miles away and one hour from the village by bicycle (Village Profile, 2012). The pupils here also have to rely on boarding services provided by the private sector. Thus, the same is true for

this community, i.e. the further the education is from the community, the more households have to pay.

The attendance level for primary school education in the village is 100% of primary school age children. However, only 32 students attend middle school, which is 7% of the community's children, and the figure for high school is 13 and 3%, respectively.

With respect to university education, the village had its first university graduate this year, who is now working in Mu Hser near to the Chinese border. Thus, there is no one who works in government offices and the villagers are hoping to have more graduates in the future. However, education has not been a priority for the villagers in the past and their level of education has not been so high, so there is little incentive for them to fund their children's education. In addition, to reach the high school students need to cross the river and this is a huge barrier in the rainy season. Moreover, the cost of education at higher grades is a barrier for households, since many struggle to afford their children's education expenses. However, there are some households that are open-minded and continue to fund their children's education (Interview, MT_FG2, 24.6.12). The following case studies will highlight the status of families in Pay Khwinit Pin village who continue to fund their children's education and those who do not.

- **Case study of a household whose children continue in education**

U Than Lwin and Daw Htaw Kyi, a family of seven with five children, have nine acres of land and are classed as an upper middle income household. Their assets also include one pig. The household income is earned from the housewife who makes and then sells food in the village and in a nearby village. Every day she earns between 3000 and 5000 kyat. They also receive an income from selling palms from the farm, which generates 600,000 to 1,000,000 kyat per year depending on the price in the market. Although they have no regular income, they also breed animals as a means to earn extra income. Currently, two of the five children are boarders at Yae Pyar and attend the 8th and 7th grades. This costs the family 250,000–300,000 kyat per year each. One of the children is in Yae Sa Kyo in the first year of GTC (Government Technology College) and stays at a hostel that costs 80,000 kyat per month. The youngest child is in the 4th grade at the village school and this incurs no specific costs. However, due to the high costs, she let her son, who was studying in the 9th grade,

take a year's break. She said, "*I dare not get sick as I need to work every day to have enough income for my children's education, and I have to work alone with no help as I send all my children to school and hope that in the future they will take care of me again when they get a good job*" (interview, PKP 12, 1.7.12).

- **Case study of a household whose children cannot continue in education**

U Hla Ngwe and Daw Tin Than's family has six members. Although they are landless, the family has enough income because the family's two daughters work in Myin Kyan and earn 35,000 kyat per month. In addition, one son works in the oil industry and earns 50,000 kyat per month, leaving one son to help with the family's goats and ox breeding. However, all the children in the family stopped their education after the fourth grade to improve the level of household income (Interview, PKP 8, 3.7.12).

3.4 Health

Health is a basic need for human beings. It has even been said that "*Health is better than wealth.*" It is also an important measurement in the Human Development Report. Without access to healthcare services there can be no proper human development. A developing country like Myanmar also has to improve the level of healthcare services in order to fulfill the basic needs of the people. Therefore, the status of the two communities' access to healthcare will be presented in order to highlight the human development status of the communities.

3.4.1 Mone Taw

The community has one assistance midwife and one health worker and the nearest health center⁵ is in Kan Pyo village about half a kilometer away. The villagers usually suffer from seasonal diseases like fever, diarrhoea, dengue haemorrhagic fever (DHF) and malaria, as well as sudden problems like snake bite and bites from other poisonous insects. Other ailments include chronic diseases such as tuberculosis (TB) high blood pressure, lung cancer etc. Thus, there are not enough health services in a community of 144 households (Village Profile, 2012).

⁵ Each health center is responsible for one village tract and usually has a midwife as the person in charge.

Moreover, to go to a health clinic in a nearby township or even hospital in Pauk Township is difficult because transportation is a barrier, especially in the rainy season when the roads are muddy. It is easier for those who can afford transportation by car to access health services than it is for those who cannot and who have to rely on the available health worker in the community or traditional methods. However, there is increased knowledge in the community of basic health care and preventing diseases by vaccinating against them (Interview, MT_FG2, 24.6.12).

The community's water resources comprise one water storage pond and 38 tube wells. The pond was recently provided by the WFP food for work program as the village is in need of adequate water resources both for household and agricultural use as well as for drinking water. In terms of sanitation, the community has 83 fly-proof latrines, 11 open pit latrines and 50 households have no latrine but use the old way of open defecation in bushes (Village Profile, 2012).

Those who can afford treatment in a clinic are likely to choose this option. However, people who cannot afford treatment will use traditional medicine.

- **Household that can afford treatment**

U Paw and Daw Ehin Myaing are the two eldest members of the family, which is an upper middle income household. They have health problems related to old age such as headaches and dizziness, which requires medicine that costs 1500 kyat for each tablet. Another family member, Daw Shwe, also had an eye problem and at first she took traditional Burmese medicine before later going to get treatment in Pauk Township. The doctor gave her medicine and she waited for three months but was not cured so finally had to buy eye glasses that cost 30,000 kyat. Daw Ehin Myain has a kind of tumor on her neck and they have to go and get treatment in a Japanese hospital in a nearby township. Before going to get treatment, she feels exhausted and dizzy. After treatment, she experiences no more dizziness although the tumor is still present. Although the cost of the medicine is around 500 kyat per 3 monthly visits to the hospital, the transportation cost, however, is 12,000 kyat per visit. Therefore, they discussed with a nurse from the village about purchasing medicine in Pauk Township instead. Generally, the monthly cost for medicine is at least 7,000 kyat and Daw Shwe said, *“As we have elderly persons at home, we have to find money for medicine, but*

we try to alleviate health problem by better prevention and proper treatment” (Interview, MT1, 24.8.12).

- **Household that uses traditional medicine**

U Nyan Htun and Daw Hla Thay own their own house and tube well, although they are classified as a lower middle income household according to their land holding (above). The family works on the farm and has a small-scale Thanat Kar plantation. In the past, U Nyan Htun used to operate a battery for the whole village and would earn about 3000-4000 kyat per day. But now people use solar energy and his income has decreased. However, he would prefer not to continue the job as a battery operator because of the negative health impacts it is having on him. His daughter is also not in good health and currently studies in 7th grade. U Nyan Htun’s niece, who is an orphan, stopped going to school at the 8th grade because of the reduced household income and deterioration in the health of her uncle. She works in Phar Kant town so that they can continue the education of their daughter. As the household has limited income, he only takes traditional medicine, which costs only a few thousand kyat. U Nyan Htun said, *“I know my health is not good, but I prefer to get treatment only with cheap medicine, which is a suitable level of expense for the family”* (Interview, MT12, 28.6.12).

3.4.2 Pay Khwinit Pin

The community has one assistance midwife and the nearest health center⁶ is in Dee Dote Kwin, which is one kilometer away and half an hour by motorbike. The villagers usually suffer from seasonal diseases such as fever, diarrhoea, dengue haemorrhagic fever (DHF) and malaria, as well as sudden problem like snake bite and bites from other poisonous insects. Other health problems include chronic diseases such as tuberculosis (TB), high blood pressure, and paralytic strokes etc. Thus, there are not enough health services for a community of 144 households (Village Profile, 2012). Moreover, reaching the hospital in Pauk Township is difficult due to poor transportation connections especially in the rainy season (Interview, PKP_FG1, 30.6.12). The community’s water resources include two water storage ponds, seven deep tube wells and eight shallow tube wells. The pond in the village is for household

⁶ Each Health Center covers one village tract and usually has a midwife as the person in charge at the center.

and agricultural use as well as for drinking water. In terms of sanitation, the community has 90 fly-proof latrines, 10 open pit latrines and 136 households have no latrine but use the old method of open defecation in bushes (Village Profile, 2012).

People will still use traditional medicine if they cannot afford treatment in a clinic.

- **Household that can afford treatment**

U Nge Thar, Daw Tin Ye has two daughters and the family has a total of four members. They are landless and the household assets include two chickens and two pigs. The two daughters work in Mandalay as housemaids and both earn 30,000 kyat per month. Daw Tin Ye works as a general worker in the village and has an income of between 500–800 kyats per day. However, she has high blood pressure and needs to take medicine every 5 days. The monthly cost of her treatment is 20,000 to 30,000 kyat as they have to invite the doctor from the township to come to their village. Therefore, her own income does not cover her expenditure on healthcare so she has to rely on her daughters' income to pay for her medical expenses. She said, *"I am sorry that all the income we get goes towards my healthcare and we are even in debt because of this"* (Interview, PKP 20, 3.7.12).

- **Household that uses traditional medicine**

U Phoe Thot and Daw Phyu Ma's family consists of five family members. They are landless and own 5 chickens as assets. The husband's main livelihood used to be working as a toddy-palm climber while his wife made palm sugar. The income from this depends on the weight of the palm sugar produced per day. As the couple do not have their own palm tree farm, and they have to pay one day's income out of every four days worked to the owner of the farm. How many viss they can produce a day depends on the amount of sap they get from the toddy-palms. One viss of palm sugar sells for 500 kyat and they usually get 10 to 15 viss per day, although they also have to buy fuel wood. However, the wife has just delivered the couple's third baby and needs to rest. Therefore, the husband works in road construction and earns 2500 kyat per day. The couple could not afford the transportation costs to the township and so the wife gave birth in the traditional way, which only cost them 3000 kyat. Daw Phyu Ma said, *"We have skillful private traditional doctors in the village, so we don't need services that cost a lot"* (Interview, PKP7, 1.7.12).

3.5 Summary

In conclusion, the human development of the two communities has increased to some extent over the past five years. In terms of income sources, income from farm produce is not stable or adequate for most households at the moment due to changes in the weather. Households that do not own any land assets have to rely on migrant work if they have no other profession or sources of income. People are now more aware of the importance of education and parents nowadays are trying their best to continue their children's education despite the difficulties they face in terms of finding reliable sources of income. However, income and transportation are still the main barriers facing households in terms of deciding whether to continue their children's education or not. Lastly, there is still the shortage of health personnel at community level so people continue to rely on traditional methods or private health personnel, if they can afford it.

Therefore, the three basic human development indicators in the community highlighted that there is still a gap or need for human development though there has been a gradual improvement. The question as to whether decentralized electrification can help support this or whether there is any relationship between DE and human development will be explored more in the next chapter.

CHAPTER IV

ACCESS AND EQUALITY TO DECENTRALIZED ELECTRIFICATION

4.1 Introduction

The information in this chapter answers the second question of this study: “*Can all people access decentralized rural electrification equally? If not, why not?*” First, access to decentralized electrification (DE) will be discussed in section 4.2 by explaining DE options for the villages in section 4.2.1; an overview of the villages is given in section 4.2.2 and 4.2.3. This is followed by factors determining access to DE in section 4.3, and a discussion on access to technology in section 4.3.1. Access to finance is covered in section 4.3.2, and section 4.3.3 analyzes access to technical assistance. Section 4.3.4 looks at community participation and section 4.3.5 presents an analysis of government policy. Finally, a summary of the findings is given in section 4.4.

Access to DE

In order to understand access to DE, first the DE options for villages are discussed since they can vary depending on the available resources and the technical feasibility, which will be followed by an overview of the two villages, including an examination of ownership and access to DE and why some households choose not to use DE.

4.1.1 DE Options for Villages

The first option that has been used in the villages of the Dry Zone Area to generate DE is the use of diesel generators. They are useful for the communities since they can be used for multiple purposes. A diesel generator can be used either to electrify a household or alternatively can operate as a standalone power station for the whole village. Moreover, generators can be used to pump water, grind rice and other crops either as food for humans and animals or as products to sell in the market, such as groundnut oil from groundnuts. The average initial purchase cost of a diesel generator ranges from 50,000 kyat to 500,000 kyat depending on the electrical load needed. In addition, the cost of diesel is around 4,500 kyat per gallon at present. Some

households provide the above services (e.g. pump water) in the communities at a cost of 1,500 kyat per hour.⁷

Since the Dry Zone has the most potential for solar power in the country, the second option for DE in villages in Pauk Township is to use solar power. Solar power can be accessed both through individual ownership or group ownership by a program supported by REAM. Solar panels producing between 35 to 150 watts can be purchased by individuals in Pauk market and the price ranges from 25,000 kyat up to 130,000 kyat. In bigger townships, like in Pakukko, Mandalay and Yangon, solar panels producing up to 300 Watts can be bought for around 250,000 to 300,000 kyat and most of them are imported from China. Solar panels need to be used with a battery and the cost of batteries ranges from 4,000 kyat to 200,000 kyat.

For the group package, there are two main non-government organizations providing DE to villages in Myanmar: REAM (Renewable Energy Association Myanmar) and RDE (Rural Development Enterprise), which they do through a candle substitute lighting project. Only REAM works in Pauk Township in partnership with the World Food Program (WFP). Together with WFP, REAM distributes food for school children and at the same time the organization explains about its solar package system, and those who are interested can come and apply to be a part of the program. Although the package is paid for by the community, REAM is a not-for-profit organization and the organization's key target group, according to its mission, is the poorest of the poor. At the time of writing, 36 packages had been distributed to 19 villages in Pauk Township, including to Mone Taw (3 packages) and Pay Khwinit Pin village (5 packages). REAM's program operates such that the community needs to find a group of 24 households who are willing to participate and one household is responsible for keeping the solar panel and taking care of the charging service. For this, the selection process is fully democratic and the community has to choose their own leaders and responsible people for the solar community with collective voices. Only the strong community with good cooperation will be provided with the package.

⁷ In Mone Taw, the diesel generator in the monastery was used to provide electricity for lighting to every household for one hour every night at a cost of 1,000 kyat per month per household. However, the service was stopped once solar panels arrived in the village.

Every three days, a household has to recharge its battery, which provides up to four hours of lighting at night per day. The group needs to pay a total of 300,000 kyat as six monthly installments, which equals 50,000 kyat per month for one solar panel, one controller and 24 batteries and bulbs together with jumpers. Among the group, 23 households pay 2,000 kyat per month and the household that takes care of the solar panel has to pay 4,000 kyat per month. By doing so, the group can access solar lighting as long as they cooperate. In case the group ceases to exist or is unable to cooperate, the ownership of the solar panel remains with the household that has to pay more and take care of it. The responsibility for managing all the regular payments is in the hands of the committee leaders. The rest of the group members do not own the solar panel but can access it by charging their battery for free after the six monthly payments.

The third DE option, which is not available in Mone Taw and Pay Khwinit Pin villages, is rice husk gasification and cow dung biogas. A rice husk gasifier is intended for business use such as by a rice mill or as a standalone power plant. The initial installation cost for this type of energy production ranges from 1,500,000 kyat to 4,000,000 kyat depending on the size and power produced. Biogas from cow dung is also one option; however, the cost ranges between 50,000 kyat up to 10,000,000 kyat because it is suitable to be used with a group of households rather than for individual use.

Therefore, the cost of DE depends on the different options chosen by the household and the option chosen depends on affordability and the sustainability of the source of energy.

4.2.1 Mone Taw

This section provides an overview of Mone Taw's access to DE by looking at the following different categories: owner of a diesel generator, owner of solar energy, access to DE through REAM's package system and non-DE households.

- **Owner of a Diesel Generator**

In Mone Taw, the monastery has a generator and there are four households that own generators. The one at the monastery was made in Japan made and has been

used for 13 years. In the past, it was used to electrify households in the community but now it is used for pumping water and for lighting the temple at night and the monastery compound. Of the four households with a generator, although three of them are classed as landless, the households operate a grocery store business, show football matches and work in the jade mining industry in Phar Kant. The last household is classed as an upper middle income household and used to offer services with the generator, although they have stopped doing this now since it is no longer cost effective. From the community's perspective, those who buy a diesel generator are considered wealthy as most households in the community cannot afford the initial purchase cost. Although the household with family members engaged in migrant working has enough income to use the generator for family use to power lighting, pump water and to listen to music, the other households that have bought a generator use it for business by using it for several purposes.

However, the rising cost of diesel has resulted in fewer people using a generator to run a business. In the case of U Than Win's family from Mone Taw, the household owns a generator that they bought for 200,000 kyat and used for running a video screening business, although now they have stopped the business as it is no longer cost effective (Interview, MT5, 27.6.12).

Owner of Solar Energy

There are 20 households that have bought their own solar panel and battery. The monastery also has a solar panel that is used for lighting the building, showing videos of both a religious and secular nature to the villagers, powering loudspeakers and in addition the villagers can come and charge their battery or electrical equipment for free.⁸ U Than Win's family as mentioned above also bought a solar panel that they use for lighting their household and the grocery store they run (Interview, MT5,

⁸ According to REAM's village profile, households are categorized into high income households if they own more than 10 acres of land, an upper middle income household if they have 5-10 acres of land. Households with less than five acres of land are classed as lower middle income farmers and the final category is landless households. See also section 3.2.1.

27.6.12). Most of the households that can afford solar energy have a regular income from family members and most of them are from upper middle income or lower middle income households. Some use solar for business purposes, for example, for lighting in grocery stores so they can stay open until late, some for working at night, such as the headmaster of the primary school of the village, and some children use it to study at night. Daw Khin Thaung, the headmaster, who represents a lower middle income household, said, *“Being a headmaster, I sometimes have guests that come to my house and I buy solar energy so that I can take care of them at night”* (Interview, ID5, 25.6.12).

Some households own their solar panel because they can get them second hand or even for free. The family of U Myo Thein, a driver and machine operator, and Daw Khin San Tint, a school teacher, represent a lower middle income household and they bought a second hand solar panel with a battery that cost 120,000 kyat to buy new. They use it for lighting and charging electronic equipment, such as mobile phones and a cassette player, and an EVD player. The family also has plans to buy a TV and has access to REAM’s package (Interview, MT19, 28.6.12).

Access with REAM’s Package System

There are 72 households in the community that have access to DE with REAM’s package system (3 packages in total). Most of them are lower middle income households and landless households that do not use DE for business purposes. The household of U Paw and Daw Ehain Myine, an upper middle income household, also accesses solar light through REAM’s package and the family also runs an electricity charging service. Most of the family members in this household are women or elderly and the rest are migrant workers. Although they have enough income to buy a generator, they cannot use it since no household member is strong enough to start it as the men mostly work as migrant workers. Access to solar lighting is useful for their household so they can work at night. Daw Shwe, the elder daughter said, *“We plan to get one more light bulb if there is a new group for the package as most of us at home are women and the light is good for working as well as for safety at night”* (Interview, MT1, 24.6.12). For some households, they compared the price with candles and found it cheaper since they can pay in installments. Daw Ma

Kyi, who represents a lower middle income household, said, *“I like this package system as I can afford it by paying through installments”* (Interview, MT3, 25.6.12).

- **Non-DE Households**

Households that do not own or have access to DE, around 48 households, use candles and torches. Almost all of them are lower middle income and landless households that do not have family members who work at night or need DE for business purposes. Although some of them are interested in REAM’s package, they cannot afford it. For instance, Ko Kyaw Htoo and Ma Ei Ei Win, a landless household, only earn 2,000 kyat per day and they continue to use candles that cost around 600 kyat per month depending on how many they use (Interview, MT13, 28.6.12). In addition, as the REAM package needs 24 households, some households have to wait for enough people to form a group so they can benefit from the REAM package. U Myint Aung and Daw Net Hla, a lower middle income household, said that *“The package system was installed while we were travelling and trading mats and we want to join if there is another package”* (Interview, MT14, 28.6.12). However, there are some households that have found alternative energy uses. For example, U Nyan Tun, a lower middle income household, has a battery that they can charge using the solar energy from a relative’s house (Interview, MT12, 28.6.12). U Mar Khin’s household sells diesel for motor bikes and at the same time they also use a diesel lamp for lighting at night (Interview, MT4, 25.6.12).

- **Equity**

When looking at equal access to DE by the community, it is clear that there is no equal access since all people cannot afford DE or afford REAM’s package system. Three percent of households have access to DE by owning their own generator and 14% of households own a solar panel, while 50% of households can access DE through REAM’s package. However, in this community, people who own DE and the monastery also share their solar panel. At the monastery, people can not only charge a battery for lighting but also an EVD player, so the rest of the households with no access to DE, some 33% of households, can access DE even though they are

categorized as non-DE households. Therefore, it can be said that there is a form of equity in access to DE in Mone Taw.

4.1.2 Pay Khwinit Pin

This section provides an overview of access to DE in Pay Khwinit Pin by using the four categories of households: households that own a diesel generator, or solar panel, households that have access to DE through REAM's package and non-DE households.

- **Owner of a Diesel Generator**

Similar to Mone Taw, the monastery in Pay Khwinit Pin village has a generator which was donated by migrant workers. This generator is mainly used for the monastery's needs such as lighting, powering a loudspeaker, pumping water and for a microphone that is used when giving sermons. In addition, there are three households that own generators and all of them are high income households and upper middle income households that use the generators for business use. One household runs a video screening business and the other shows football matches. The last household, an upper middle income household, uses its generator for grinding rice and other services. U Bo San from the latter household said that *"With the rising cost of diesel, we are not able to run the generator in the long run as the profit is less and if we charge more, people will not be able to use it"* (Interview, PKP_FG2, 3.7.12).

- **Owner of Solar Energy**

In Pay Khwinit Pin, there are 10 households that have their own solar energy. Most of them are lower middle income households and landless households but many of the family members are migrant workers. For instance, U Pae Ye's household is landless but as many family members are migrant workers the family has bought its own solar panel for lighting and listening to music and watching videos. For the family, the solar panel saves time as they can charge their equipment at home whenever there is sunlight and it is easy to use as the technology is simple. U Pae Ye said, *"For me, using this solar energy is cost effective and we can enjoy our leisure time together with our neighbors' children who come and visit us when we watch videos"* (Interview, PKP1, 30.6.12). U Hla Ngwe Lay, a lower middle income

household, said that they bought the solar panel at Pakkoku for less compared to the price in Pauk market and he said, *“By using this, we don’t need to pay for energy all the time like in the past and I enjoy using it”* (Interview, PKP20, 3.7.12).

- **Access with REAM’s Package System**

In addition, there are 120 households that have access to DE from joining REAM’s package system (5 packages in total). In this village, it was agreed that the payment would be 200 kyat every 3 days for a six month period. Most of the households who have access to it are landless households and lower middle income households, although there are a few exceptions with some upper middle income households. U Tun Tun Oo and Daw Tin Mar, a lower middle income household, use this light for opening a grocery store at night (Interview, PKP12, 1.7.12). The headmaster, Daw Than Than Swe, uses solar lighting to continue his school work at night (Interview, ID12, 30.6.12). In addition, U Than Lwin and Daw Htaw Kyi, an upper middle income household, use solar for working in the early morning and also so that their children can study at night (Interview, PKP12, 1.7.12). U Poe Lone and Daw Nyunt Aye are a landless couple who sell snacks and work at night if they do not get everything finished in the day time. Daw Nyunt Aye said, *“The light from the solar panel is brighter than candles and it is good for working in the dark”* (Interview, PKP13, 1.7.12).

- **Non-DE Households**

The rest of the 103 households only use candles and torches. Most of the households in this category are lower middle income and landless households and poor families who do not have regular income and thus cannot pay the installments. For example, Daw Tin Nyo’s family cannot afford the payments and they continue to use candles that cost around 700 kyat per month. Daw Tin Nyo said, *“we offer the candles to the altar but they also light the house at night and if we need brighter light in an emergency we use a torch”* (Interview, PKP, 12). In addition, many of these households are far from the village, making it difficult to join REAM’s package as the households are widely scattered and if the solar panel is in the village it would take a

long time to go back to charge the battery. In the case of U Aye Win and Daw Htay Kyi, a high income household, the family took part in the package system, although they later left the group, and U Aye Win said, “*Since we live far from the village, we do not want to go and charge the battery there, which is far for us*” (Interview, PKP4, 1.7.12). Nobody wants to own REAM’s solar panel because in rural areas there is inadequate protection from animals. For instance, U Kyaw Thaug, a lower middle income household, uses torchlight as he only needs light to see where to go in the dark and rarely works at night in the field (Interview, PKP-FG2, 3.7.12).

- **Equity**

In terms of equity, 1% of households own a generator while 4% of households own solar panels. Access to solar energy is 51% through REAM’s package and the remaining 44% are in the category of non-DE households. There is no sharing of solar panels in this community as was the case in Mone Taw because the community is bigger and more dispersed. Half the households live in the village and the rest look after their plantations outside of the village. So, for those who are not in the village, it is not possible to take part in REAM’s package as it is too far for the villagers to go to charge batteries. In other words, there is no equal opportunity to access DE in Pay Khwinit Pin community.

Factors Determining DE Access

There are many factors determining access to DE and the following are chosen for discussion. (See section 1.4.4 of the conceptual framework.)

4.3.1 Access to Technology

In Myanmar, there are various resources available that could be used for rural electrification although the availability of technology depends on geographical areas. At present, electricity generation is based on a centralized model with a power grid using non-renewable energy sources (gas, oil and coal) and renewable energy sources (large-scale hydropower). Some decentralized electrification is available from non-renewable energy sources (oil) and renewable energy sources (hydropower, tidal power, geo-thermal, solar and wind power, and biomass, see also section 2.2).

Looking at access to the national grid by the two communities, firstly, Mone Taw village is only five miles away from the national grid. However, it is very expensive to install since there is a fast flowing river on the way to the community and the bridges are often damaged when there is bad weather and heavy rain (Interview, MT_FG1, 23.6.12). Similarly, although Pay Khwinit Pin is near to a surfaced main road, there is a river between the community and Pauk Township. However, a new road is being built near to the community, and the villagers are hoping the grid will also arrive in the near future. However, so far the government has not committed itself to expanding the national grid to the village since transportation might be the first priority of the community (Interview, PKP_FG1, 30.6.12). Therefore, the technology that is available and unavailable in the study area will be discussed further to gain a more in-depth understanding of the issues.

- **Available Technology**

In Pauk Township, which is in the Dry Zone Area, there is a lot of sunlight and thus solar energy is a good choice for DE (Interview, ID2, 20.6.12). As stated by community members during in-depth interviews, the available solar energy helps them access simple DE. It is easy to buy solar panels in the market, easy to install and maintain and the light is also clean and there is no noise pollution and it is safe from fire. Therefore, most households are interested in accessing more solar power or other DE power in the long run if it is affordable. For instance, Ma Hla Win Soe from Mone Taw village said, *“As I am at home alone with my mother, solar is the most suitable option as it is simple and easy to use”* (Interview, MT10, 28.6.12).

In terms of private sector suppliers of individual solar systems, there are already players in the market due to demand. For instance, Sun Power Company sells solar packages, solar panels, solar charge controllers, batteries, inverters and light fittings. The company has been selling solar equipment in Myanmar since 1993 and most of the customers are from the Ayeyarwaddy Division, the Dry Zone Area and Upper Myanmar. The available solar power systems start from five Watts and can produce up to 300 Watts (Interview, ID17, 18.7.12).

There is another DE option in this area: diesel generators. However, the rising price of diesel is a barrier to using a generator. In addition to this, communities used

Japanese generators in the past but spare parts are difficult to find and have to be replaced with Chinese made ones. Chinese generators are cheaper and more households use them although the maintenance costs are higher as well. The monk from Mone Taw said, *“After using a generator for years, solar is now a better choice though we still use the generator for some things”* (Interview, ID8, 28.6.12).

- **Unavailable Technology**

Some DE options are not available in the market due to the fact that most DE options are imported in Myanmar even though they might be useful for the community. In terms of biomass, the technology is not available in the area although it would be a good option. Sun Power Company is also in the process of developing biomass for community use (Interview, ID2, 20.6.12). In addition, there are resources to generate electricity using rice husk gasifiers and also some potential for cow dung biogas. Rice husk is available in the community from rice plantations. However, with the increased use of tractors and machines, the use of oxen on plantations is decreasing in some communities so there is uncertainty about the availability of cow dung in the long run (Interview, ID6, 25.6.12).

In addition, there is a simple technology that most people are unaware of: the position and design of the household. For example, if a household’s design is open to the air and faces the sunlight, the household will only need light at night, which is also good for health and can reduce the use of a fan.

Nonetheless, being able to access the available technology and DE resources are not the only issues; access to finance is crucial for the communities to gain access to DE and the following section will discuss this in more detail.

4.3.2 Access to Finance

Access to finance plays an important role in terms of equal access to DE, since there are different levels of income among the households in the community. It is also important because the affordability of the system influences the community’s choice of whether to use DE. Only a limited number of households can buy DE with their own resources.

According to the Ministry of Electricity 2 in Pauk Township, the department was instructed to support the community access DE. Therefore, firstly data was collected on the current status of electrification in the villages of Pauk Township. The result showed that out of 235 villages, three villages have access to the national grid because of their location near to the grid, three villages have rice husk gasifiers, eight villages have large-scale solar power and 57 villages use a diesel generator to power the whole village. There is also one village that is supplied with electricity from the national grid to pump river water for a plantation. The remaining 164 villages arrange their own energy needs independently. The current plan of the government in providing DE will be to give a loan of not more than 3,000,000 kyat for a single village as partial support, which can be used to buy a diesel generator and relevant DE equipment for the community. At present, 11 villages will be chosen upon application to receive money for a diesel generator (Interview, ID18, 4.7.12).

According to U Than Htay from Ye Mon Company, in addition to the government loan, policy support to encourage the banking system to provide loans for DE could be a further option. This is because most of the rural communities lack the capacity to initiate their own cooperation fund for DE. In addition, although REAM's package is a good initiative, individual use is much more effective for business purposes. He also said, *"in terms of Government support the best thing would be initial capital for the development of DE and to get better products imported"* (Interview, ID1, 20.6.12). Moreover, U Win Maung from RDE said that, *"If we were to give them systems for free, all households in the communities would surely use it. However, there are no means to do this yet and we have to explain to them the costs and benefits of it"* (Interview, ID15, 14.7.12). However, in the two communities in this study, there was no government support for DE.

For the community, the initial installation cost of DE is still the barrier in most cases. In Mone Taw, the community receives micro finance support for income generating activities from Oxfam, although DE is not included in this. For example, once the community was able to access REAM's package, 50% of the community got access to DE. Similarly, 51% of the community access DE with REAM's package in Pay Khwinit Pin, highlighting the fact that access to finance is an important matter for community decision-making. In addition, according to REAM's strategy, the money

collected back from the communities for the package is used on other packages for more groups of households. However, even with REAM's package system, 33% of households are non-DE households in Mone Taw and the figure is 44% in Pay Khwinit Pin, respectively. During the focus group discussion in Mone Taw, it was stated that there are households that want to access solar energy but at a cost of less than 1,000 kyat per month. On the other hand, there are some households who would be happy to pay more and get the package with just 12 households as they cannot wait for 24 households (Interview, MT_FG2, 24.6.12). Therefore, there is a need to have more access to finance for DE in both communities.

In addition to access to finance, communities need locally appropriate products at affordable prices. The cost of solar panels and equipment is falling at the moment due to increased demand, but there are concerns about the quality of some products. The solar panel shop owner in Pauk market said, *“For us, we will follow the market price and if the price of the products goes up, we will increase the price and if they go down, we will also reduce our prices as well. In my opinion, the market price is somewhat linked to demand too”* (Interview, OB2, 26.6.12).

4.3.3 Access to Technical Assistance

Weak knowledge of technical skills is one area preventing the adoption of renewable energies. Therefore, it is important that all relevant stakeholders either the government, private or non-governmental organizations, should pay attention to the technical assistance need of the community and ensure they have the technical skills to maintain and use the systems adopted.

The problems of technical assistance are highlighted by the case of Payar Taung village, where a rice husk gasifier was installed costing around 3,000,000 kyat four years ago.⁹ However, later the gasifier suffered a technical failure and finally it was replaced with an 18 KVA diesel generator. U Khin Maung Myint said, *“The business was a failure for us just because we did not have enough technological knowledge after it was installed and because we did not know how to maintain the machine.”* (Interview, ID6, 25.6.12). Therefore, this technical failure shows that technical

⁹ The researcher visited this village to learn about the community's experience with rice husk gasifier technology. (25.6.12)

assistance should be provided in addition to technology and that the technology should be understood by the community.

In addition, as was stated during most of the in-depth interviews, solar energy is the best and most simple DE to use at community level. The community also prefers to get technology that they can use with equipment that is readily available locally and which is easy to learn how to use (Interview, MT_FG1, 23.6.12). Currently, private sector actors like Sun Power and Ye Mon are providing relevant technical assistance to the community. For instance, the products from Sun Power have a five-year warranty and a repair service. They also give advice on selecting the location for large installations, as well as advice on how to transport, install and maintain equipment (Interview, ID17, 18.6.12).

In the NGO sector, REAM is helping where it can and this has resulted in more people becoming interested in using DE. Before receiving REAM's package system, all interested groups are invited to a special talk on planning the technical parts of the system for free. After installation, there is monitoring and evaluation of the technical use of the system. In a monitoring report from May 2012, some of the issues reported included reduced power from a solar panel and a broken battery due to its improper use. Light bulbs are also known to sometimes break in some of the communities (Pauk REAM Office, 2012). Monitoring like this supports the technical knowledge of the community by recommending ways to solve the problems.

In addition, the communities are interested in solar energy for cooking since this would enable a reduction in the use of firewood, which they know to be a cause of deforestation, which in turn leads to climate change and contributes to the drought they were suffering from at the time of the field visit. This is having negative impacts on the communities' plantations and thus income reliability (Interview, MT_FG1, 23.6.12). As a result, their interest in solar energy for cooking was discussed with the local REAM officer. He said that there are certain technologies that would allow cooking with sunlight and no special equipment would be needed but that this method takes longer than the traditional way of cooking with fuel wood. Therefore, this is a matter of choice for the community, i.e. whether to spend more time cooking or wait for another alternative DE technology to become available (Interview, ID16, 16.7.12). At present, this technology is not used by the community.

4.3.4 Community Participation

In order to participate in REAM's scheme, a minimum of 24 households must work together. There are some cases when the leader of the group has had to pay in advance for some households and get the money back later as the households did not have the money on time. U Soe Myin, a school teacher and the leader of one of the solar groups explained that, *"I want the children to study at night, so I have to be patient and take responsibility so that more and more parents will use solar energy at home."* In addition, every day eight batteries need to be charged as there are 24 households and the batteries are charged in 3-day rotations. If some households forget to come and charge their battery, the person in charge has to remind them by calling them over a loudspeaker (Interview, MT_FG1, 23.6.12).

In Pay Khwinit Pin, each household has to pay 200 kyat every three days, which reduces the burden of the household but increases the responsibility on the leaders in terms of the accounting. However, there is less unity in this community as some households have canceled the package deal and brought the battery back to the leader. Furthermore, those households that are interested in the package do not wish to join because they know the battery is second hand. However, up until now, the problems have been managed by the leaders who know the nature of communities well (Interview, ID3, 22.6.12). This is the reason why REAM always lets the community choose its own leaders as part of the democratic process (Interview, ID16, 16.7.12). Therefore, community participation is important especially with REAM's package system.

With respect to equal access, In Mone Taw village some households that have access to solar energy together with the monastery share their energy with those who do not have their own. This has resulted in equal access to decentralized electrification and good cooperation in the community. Nevertheless, this is not the case in the second village where people live far from each other and the village is divided between the settlers inside the village and those who live outside on farms. Therefore, a sharing society like Mone Taw village is something that has not been measured by human development indicators elsewhere.

The more a community can afford it, the more its members will try to access DE. It has been shown in Mone Taw that people who own DE sometimes also share it with those who do not have access to DE. Unity in the community is thus also one factor in this instance that contributes to increasing the community's access to DE using REAM's package system.

4.3.5 Government Policy

In Myanmar, increasing rural electrification by expanding high voltage transmission lines is not a priority of government policy unlike urban electrification. This has in part been due to high costs and geographic barriers associated with supplying nationwide access to electricity through a power grid on a large scale (Myint, 2012). Given that access to electrification is not free but has certain costs, without government policy and support rural communities have little capacity to influence whether they get access to electrification.

However, the advancement of rural energy is one of the seven tasks of the newly elected democratic government's policy on rural development and poverty alleviation. This was highlighted again in 2012 in the President's speech in which he stated that the second phase of the country's development will include the formation of a National Energy Management Committee, which will be in charge of the creation of a National Energy Plan according to the country's National Energy Policy (President, 2012). Moreover, sustainable energy development is one of the integrated goals in the National Sustainable Development Strategy. Therefore, DE that uses renewable energy can be a solution for the country's sustainable energy development (NCEA, 2009), although there is no clear policy as yet in favor of DE for rural energy.

In terms of DE equipment, most of it has to be imported from China, especially solar panels. Under the tax system in the country, tax is levied on imported goods, which makes them expensive in Myanmar compared to Thailand, which has zero tax on such products. Therefore, policy and financial support is needed for the development of access to DE in Myanmar since without government support, implementation will not be effective (Interview, ID2, 20.6.12).

In addition, from the point of view of the local authorities, being able to access the national grid is much more effective and efficient than using DE. However, it was acknowledged that the national grid cannot be expanded to places where transportation is difficult and places far from townships and furthermore it will take time for the national grid to cover the whole of Pauk Township (Interview, ID14, 4.7.12). For the Ministry of Electricity 2, there is a plan to provide a loan for DE in selected villages. The officer in charge explained that the government is examining the provision of DE as part of the development needs of communities by recognizing the fact that the national grid will not reach all communities and DE is useful for those communities that lack access to the national grid. However, the plan is only at an initial stage (Interview, ID14, 4.7.12).

There are certain private sector actors that supply DE for sale and also some NGOs who support access to DE as part of human development projects. However, without clear government policy supporting these activities, they face certain difficulties. Mr. C Y Lin from Sun Power Company said that, *“I want stronger policy and institutions in place to promote DE use nationwide as the investment and loans are important to kick start small-scale businesses and livelihood improvement using DE in rural areas”* (Interview, ID2, 20.6.12). For NGOs, permission is needed for the activities they carry out in the community and thus they are eager for a government policy agenda related to DE, which they hope will facilitate their work. At the community level, people are not aware of any government policy on DE and their only concern is to fulfill their energy needs. Nevertheless, they do agree that for more advanced energy sources, they will need support either from the government or a bank or civil society to help them with both financial assistance and technical skills (Interview, ID16, 16.7.12).

All in all, there is little evidence of government support for a policy on promoting DE access in Myanmar.

4.4 Summary

In short, there is increased access to DE through the available options, yet equity in access is still an issue. In Mone Taw, the sharing practice of the community helps increase access to DE among households and creates a form of equity although about

one third of households do not have access to DE. In Pay Knwinit Pin, the community is bigger and more scattered and thus cooperation is more difficult, as a result of which half of the community lacks access to DE.

In terms of the factors determining access to DE, all five sections highlighted that there is room to improve services for access to DE. Although there is access to technology to some extent, not all technologies are available or affordable for the communities. In addition, access to finance is crucial but there is not enough support for this at the moment and more investment is needed. Moreover, lack of access to technical assistance can act as a barrier to DE. Community participation is key because if there is more cooperation, more people can access DE. Last of all, the current government's policy planning and management needs to be more competent with respect to the community level.

CHAPTER V

LINK BETWEEN HUMAN DEVELOPMENT AND DECENTRALIZED ELECTRIFICATION IN THE TWO SELECTED COMMUNITIES

5.1 Introduction

The previous chapter discussed the human development of the two communities included in the study. Since one of the conclusions was that there had been changes and improvements in the human development of the communities over the past five years, this chapter examines whether there is a significant link between human development and the use of decentralized electrification (DE) in the two communities. Therefore, this chapter will answer the third question of this study: “Has decentralized rural electrification improved human development in the Dry Zone Area of Myanmar? If so, how?” Firstly, the findings for the link between DE and increased income will be presented in section 5.2. Secondly, in section 5.3, the relationship between DE and higher education will be examined. Finally, there will be a discussion on the connection between DE and better health in section 5.4. For each section, the presented findings will be both in the form of qualitative and quantitative data. There will also be a comparison of households with and without access to DE as well as a comparison of the two communities. A summary of the chapter will be provided in section 5.5.

5.2 Increased Income and DE

The link between increased income and DE looks at the cost of using either solar power or a diesel generator versus using candles and/or a torch to establish whether access to DE leads to reduced expenditure on energy. In addition, a study is made of whether people who have access to decentralized electricity (DE) can continue to work at night and work for longer, which will either increase their existing income or provide an opportunity to create extra income generating activities. For instance, potters and other types of occupations such as weaving clothes and mats, as well as thatching can continue if the community has light at night. In this study, lighting at night from DE is the focus of this paper as the studied communities could

only access this type of DE at this point in time. See section 1.4.2.1 for the conceptual framework.

The sections below examine reduced household expenditure on energy (section 5.2.1) and increased income generating activities (section 5.2.2), using households that own their own source of DE as well as those that can access DE and those that cannot as case studies. An analysis of the results is presented in section 5.2.3.

5.2.1 Reduced Household Expenditure on Energy

When examining the question of household expenditure on energy in non-electrified and electrified sample households, all the interviewees gave the same answer: the use of solar energy for lighting at night reduced the costs of energy expenditure in the two selected communities. This is because in order to be able to access solar energy, a household can buy their own solar panel and battery or be a member of a 24-household package system provided by REAM. If a household buys its own system, costs are incurred on the equipment and initial installation, after which the battery can be used for one to two years and the solar panel for up to 15 years. The initial purchase price of a solar panel ranges from 25,000 kyat to 300,000 kyat whereas the initial purchase price of a battery that is used together with a solar panel can range from 4,000 kyat to 200,000 kyat (Interview, ID1, 20.6.12 and OB3, 29.6.12). If a household joins REAM's package program, the cost is 2,000 kyat per month for six months and after that the system can be used for many years just by replacing old and broken batteries at a cost of around 3,500 kyat. Therefore, in this study, households that can afford to buy their own solar system or generator are classified as households that own DE and those household who are part of REAM's package are categorized as households that can access DE.

-For households that have no access to DE, a packet of candles costs 300–350 kyat. Depending on the family's needs, a packet will on average last for either 3 days or up to one to two weeks. However, candles are not reliable in windy weather as most households in the community are huts made with bamboo and a thatch roof, which can easily catch fire. Therefore, people also buy and use torches for lighting and the initial purchase cost is between 1,500 kyat to 4,000 kyat. The batteries for the torches cost between 600–1,800 kyat and last around one or two months depending on

the frequency of use. When calculating the overall average annual household expenditure on energy, the figure ranges from between 10,000 kyat to 30,000 kyat. In this study, households that use candles and torches are categorized as households with no DE. Therefore, apart from the initial purchase cost, the cost of DE is less than other lighting systems compared to candle light, torch light or the national grid.



Picture 5.1 and 5.2: Types of torches available in the communities (author's photograph)

In addition to solar, the community also uses diesel generators as DE for lighting, watching television or showing videos. This requires expenditure for the initial purchase of the diesel generator and the use of diesel for generating the electricity. Some communities also use a big generator as a common resource to generate electricity for the whole village. For instance, in Mone Taw, there is one generator at the monastery that is used for the community's needs. In the past, the generator was used for generating electricity but now it is also used to pump water and to power a television and loudspeakers. The community has households that can afford to buy their own generator for the family's use and for business purposes. On average, the initial purchase cost of diesel generator ranges from 50,000 to 500,000 kyat or more depending on the power produced, brand and quality of the machine. However, it was clear both from the focus group discussion and in-depth discussions that the increasing price of diesel is the main barrier for people in terms of the cost

efficient use of diesel generators. Currently, one gallon of diesel costs around 4,500 kyat (Interview, MT-FG1, 30.6.12 and PKP-FG1, 30.6.12).



Picture 5.3: Diesel generator in Mone Taw monastery (author's photograph)

- **Households that own DE**

U Mya Pae, a family of five living in Mone Taw, represents an upper middle income household and the family's assets include nine acres of cropland, two oxen, one bullock cart and 15 chickens. The main household income is from farming but because of bad weather last year that affected farming, the family's income dropped from an average 500,000 kyat to 250,000 kyat, which put them in debt. The family owns two diesel generators that are used for the household's energy needs and to operate a mill. The operation of the mill is not dependent on the electricity from the generator, but access to the generator also allows the machine to be used for multiple purposes and activities. In the past five years, the household has been running a business by using the generator to charge batteries for electricity at a cost of 200 kyat per eight volt battery. They also hire out the generator to the mill for 1,500 kyat per time. However, the cost of diesel is increasing and now that costs 1,000 kyat per hour and it is no longer profitable to run the business as before. For instance, the income from charging batteries is 1,200 kyat per one charging session for six batteries and the cost of the diesel is 800 kyat. As there is only one adult and the other family members are elderly and children, sometimes the household needs to hire workers to run the machine, which costs 1,500 kyat per service. In addition, the household also has to

bear the cost of repairing the generator when necessary. The household income has decreased as more and more households are using solar energy now and so do not need to charge batteries using a generator. The mill also has competition as there are new types of services in the community provided by people who can carry a generator to the client's household using a bullock cart, so it is not necessary to bring the product to the mill. Therefore, the household no longer uses the generators both for business and family use and now they use candles and a torch for the family's energy needs. The family's energy costs are around 3,000 kyat per month and therefore this household is interested in getting REAM's solar package system, which would reduce their current energy expenditure. U Mya Pae said, *"It is difficult for us to continue using the generator cost effectively but solar lighting can help reduce our energy costs and if we can afford it we will buy our own system but if not REAM's package is also an option"* (Interview, MT20, 28.6.12).

Similarly, in Pay Khwinit Pin, U Hla Ngwe Lay and Daw Tin Than have a family of six and are classed as a lower middle income household. The family owns three acres of cropland, two oxen, one bullock cart, four chickens and 32 goats. The family earns enough income from farming, animal husbandry and migrant working and the average family income is approximately 100,000 kyat per month. None of the family's children are of school age. The household has a solar panel that they purchased for 20,500 kyat from Pakukko Township. In the past, they used a battery for lighting and it cost 500 kyat to have it charged. By using solar power as DE, the household has reduced its expenditure as there is no longer any cost for charging the battery. U Hla Ngwe Lay said, *"In addition to reduced costs, I can use solar energy without worrying about running out of battery energy for emergency work that I need to do at night, and I can use more energy for multiple purposes as much as I want such as for listening to the radio and playing cassettes"* (Interview, PKP20, 3.7.12).

- **Households that can access DE**

U Paw and Daw Ehine Myine are a family of five and own five acres of cropland, two oxen and one bullock cart. The family is classed as an upper middle income family. The family earns its income from farming, trading, thatching, sewing and one family member works in government service. The family's average income is around 1,800,000 kyat a year. In the past, candles and torch light were used for the family

business and the household, which cost between 5,000-6,000 kyat per month. At the moment, the family has access to one solar light from REAM's package, which cost 12,000 kyat over six months. They also use candle and torch light for offering at the altar, which costs about 900 kyat per month. By using solar power as DE for lighting, they can reduce the family's energy expenditure by saving between 37,000 to 47,000 kyat per year. They want to get an additional light with the next package, and are also considering buying their own diesel generator in order to generate more electricity. Daw Shwe, one of the family members, said, "*As most of our household work needs lighting at night, this solar light is very useful as well as cost effective*" (Interview, MT1, 24.6.12).

U Than Lwin and Daw Htaw Kyi, a family of seven members from Pay Khwinit Pin village, are an upper middle income family and have access to nine acres of crop land and one goat. The housewife is a mother of five children and she has to wake up early at two in the morning to prepare the snacks that she sells around the village for breakfast. In the past, it cost between 5,000-6,000 kyat per day to use torch light and candles for her work, and the candles also posed a risk of fire. Now with the use of a solar battery light, which cost a total of 12,000 kyat and was paid for in installments of 200 kyat every three days, she can reduce the household energy expenditure by up to 60,000 kyat per year, and the children can also study more time at night at reduced cost. Therefore, she is also considering saving money for buying her own solar system for the family and business use in the future. She said, "*Now, I can happily work with no worries about fire even when it's windy and the lower costs help me to spend money on other things the family needs*" (Interview, PKP12, 1.7.12).

- **Households without access to DE**

In Mone Taw, all the villagers can access DE as the monastery shares its solar electricity with the community and some households that own solar systems share their electricity with their relatives, which is not the case in Pay Khwinit Pin. U Mar Khin has seven family members and they are a landless household and their only assets are five chickens. The family earns income from selling diesel oil, and two family members work for the government: one as a school teacher in Zee Phyu village, the other as a nurse in Yangon. The family earns a monthly income of around 12,000 kyat from selling diesel. The income from the two working in public sector

services is around 160,000 kyat per month and in addition one family member works in the oil fields as seasonal work and earns 30,000 kyat per month. The family's energy expenditure is between 2,000-2,500 kyat per month, which is spent on torch light and a kerosene lamp that uses diesel. They listen to the radio as well as watch videos with a battery powered EVD player. The initial purchase cost of the battery was 25,000 kyat and the household charge the battery with solar energy from the monastery. The family's average energy use costs around 35,000 kyat per year, which is still higher than access to DE. This shows that while the household has no DE, the family can still access it, although their expenditure is higher than those who can access DE with REAM's package or their own DE system. Although they want to buy a television, they cannot afford it as a television needs a lot more electricity (Interview, MT4, 25.6.12).

U Tin Htwe, a family of seven in Pay Khwinit Pin Village, is a landless household with two chickens and one goat. The main family income is earned by the husband, who works as a toddy-palm climber, and the wife, who makes palm sugar or jaggery¹⁰. One of their sons works in the oil fields, another one helps the parents with their work and the rest are school children at primary school. Generally, the daily household income ranges between 4,000-7,500 kyat and the income from one day out of four is used to pay the owner of the toddy-palm trees. The family use only torch light for lighting and a small radio at a cost of 1,200 kyat per month. In order to make the jaggery, they need to buy firewood at a cost of 25,000 kyat per month, which is a burden for family that reduces household income. U Tin Htwe said, "*We hope to get other alternative DE or better energy sources rather than firewood to reduce our energy expenditure in order to increase household income*" (Interview, PKP3, 1.7.12).



Picture 5.4: The use of firewood is costly and a burden on the household's expenditure (author's photograph)

¹⁰ Jaggery is a traditional unrefined palm sugar made from the sap of toddy-palm which is consumed in Asia, Africa, Latin America, and the Caribbean.

5.2.2 Increased Income Generating Activities

To examine whether access to DE can increase household income, the average increase in household income attributable to access to electricity was explored during the interviews with focus groups and individual households. DE can reduce the cost of energy use when extending the national grid would be too expensive. Compared to candle light, DE not only reduces costs but also provides safety from fire and this is the invisible value given by DE. See section 1.4.2.2 for the conceptual framework.

Generally, the household income for the two communities comes from farming, weaving mats, migrant working and animal husbandry. In both villages, the available DE is mostly for lighting at night either by solar energy or diesel generator. Nevertheless, when studying the link between DE and increased income, there were some interesting findings and case studies that pointed out the need for more reliable and powerful sources of DE in order to create more income generating activities in the communities. The following case study will expand on this in more detail.

- **Households that own DE**

In Mone Taw, U Than Swe has a nuclear family of three and is a landless household. The household earns income by screening football matches using a Sky Net Satellite in addition to trading. For the screening, the household uses a diesel generator to power a television, which costs around 3,700-4,200 kyat for the diesel per night and each person is charged 200 kyat per match. The household only earned a lot of income in the 2010 World Cup football season as many people watched matches at that time and everynight the family's income was around 10,000 kyat per night. Normally, the income merely covers the diesel cost as there is usually around 10-20 people per night and the diesel costs around 2,000 kyat per night. The owner, U Than Swe, stated that, *“As I am also crazy about watching football matches, this is a hobby business for me and even if I can't make a lot of profit, I am happy to do this”* (MT16, Interview ,28.6.12).



Picture 5.5: Sky Net for showing videos and picture 5.6: Advertisement for a football match at U Than Swe's house (author's photograph)

U Saw Aung, a family of 22 members in Pay Khwinit Pin village, represents an upper income household. The family owns two acres of paddy fields, 25 acres of cropland, six oxen, one bullock cart, six pigs, 15 goats and 14 cows. The main family income is earned from farming. The household also has a diesel generator for electricity that they also use for income generating activities. The current generator was made in China and cost 300,000 kyat. They show videos at night in the community for 50 kyat per person. In the past, the income they received was about 5,000 kyat per night; however, this has reduced to 2,000 kyat per night nowadays as more households have their own EVD¹¹ that they use with solar energy. They try to cover the costs of the diesel by offering a battery charging service for 200 kyat per battery. This generator can also be used for pumping water for the family's use while showing videos and the lighting is useful for school children so they can study and the light also means the family can sew to generate income. In addition, this generator is used with a mill to grind rice and cut grass for the cattle. They also charge the battery to hire out to the community, as well as listen to the radio and cassettes. The average household income from all these activities with the generator is between 40,000 to 50,000 kyat per month. U Soe Sin, the son of U Saw Aung, said, "*We can use this generator for multiple purposes and this gives the family increased income generating activities*" (PKP21, Interview, 3.7.12).

¹¹ The Enhanced Versatile Disc (EVD) is an optical-medium-based digital audio/video format, developed to provide a means for playing [HDTV](#) content using existing optical media. (Wikipedia)

- **Households that can access DE**

U Thein Swe and Daw Tin Tin Kyi from Mone Taw village are a landless household with eight family members. The family earns income from the migrant working of their three sons in Phar Kant, a daughter who works in government service as a school teacher in Louk Khine village, as well as from making mango paste and weaving mats as seasonal work. One daughter studies at the University of Distance Education majoring in English. The household has solar lighting from REAM’s package, which cost 12,000 kyat and was paid in six-month installments. The family also uses a radio powered by small batteries, which costs around 600 kyat per month. The lighting is useful for the family for studying and doing work that cannot be finished during the day time, especially weaving and cutting mangoes to make the mango paste. The lighting means the family’s income increased from 30,000 kyat to 40,000 kyat per month. U Thein Swe said, “*We are pleased that we can get increased income by using solar light at night and the only reason we cannot raise more is because we have a shortage of capital to enhance our business*” (Interview, MT2, 24.6.12).



Picture 5.7: Working at night under the solar light and picture 5.8: Seasonal work weaving mats (author’s photograph)

U Tun Tun Oo and Daw Tin Mar are a lower middle income family of five in Pay Khwinit Pin and own three acres of crop land, two oxen and one bullock cart. The head of the house, U Tun Tun Oo, works in jade mining in Phar Khant and his average salary is 80,000 kyat per month (seasonal work). One child is in the primary school and the other two are infants. The family has a grocery shop that they opened two years ago. The family has access to solar light from REAM's package and they use this for the shop although they also use torch light and candles. The candles are used to offer lighting at the altar and this costs around 1,500 kyat per month. In the past, the torch light used in the shop cost 1,200 kyat per month, but now they use solar light for which they pay 200 kyat every three days over a six-month period. The shop generates a monthly profit of around 20,000 kyat, and the solar light is useful for the family's income generating activities as they can keep the shop open longer at night. However, Daw Tin Mar said, "*There is not much difference in terms of increased income but the light helps to some extent*" (Interview, PKP12, 1.7.12).

- **Households without access to DE**

In Mone Taw, Ko Kyaw Htoo and Ma Ei Ei Win are a landless household who have an infant. Both of them are manual workers and also weave mats as seasonal work. The income they earn from manual labor is 1,000 kyat each per day and from weaving mats around 45,000 kyat per month. They use torch light powered by three small batteries and candles that cost around 800 kyat per month. The household is also interested in REAM's solar package as the light is brighter and also safe for household use. The family also benefit from the monastery where they charge the family's electrical appliances with solar energy. When interviewed about increased income from DE, Ko Kyaw Htoo said, "*We are not familiar with using electricity and have not done any work using DE, so we have no plans for that yet*" (Interview, MT13, 28.6.12).

Daw Tin Nyo has six family members and is a landless household in Pay Knwinit Pin. The family's assets include three oxen. Their main source of income is from migrant working by one son who works in the oil fields and one daughter who works in Mandalay. Two children are still at primary school. The average income of the family is 100,000 kyat per month. Daw Tin Nyo has a stomach disease and she needs to go and get treatment both in Pauk Township and Pakukko Township. The total cost

of the medicine has so far exceeded more than 200,000 kyat and therefore the family is facing financial difficulties. The household cannot afford REAM's package and candles cost 700 kyat per month. They also use a motor cycle battery for lighting and listening to the radio. Daw Tin Nyo said, "*We cannot afford DE and have no specific income generating activities from DE so we have no plans to access it*" (Interview, PKP14, 1.7.12).

5.2.3 Analysis

In terms of reduced energy costs, almost all the households were able to decrease their expenditure on energy over the long run by owning or accessing DE. People prefer REAM's package system as they can pay the costs without being financially burdened. However, not everyone wants to operate as part of a group and those who can afford it try to buy their own solar system. When comparing the costs, the communities prefer solar energy mainly for personal use but if they run a business a generator is more popular at the moment. The research also discovered that for some people there is no need to use DE because some households have no children studying at school and have no specific work to do at night, so the need for lighting is thus very modest. Some households wanted to participate in REAM's program but there needs to be 24 households and there was not always an adequate number of households to take advantage of the program. Some households cannot afford to buy their own system. The two communities realized that they can reduce their costs by using DE and that DE is good to use over the long term compared to candle light and torch light (Interview, MT_FG1, 23.6.12 and PKP_FG1, 30.6.12).

Moreover, in terms of income generating activities, since only a limited number of households work at night in the two communities, there is no specific increase in household income after using DE for lighting at night. This is also because the work that people do at night only relates to farming and does not generate much profits. If there are no new income generating activities, people prefer not to work at night but to relax and rest. Most of the villagers in the study area are not actually accustomed to working at night because in the past there was only candle light. Generally, from the villagers' point of view, they can work the whole day when there is sunlight but night time is their leisure, relaxation and family time.



Picture 5.9: Having family dinner under the moonlight (author's photograph)

However, there are also some people who use DE to run businesses at night. For most businesses, people need to have their own capital to be able to buy a generator and relevant machinery. The people who run businesses are interested in better sources of energy as well as reduced fuel costs so they can operate the business in the long run in a cost effective way. Therefore, with respect to lighting at night with DE, most households did not see an increase in income generating activities whereas some households are eager to continue their current business with better investment options (Interview, MT_FG1, 23.6.12 and PKP_FG1, 30.6.12).



Picture 5.10 and 5.11: Machine vs. manual work (author's photograph)

During the interview with a staff member from the Oxfam office in Pauk Township, the interviewee pointed out that not all the villages have a mill (Interview, ID 9, 29.6.12). If people can access DE that can be used to power machinery, it will help support farming activities and the creation of farm produce, which in turn will allow more income generating activities. In addition, in both the focus group discussions and in-depth interviews, the respondents mentioned that small and medium-sized enterprises could benefit from DE, which in turn improved income for the villagers. For example, most farm products are sold as raw materials but the communities would like to sell finished products and for this they need electricity to use machinery. Therefore, it can be concluded that more reliable and powerful sources of DE are needed in order to increase income generating activities in the communities.

According to the experience of U Than Htike from Ye Mon, there are increased income generating activities when communities get access to DE, although this was not yet the case in the two selected communities (ID1, Interview, 20.6.12). There are communities that need DE for their income generating activities. For example, there are certain types of machinery such as oil presses that require DE. The communities do not necessarily need the electricity from the national grid but they can manage with DE for their small-scale businesses. However, DE generated by diesel generator has been the most useful for producing the amount of power necessary for operating machinery such as an oil press. However, a generator is not the best machine for the community as diesel is expensive. Therefore, as Mr. C Y Lin from Sun Power explained, the company is trying to manufacture a machine that can run using biomass such as household waste and leaves from the forest, which communities have in abundance (ID2, Interview, 20.6.12). In conclusion, it can be stated that the private sector is trying to improve services for DE so that more and more people from rural areas can stand on their own by having access to affordable electricity both for family use and income generating activities.

However, as was stated by the village chief and villagers of both communities, the main reason for increased income is due to family members who migrate and work in other areas. By and large, from the perspective of the local authorities, there is no direct link between increased income generating activities and increased household income from being able to access DE. At present, although there are small businesses, such as video screening at night using diesel generators, the income

generated over the past five years by this type of activity has not increased but decreased due to more and more people buying EVDs or DVDs for family use. However, it is interesting to note that people in the two communities can rarely increase their household income using DE but DE is what people want once they have increased income in order to improve their personal human development by having increased income for their children's education.

Therefore, it can be concluded that DE reduces energy expenditure although the increased income of the communities with the exception of some cases is not directly related to the use of DE. Despite this, communities still want to be able to access DE.

5.3 Education and DE

In terms of the overall education of the communities, the qualitative study demonstrated that the nearer the school is to the village, the higher the general level of education. For example, Mone Taw village is closer to a high school and thus there are more than 40 university graduates in the village, whereas in Pay Khwinit Pin, where the high school is across the river, there is only one graduate and the rest stop studying after the fourth grade as the school in the village is only a primary school. Furthermore, in the rainy season it is difficult for students in both villages to go to school because of muddy roads and unsafe weather conditions.

The World Food Program (WFP) gives rice to households with primary school children and this has become an incentive for communities because villagers can have food security while their children go to school. However, when it comes to higher levels of education, not many households can afford this and some households need their children to help them either with plantation work or doing household chores, so they withdraw the children from school. For some households, they cannot afford to send their children to school every day because the schools are far away.

Therefore, the main barriers of the two communities to improved education are transportation difficulties and insufficient household income. This paper studies the relationship between DE and improved education to explore whether there is a link in both communities between improved education and increased access to DE. See section 1.4.2.2 for the conceptual framework.

In this section, increased study time at night is considered (section 5.3.1) by using case studies of households that own their own DE, as well as households that can access DE and those that cannot. An analysis is presented in section 5.3.2.

5.3.1 Increased Study Time at Night

- **Households that own DE**

U Myint Kyi and Daw Paw Khin are a family of nine in Mone Taw and represent a lower middle income household. The family's assets include four acres of cropland, two oxen, one bullock cart and two chickens and one tractor. The household income comes from farming, hiring out the tractor, and migrant working. The family owns a solar panel that they bought for 70,000 kyat and a battery that cost 40,000 kyat. The family uses the solar energy for multiple purposes such as lighting, listening to the radio and cassettes as well as watching television and video. The main reason why the family bought the solar panel was to use it for lighting so the children could study. The family has four school children, two of whom are in boarding school in Yay Pyar Township. One of the other two children is at middle school (grade 7) and the other is a student at the Distance Learning University and both live at home and study every evening. Compared to the past, the student's study time has doubled and nowadays the average study time of the students is three hours starting from 7 pm until 10 pm. Daw Paw Khin said that, "*The lighting is very useful for us to encourage our children's education*" (Interview, MT18, 28.6.12).

Daw Khin Thaug is the headmistress of the primary school in Mone Taw village and is herself from Mone Taw. She is a widow with two sons and owns two acres of land and is classed as a lower middle income household. She has her own solar panel that provides power for lighting and listening to the radio and cassettes. The initial purchase cost was 80,000 kyat for the solar panel and 4,000 kyat for the battery. Lighting is essential for her to do correction and planning work for her classes and for doing school work at night. She also makes her house available for students so they can come and study at night. She happily told the interviewer that "*In the past, the students used to give excuses about why they cannot study and do homework, and would say that their parents can't afford to buy candles for them. However, nowadays*

far fewer students use this excuse anymore as most parents provide solar lighting for them” (Interview, ID5, 25.6.12).

In Pay Khwinit Pin, U Shwe Maung and Daw Than Yin have nine family members and are classified as an upper middle income household. The family owns eight acres of cropland, 23 chickens and one pig. Farming generates the main family income and the family also has three sons engaged in migrant working. Two of the family’s children still attend school. The household has one diesel generator with a dynamo that cost 500,000 kyat and a satellite that cost 200,000 kyat. The household shows football matches by charging 200 kyat per person. One show brings in around 3,000 kyat and the fuel costs around 2,000 kyat. Therefore, it is not so profitable and the business is more a hobby. While showing football matches upstairs using DE, the household can also turn on the light and so the children can study downstairs. However, at other times candles and torch lights are used at a cost of around 4,000 kyat per month. The children study for two to three hours every night. U Shwe Maung said, *“If we are still healthy and can still afford it, we want them to continue in education at least up to grade 10”* (Interview, PKP15, 1.7.12).

- **Households that can access DE**

U Win Aung and Daw Khin Htay, a lower middle income household in Mone Taw, have eight family members and own five acres of lands, two cows, one bullock cart and two chickens. The family earns an income from weaving mats and animal breeding, especially cows. In the past, the household used torches and candles but the family can now access solar lighting from REAM’s package. The average monthly cost for lighting the household is 150 kyat for candles and the torch in addition to the six monthly installments for the solar energy. The household includes three school children, one of whom is at primary school, another one attends middle school and the oldest one is in high school. The solar light is mainly for the children to study at night. Since to the family gained access the solar power, the children’s study time has increased from one hour to two to three hours. Daw Khin Htay said, *“We continue to use candles as we have three children, and the one at high school has to study separately with candles so as not to be distracted by the younger ones, so we want more DE for our household”* (Interview, MT6, 27.6.12).

U Shwe Thin and Daw Htay Htay are a family of eight in Pay Khwinit Pin. They are a landless household and own two chickens and 27 goats. The family's income comes from migrant working and animal husbandry, especially goats, and rice trading. The family has three children who attend primary school. The family can access solar energy from REAM's package but they also use candles and torch light. The average amount of time the children spend studying has increased from one hour to two to three hours. The family said that "*since we got access to solar light, we can let our children study as much as they want*" (Interview, PKP9, 1.7.12).

The headmistress of Pay Khwinit Pin village's primary school, Sayama Daw Than Than Swe, also has access to solar light, which is useful for her as she can do correction work, prepare lessons and do emergency office work as needed. She said, "*I hope the whole village will learn about the benefits of DE for their children's education, and I want to encourage more households to use DE because only half the community has access to DE*" (Interview, ID12, 30.6.12).

Households without access to DE

U Thar Pain and Daw Kyi Win, a family of seven in Mone Taw, are classed as a lower middle income family. They own three acres of cropland, one cow, one bullock cart and five chickens. The family earns its income from making bamboo matting for use as building material and hiring out the ox to work on plantations for 4,000 kyat per one morning's work. There are four school children in the household. The family uses candles and torch light, which costs around 1,200 kyat per month. Daw Kyi Win said, "*We buy as many candles and batteries for the torch as we can so the children can study*" (Interview, MT8, 28.6.12).

U Sein Po and Daw Nyein Myint are a household of 12 family members in Pay Knwinit Pin village. They are a landless household and own two oxen, two bullock carts and two pigs. The family earns an income from migrant working, manual work, and planting Thanat Khar. Two family members work in Mandalay and earn 40,000 kyat per month, and the other two work in Mu Hser near the Chinese border earning between 50,000 to 80,000 kyat per month depending on the available work. The household has three primary school children. The family use candles and a torch for lighting at night as they cannot afford to join REAM's package. This household has financial difficulties and they only use candles when they have enough

money to buy them. The candles and torch cost around 900 kyat per month and when the household cannot afford the candles and batteries for the torch, they have to encourage the children to study before sunset. Daw Nyein Myint said, “*As the children are young, we try to provide candles with what we can afford. However, when they reach the higher grades, it will not be enough and we hope to get better lighting for the household*” (Interview, PKP23, 3.7.12).

5.3.2 Analysis

In both villages, there has been an increase in the average number of girls and boys aged between 4 and 16 per household enrolled in school over the past five years. The reasons explained by the interviewees were varied but the most common reasons given were that parents are more aware of the importance of education and there is increased access to education because more schools have opened in townships close to Pay Khwinit Pin village and a middle school near Mone Taw village has been upgraded to high school level.

Almost all answers to the question of why there is a need to use DE for lighting at night were the same: “*for my children to study at night time*”. Therefore, it is a clear fact that being able to access DE definitely increased study time at night. In addition, from the perspective of the two headmistresses, using DE enables households to spend less on energy and lets parents support their children to study at night. It was also observed that children who studied with the aid of lights powered by DE also studied every night. In the past, children in the communities were constrained from being able to study at night under candle light because the parents could only afford a limited numbers of candles per night. Furthermore, in windy conditions children had to stop studying as the candles would blow out at all time. Therefore, parents were able to witness for themselves that children can study more at night with DE.



Picture 5.12 and 5.13: No access to DE vs. access to DE and light for education (author's photograph)

In terms of a greater amount of household income being devoted to education, this is difficult to measure for a family that is only managing to get by in terms of income. However, the more income the parents have, the more they provide for education. Since the children are able to study more at night with the light from DE, parents try to ensure more of their children receive an education as far as is possible with their income and with the reduced costs for lighting. Daw Mya, one of the mothers from Pay Khwinit Pin, said that, *“I got the idea to do this business because there was increased costs for my children’s higher education and now I’m really happy that I can access DE to reduce some of the costs and I can provide a bit more for their education.”* Thus, it can be seen that access to DE indirectly assists parents and enables them to make more resources available for education.

5.4 Health and DE

In terms of the health sector, given that there are no medical personnel in Mone Taw except in nearby Kan Phyo village and only one midwife in Pay Khwinit Pin, the communities still rely on traditional medicine to a large extent. In case of an emergency, the villagers travel to nearby hospitals in the township. However, due to transportation difficulties, especially in rainy season, the cost of healthcare is high compared to the income level of the villagers. Therefore, transportation is an

important barrier for the improved health of the communities. This study looked for a link between better health and DE and this will be discussed below. See section 1.4.2.3 for the conceptual framework.

In this section, increased access to healthcare services is considered (section 5.4.1) by using case studies of households that own DE, and those that can access DE and those that cannot. An analysis is presented in section 5.4.2.

5.4.1 Increased Access to Healthcare Services

- **Households that own DE**

U Than Win's household is a landless household in Mone Taw with nine family members, and the family's assets include 12 chickens. They have opened a grocery store as the family's main income. In the past, they used to show videos to the community using a diesel generator for 50 kyat per person. However, this is no longer cost effective because of the increasing price of diesel so they stopped running the business. However, they have solar energy which they bought for themselves. The initial cost of the solar panel was 80,000 kyat and the battery was 160,000 kyat. The household uses light at night both for family use and for the shop, which opens until midnight. The light at night is not only useful for the business, but is useful for health as the head of the family suffers from poor eyesight. In addition, Maung Zin Min Thant, the son of U Than Win, said, "*Since we turn on the light at night, it also keeps away mosquitoes as there are less mosquitoes under the light than in the dark*" (Interview, MT5, 27.6.12).

U Pe Ye and Daw Wine Sein are a landless family of 11 in Pay Khwinit Pin. The main family income is from migrant working and U Pe Ye is also a practitioner of traditional medicine. The household has a solar panel that they bought for 36,000 kyat and the battery cost 18,000 kyat. The household can light up to four fluorescent lights and also watch videos with an EVD player using the DE. As a result of access to DE, the household always has guests, either children who come to watch the videos or those who come and get treatment from U Pe Ye even at night. U Pe Ye said, "*we can use the light abundantly which we get from nature and this is good for our household including for my health service*" (Interview, PKP1, 30.6.12).

- **Households that can access DE**

Ko Zaw Oo and Ma Moe are a landless family of three in Mone Taw. The family's main income comes from making bricks as seasonal work. Their income for the season is around 500,000 kyat. The couple's child is now in primary school. The family owns a solar panel that they got from their relatives. They use it every night for lighting as well as for watching videos with neighbors. Their son gets sick sometimes and the medicine cost 1,500 kyat for one week's treatment. When it is rainy, they have to ask the doctor from the town to come to their household and give treatment to the child. Ma Moe said, "*Because we can save money on energy and lighting, we are able to afford our child's health care*" (Interview, MT7, 27.6.12).

U Kyi Hla and Daw Sein Myint are a landless household with eight family members in Pay Khwinit Pin. U Kyi Hla is a classical musician who plays the oboe for the Myanmar Orchestra. Daw Sein Myint sells distilled liquor. Three of their daughters are migrant workers in Mandalay and the other two family members are school children. The head of the household, U Kyi Hla, has a lung problem and he is not in good health as a consequence of which he has no income at present. In the past, the family used candles for lighting at night, which cost around 3,000 kyat per month. The household has access to solar lighting from REAM's package system at a cost of 12,000 kyat, which is paid in installments over six months. REAM's system has reduced the amount of money the family spends on energy and because of this it has helped them pay for U Kyi Hla's medicine. Daw Sein Myint said, "*The reduced cost of energy has partly relieved our burden as the family is in financial difficulty*" (PKP16, Interview, 3.7.12).

- **Households without access to DE**

U Myint Aung and Daw Net Hla are a family of three in Mone Taw. The family owns two acres of land and is considered as a lower middle income household. The family's income is generated from farming, trading mats and one son is in government service as a school teacher in another community in Pauk Township. Last year, the household income was around 150,000-200,000 kyat. The son's income is 80,000 kyat per month and the mat trading is only a seasonal occupation that brings in

around 20,000-30,000 kyat per season. The household only uses torch light, candles and a small battery for a radio, the total cost of which is 1,800-2,000 kyat per month. The family has no children of school age and they do not need that much lighting at night. Daw Daung Wai is not in good health and suffers from high blood pressure and her medicine costs about 20,000 kyat per month. She said, *“I am interested in REAM’s package so we can reduce our energy costs and spend the money on other things, especially my health”* (MT14, Interview, 28.6.12).

U Phoe Thot and Phyu Ma are a landless household in Pay Khwinit Pin and have five family members and own five chickens. The household has three children, two of whom are at primary school. Phyu Ma has just delivered her third baby, which cost about 3,000 kyat. The average expenditure on candles is 500 kyat per month. The family is not yet able to afford to buy solar lighting from REAM’s package although they are interested in it to help with looking after the baby. Phyu Ma said, *“My mother keeps pushing me to get one for the family and for the baby’s healthcare”* (Interview, PKP6, 1.7.12).

5.4.2 Analysis

In short, this paper examined three measurements of human development in relation to DE: increased income, higher education and better health. The key finding was that communities wish to access DE (solar energy in this case) in order to provide light at night so children can study. Other than this, only a few people with specific work needs use light at night to help with increasing their income. No link was discovered between better health and the current status of DE. However, communities would like a larger amount of power from DE for daily cooking and for small and medium-sized businesses at the local level, in addition to lighting at night.

Most households in the communities have no money saved for health expenditure. If the illness is not serious, people will try to cure it with the available medicine and only if it becomes serious will they go and get treatment from a nearby township hospital. Although there was no specific direct link between average health expenditure per capita and access to DE, the study showed that if the villagers have more income they can spend a greater proportion of it on health care. If people can

save money by reducing their energy costs, this can help support households access healthcare services to some extent.

The clinic in Kan Phyto village tract, which is near Mone Taw village, has DE for lighting, which is a necessity for the clinic in order to provide treatment to patients at night. However, at present there is no electrification that could provide better healthcare services and, for example, enable medicines to be stored or the use of medical equipment in giving treatment. According to the discussion with the person in charge of the clinic, more access to DE would be useful for healthcare services. Therefore, there is no direct increase in access to healthcare services in the two communities in relation to having access to DE, but it could be argued that there is a potential indirect benefit in terms of money saved.

5.5 Summary

In short, this chapter discussed three measurements of human development in relation to DE: increased income, higher education and better health. The key finding was that decentralized rural electrification contributed to human development to some extent in the Dry Zone Area of Myanmar. This is because, as most of the households pointed out, there is reduced energy expenditure from using DE. Some households with specific work needs use light at night and use a generator to help increase their income. The most important contribution of DE is that it provides increased study time at night. The communities wish to access DE (solar energy in this case) in order to provide light at night so children can study. Finally, not much link was discovered between better health and the current status of DE apart from the indirect benefit of being able to save money to use on healthcare if the household can reduce their energy expenditure. In general, the communities acknowledge the usefulness of DE for their human development. The communities would like a larger amount of power from DE to improve income earning activities through small and medium-sized businesses at the local level in addition to lighting at night.

Moreover, the use of solar systems as a means to provide DE are the most suitable for the Dry Zone Area, including the two selected communities, since the technology is easy to use technically and there is abundant sunlight. Although the

three measurements of income, education and health make up the framework of this study, the findings are not limited to those three indicators alone. In their attempts to access DE, people in the communities have also shown themselves to be creative. In order to gain brighter lighting, since the current LED light is quite dim, one villager from Mone Taw put a used compact disc (CD) on top of the light bulb so that the reflection from the CD would brighten the light from the bulb.



Picture 5.14 The use of CD to reflect the light from the bulb (Author's Photograph)

Although the communities have earned their living mainly from agriculture, the livelihoods of the two communities have diversified due to the failure of traditional farming. The communities now believe that if they can access more energy sources, they can diversify their livelihoods and increase their income. It should be noted, however, that the cost of energy varied for different household and the calculation of increased income likewise fluctuated. In terms of increased income generating activities from access to DE for lighting, most of the households did not gain much benefit in the two selected communities. At present, villagers with more reliable work, such as grocery store owners and those who can use diesel generators for video screening businesses, help support their livelihoods by using DE.

Lastly, from the communities' perspective, access to electricity either from centralized or DE is for lighting as a substitute to candle light, which can cause fires and involves higher costs in the long run. During the focus group discussion with the Mone Taw Solar Committee, they commented that if they can improve access to DE they would even prefer to use it for cooking as they can spend less time collecting firewood, save money on buying firewood, and help stop deforestation and thus

climate change. As a result, there will be a greater number of shady trees around the communities, which would also help reduce the heat and thus would be better for health.



Picture 5.15: Using firewood for cooking (author's photograph)

In conclusion, the three measurements of human development are linked to each other in a loop and the results of this research can be used to guide future ways of improving human development and demonstrates the contribution DE is making to human development in the Dry Zone Area as well as the country as a whole.

CHAPTER VI

CONCLUSION AND RECOMMENDATION

6.1 Introduction

In the previous chapters, the relationship between three measurements of human development and DE has been discussed. Based on the two case studies in two villages, the human development of the two communities is presented firstly in Chapter 3. Access to DE and Equity in the two communities together with an analysis from five perspectives, i.e. access to technology, finance, technical assistance, community participation and government policy, are discussed in Chapter 4. In Chapter 5, the link between DE and income, education, and health is analyzed after gaining access to DE. Based on this analysis of the findings from Chapter 3 to Chapter 5, the conclusions and recommendations are made in this final chapter. The chapter begins with the conclusions of the findings based on the conceptual framework and hypothesis stated in Chapter 1. The recommendations appear in the last part of this chapter.

6.2 Conclusions

The conclusions of this paper will answer the four research questions of the study: 1) What is the level of human development in Myanmar especially in the Dry Zone? 2) Can all people access decentralized rural electrification equally? 3) Has decentralized rural electrification improved human development in the Dry Zone Area of Myanmar? If so, how? 4) How could rural electrification further promote rural development in Myanmar? In doing so, the answer to the main research question, “What are the impacts of decentralized rural electrification on human development and equity in Myanmar?” will be analyzed.

6.2.1 Human Development of the Two Communities

In general, Magway Division in the Dry Zone Area is one of the most food insecure regions of the country due to irregular rainfall and drought that resulted in poor agricultural yields. However, this region is also rich in crude oil and also has cane, bamboo, charcoal, catch, teak and hardwood product to some extent. Pauk is

one of the townships in Magway Division and the two studied communities: Mone Taw and Pay Khwinit Pin villages are in Pauk Township.

In Mone Taw, the community is far from the township and transportation is the main barrier for the development of the village. However, the average human development level of the community has increased in the past five years. There has been an increase in income levels to some extent mainly due to migrant working. Bad weather is one of the main reasons for the decreased income from agriculture in the community. Planting Thanat Khar is one good income source for households that can wait 10 to 15 years before selling it. In terms of education, more students in the community have gained a higher educational level during the past five years. The most important reason for the increase in the number of children attending primary education is due to the World Food Program's support in the form of rice for primary school children. However, increased access to DE has resulted in a greater number of students overall.. When looking at access to health, there is one health center near the community and access to health has not improved in the community over the past five years. Generally, most households use traditional medicine and those who can afford it get treatment in the Township's hospital and clinics. However, there remains a need for better health access in the community.

In Pay Khwinit Pin, the community is near to a surfaced road and Pauk Township; however, there is a river between the township and the village which means transportation is still a barrier for the community. The average level of human development in the community has increased to some extent over the past five years. The main sources of increased income have come from animal husbandry, especially goats that are sold to China, and migrant working. There is not enough water sources in the community for agriculture and the bad weather resulted in poor yields. In terms of education, the community also saw a significant increase in the number of pupils over the past five years, especially in primary school due to the WFP's rice support program.. In terms of health, there is one midwife in the community and a health center near the community and access to health has not improved over the past five years. Similarly to Mone Taw, there are some households that can afford to get treatment in the Township and the rest of the households use traditional medicine for minor illnesses. This shows that there is still a need to improve access to healthcare services in the community.

In conclusion, there is increased income in the two communities mainly due to migrant working, Thanat Khar plantations and animal husbandry. More students are attending higher education in the two communities and there is greater parental support as well as support from the WFP. However, access to health remains the same in both communities. Therefore, it can be concluded that the level of human development has increased to some extent in Myanmar, especially in the Dry Zone Area.

In terms of the model used to study the human development of the two communities, the village profile from REAM was used as quantitative data and in-depth interviews and focus group discussions were used to gather qualitative data and used together these two types of data provide a full picture of the development of the communities. In addition, the three chosen measurements, income, education and health, are suitable in terms of the available data, which is a concern of experts working in the development sector.

On the other hand, development from the perspective of the communities is much more about their real basic needs and these are different in the two communities. For the first community, Mone Taw, improved access to transportation is the most important need for the community's development since it is far from the main road. By being able to access good transportation links, community members can increase their income by reducing the burden of transportation costs, and can have improved access to education and healthcare by being able to go to reach schools and health centers in a shorter time. The community's second development need is improved access to education and third is increased access to healthcare services. In addition to this, the nature of sharing resources among the communities can be seen in terms of the well-being of society and this has not been measured elsewhere. For the second community, Pay Khwinit Pin, the most important need of this community's development is access to water for agriculture. This community has a shortage of water sources and increased water sources for agriculture would increase income from agriculture, which in turn would provide more income for children to go to school. Although the village is near to a main road, the community's second development need is transportation in term of the bridge over the river between the community and Pauk Township, which would enable villagers to sell their products in the market, make it easier for children to go to school and facilitate access to health centers and hospitals. Therefore, for the community, rather than increased income, higher

education and better health, the first and most basic need is to be able to improve human development.

6.2.2 Access and Equity To Decentralized Electrification

Although there may be different types of DE available, it is important to understand why people can access DE on an equal basis in rural areas of Myanmar and also why they cannot. The very first option for DE is the market system, which means those who can pay can get it. In the Dry Zone Area diesel generators and solar panels with batteries can be used for individual household use. Those who can afford to buy their own diesel generator use them for multiple purposes, including small-scale services so that they can cover the costs of diesel. Buying solar panels for individual household use is usually for lighting at night and power to turn on videos for entertainment.

The second option is to have DE through cooperation and collective ownership. The two communities have increased access to DE with REAM's package program. This option requires good cooperation to access DE for lighting with solar energy as 24 households must cooperate together.

The third option is those who cannot make accessing DE their priority but who try to access it free of charge. In Mone Taw, the monastery shares its solar panel with the community so villagers can come and charge their batteries and electrical appliances. There are also some households who own solar panels and who share it with their relatives for free. However, this is not the case in Pay Knwinit Pin as the community is separated into two: half live in the village and the other half further out in more rural areas.

Therefore, access to DE has increased although there is not yet equal access in rural areas of Myanmar, especially in the Dry Zone Area. However, the sharing and collective ownership options show that there is a form of equity for access to DE.

Moreover, in terms of factors determining access to DE, all the five chapters highlighted that there is room to improve services for accessing DE. The five factors identified were the following:

- Access to Technology

In the communities, solar energy and diesel generators are the most widely available DE technologies. Although there are some other relevant DE options

such as rice husk gasifiers, biomass and cow dung biogas and biomass generators, these are not available in the communities studied at the moment. Therefore, improved access to technology is also necessary to increase access to DE.

- Access to Finance

At the moment, the government has plans to provide DE, though as yet the policies are not in place. There are also no loans available to the communities so they can access DE. To date, REAM's package provides most support to the communities enabling increased access to DE, since the installation cost acts as the barrier to most communities. Therefore, access to finance is crucial but currently this is limited and more investment is needed in DE.

- Access to Technical Assistance

For the community, DE from solar panels is popular since the technology is the simplest to use. While the communities want improved access to DE with better technology, at present only REAM and some private sector actors are providing technical assistance under certain conditions. This limited support for technical assistance cannot cover all the needs of the communities. Thus, without being able to access technical assistance to implement renewable energy projects, it is not always possible for the communities to be able to access relevant DE options.

- Community Participation

In terms of community participation, if there is more willingness to cooperate, more people will want to try and access DE. This has been demonstrated through REAM's packages in the communities, which requires 24 households in order to be implemented. As a result, community participation is the key to increased access to DE for REAM's packages.

- **Government Policy**

In terms of government policy, rural electrification is not yet a priority even though there is a rural development plan. A centralized national grid is also not the option for rural communities since it involves high costs. Moreover, there is no proper policy in favor of DE in terms of tax exemptions, investments or loans to help support increased access to DE. So, the current government policy needs to be more proactive with respect to implementing the plans and managing DE activities.

Equity in Access to DE

While it is true that there is increased access to DE, equal access is still the issue. However, when examining the case studies an understanding of equitable access to DE is gained, especially in terms of cooperation and sharing practices among the communities.

On the other hand, the model used for this section clearly highlights the main answers needed for the study. Although there is no qualitative data on equal access to DE, the interviews undertaken and observations made provide the complete answer. The five factors determining access to DE are also useful and supportive in evaluating why the communities can access DE and why some cannot.

6.2.3 Link between Human Development and Decentralized Electrification in the Two Communities

When looking at the relationship between the three measurements versus DE, it was established that access to DE led to increased income and greater participation in higher education, although there is no link between access to DE and better health.

There is a link between increased income and DE when a household uses DE, especially diesel generators, for business purposes. If solar is only used for lighting, with the exception of some case studies where the household continued working at night, few income generating activities were created although there was reduced costs on energy expenditure.

In terms of education and access to DE, in most households lighting at night is intended so that the children can study. The WFP's rice support program is a further important incentive for parents to send their children to primary school. In general,

the greater the increases in income, the more parents spend money on their children's education.

For the relationship between better health and access to DE, there is only a link between expenditure on health if there are reduced costs resulting from DE and this was similar in both communities.

Therefore, of the factors that were identified as the most important in terms of linking DE to human development (increased income, higher education and better health), only higher education shows a clear link and to some extent increased income as well. In addition, the model used for this section is mainly a case study. This is because some data, such as school enrollment, are not useful since most primary school pupils attend school due to the rice support from the WFP. Since there is not much data available for improved access to health services in the past five years, this is also not taken into consideration in this analysis. In conclusion, relevant research findings can be ascertained from the available data, although there are limitations to this.

6.2.4 From Rural Electrification to Rural Development

This section will analyze the fourth question that needed to address, "How could rural electrification further promote rural development in Myanmar?"

First of all, human development in the Dry Zone region is hindered by many factors. It is well known for food security issues due to high poverty and reduced agricultural yields. Droughts and floods are also common in the study areas. Moreover, there is not enough infrastructure development in the regions as well. Therefore, rural development in the region has also been left behind.

In terms of poverty and reduced yields, this is mainly due to frequent droughts and floods in the region along with changes in weather patterns. The use of fuel wood for household energy has resulted in deforestation and this is also one reason contributing to climate change in the region. Though there is a need to reduce the use of fuel wood, it is not possible without any alternatives. Therefore, proper technology for household energy use would be important to overcome some of the rural development issues facing the region.

In terms of education, basic light at night is very important. Better access to DE leads to greater access to education. This will in turn improve human resources in the

region and in the long run will have an impact on human development in the country within the education sector.

For the community, infrastructure development such as roads and irrigation systems are important in order to be able to increase incomes. It was also noted that the greater the increase in the community's income, the more the villagers consumed DE. It shows that although DE does not take precedence over their basic needs, DE is what the community wants when they have increased income.

Last but not least, the communities are not similar with respect to the use of DE for small and medium enterprises (SMEs). However, it is true that the greater the income, the better type of DE they want for business use as well. With increased access to DE, the communities in turn want to generate increased income by setting up SMEs. Therefore, the communities want to have a better understanding of how DE technology can help SMEs, which will also help rural development in the country.

However, increased levels of access to DE can also risk negative impacts to the community in terms of community value. Due to low levels of access, at present, the community has a form of unity and sharing among each other for the use of DE. If all can access more electricity, the kind of community sharing and unity, such as the practice of gathering together for watching video, are at risk of disappearing and this is a concern to some extent.

Apart from this, DE plays an important role in rural development though it is not the first priority for the community and improving DE systems will also improve the human development of the community.

6.3 Recommendations

The following recommendations will cover four main stakeholders 1) Policymakers 2) Private sector actors 3) NGOs and 4) Communities.

6.3.1 For Policymakers

- Current government policy needs to improve in terms of more research and technical support that reflects the communities' needs. The concern here is that current government policy should reflect the available resources as well as be suitable for the community's needs by taking into consideration the advice of

experts who have experience and technical skills in DE. For example, the government plans to destroy old cars but from the point of view of technical experts, the engines from these cars could be useful for communities in providing small-scale electrification (Interview, ID16, 16.7.12).

- Since, there are different ministries involved in the energy sector, there should be more cooperation led by the Ministry of Energy and better planning on energy provision in the country.
- The government needs to make more financial assistance available for small-scale DE so that projects can be implemented nationwide. For example, the government can encourage banks to provide loans for DE projects.
- There is a need to control the price of the market, provide incentives through tax exemptions or a specific tax system that favors DE to help support the private sector and NGOs in helping the community.
- The relevant government body also should take study trip to neighboring countries for exchanging experiences and learning new technology suitable to the country. There is technology available in the neighboring countries for solar cooking; however, it is not yet introduced in Myanmar. The following can be one example to substitute the use of fuel wood with solar cooking.



Picture 6.1: Sample of Solar Cooking Technology(Professor Toh Peng Seng's Photograph)

- It is important to have public consultation or listen to public voices on energy investment issues and there should be multi-stakeholders involvement in DE policy implementation efforts because although this would involve more time and work, it is important to adopt what is most suitable for the community concerned.

6.3.2 For Private Sector Actors

- There is a need for the private sector to improve their services such as technical assistance for installation projects and to provide relevant guidance on using DE in a sustainable way, since some technologies are not available in the chosen community although they would be interested in being able to access certain DE systems.
- There is also a need to survey what the community needs in terms of products and introduce technology such as solar cooking so that the most relevant ones can be made available in the market and thus increase access to DE. This has already been done by Ye Mon and Sun Power companies, which are trying to improve their services from feedback from the communities.
- The REAM model has been shown to be successful and thus this should be used as a business model by the private sector as well for increasing access to DE.
- There should also be quality controls and price controls for individual DE systems for those who want to increase income generating activities.

6.3.3 For NGOs

- The need of energy and finding alternatives to fuel wood need to be taken into consideration when undertaking development projects and in environmental conservation work. The study tour to neighboring countries DE program should be taken as well.

- REAM's model is a useful one since it has been shown to be successful in the community and the lessons learned from this can be studied to further improve it and to provide more effective support to communities in accessing DE.
- There should be more technical and financial support for communities in terms of increased access to DE.
- It would be useful to conduct more research in order to get communities' perspectives on their own human development needs and to ascertain the most suitable technology for implementing DE projects depending on the region, which would better meet the needs of the community.

6.3.4 For Communities

- The community knows best what is needed in order to improve its own human development. Communities need to make stakeholders, such as the government, private sector actors or NGOs, understand what their needs and concerns are through a collective voice. For instance, the community can collect documentation such as photos of bad roads in rainy weather to show as evidence when they have discussions about the need for assistance.
- The practice of democratically selecting the leaders for REAM's package can also be useful for other activities in the communities, and successful practices can be shared with other communities to improve access to DE.
- The community's understanding of DE technologies should be improved with the help of government, the private sector and NGOs.
- It is also important to continue to retain the social value of cooperation to help increase access to DE through a model like REAM's package.

6.4 Further Study

This thesis has identified the following three priority areas for future study:

- Rural Energy in Myanmar

The study conducted for this paper is on the relationship between DE and human development using a qualitative method. However, a more concrete understanding on the available DE sources and technology should be explored. In 2003, JICA

conducted a similar study; however, with the current changes in the country it is already outdated. Therefore, to understand the appropriate DE technologies for the country, there is a need to update the available DE sources and technology in Myanmar to be useful for further policy development to enable better access to energy in rural areas. Therefore, the research question would be:

“What are the most relevant DE sources and technologies available in rural areas of Myanmar?”

- Cost effective DE Products for Rural Areas in Myanmar

The cost of DE acts as a constraint for communities in being able to increase access to DE. As was the case with the increasing cost of diesel, generators became less popular as their cost effectiveness decreased. When private sector actors improve their services and products, there is increased demand for DE. In addition, there is a price and quality differentiation between different DE products as well as between imports and local products. Moreover, tax and investment are also important drivers for the price of the products on the market. Therefore, it is important to study what the most cost effective DE products might be for a community in terms of the existing resources in the country. Therefore, the question for this research area could be:

“In what ways can cost effective DE Products be Made Available for Rural Areas in Myanmar?”

- A Policy Review of Myanmar Energy Planning

In Myanmar, different ministries take part in the planning and implementation of energy policy in the country. It would be necessary to study in terms of policies aiming at equal access to electrification whether there are any gaps and overlapping policies that could be improved. Therefore, a review of all the current planning bodies will be helpful to formulate a better plan for improved energy access in the country. Thus, the research question should be:

“What are the gaps and overlaps in current energy planning in Myanmar?”

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APPENDIX

Appendix A: Sample of Interview Questionnaire; Interview Question for community in depth interview with electrified households

General Question

How many family members do you have?

How many of them are at school?

How many of them are at work?

How many dependent family members? What do they do at home?

HD

- ❖ In your opinion, what are the development needs of this village?
- ❖ Is there any priority needs require electrification provision?
- ❖ If the need of rural electricity is met, will that be resulted in community development in terms of health, income-generation, and educational improvement?

Income

- What are the main sources of income for your household?
- What are the main livelihoods cash and savings for your household?
- Do you have food security for your household?
- Does your household has enough income to meet basic needs? (food, health, education, basic good purchases)
- Over the last five years, has income increased, decreased or stayed the same for your household? Why?
- If increased, what, in your opinion, are the main reasons for increased income for your household ?

Education

- To what extent, access to education is promoted in your household?
- What, in your opinion, are the main reasons for better access to education for your household?
- Over the last five years, has the education level become higher, lower or the same for your household? Why?
- What are the barriers and opportunities of higher education for your household?
- Which school your family members choose to attend? Why?

Health

- What is the main health problem in this village?
- What, in your opinion, are the main reasons for better health for your household?
- What are the opportunities and barriers for better health for your household?
- Over the last five years, is there improvement in health status in your household?

Access to DE

- ❖ What, in your opinion, is electricity access for the community? (Self-definition)
- ❖ Can all people access to DE in this village? How, What types, why and why not?
- ❖ Which are the main reasons why your household decided to use this certain type of decentralized electrification?
- ❖ In what ways, at what cost, your household can afford for decentralized electrification?
- ❖ Could the technology be made, installed, maintained and repaired by your family members?
- ❖ How you manage DE system? Strength? Weakness?
- ❖ What kinds of funds are available for your household in order to have access to electrification?
- ❖ How can the church, monastery, CSO, or CBO be involved to ensure access to DE?
- ❖ Is there any job creation by DE?
- ❖ How long are you planning to use this DE? Is there any plan to change, improve or not to?
- ❖ Have you ever heard of any government policy that help the community to be able to access to DE? What is the strength or weakness of this?
- ❖ How could the policies change and how helpful could the government policy contribute for better access to electrification in your community?

Cost Benefit Analysis

- ❖ How much does it cost for your to be able to access the current DE system?

- ❖ In what ways, DE project in your household can be sustainable or is there any idea to improve in the future?

Link between DE & HD in Dry Zone Area of Myanmar

- ❖ After being access to electrification what are the changes or improvement for your household in general?

Income

- ❖ Can decentralized electrification increased income for your household? In what ways?
- ❖ What types of income generating activities in your household need DE?
- ❖ Being access to DE cost you more or less compared to the use of candles?
- ❖ What are the opportunities for electrified households in comparison to un-electrified household in the community in terms of income generating activities?
- ❖ Is there any case study related to increased income and DE for your household?

Education

- ❖ Can decentralized electrification improve education for your household? In what ways?
- ❖ How many hours of children study at night?
- ❖ How much monthly cost of children`s education that household contribute to?
- ❖ What the opportunities are for electrified households in comparison to un-electrified household in the community in terms of improve education?
- ❖ Is there any case study related to higher education and DE for your household?

Health

- ❖ Can decentralized electrification contribute better health for your household? In what ways?
- ❖ Over the last past five years, do you have better access for health care for your household? Why and Why not?
- ❖ Over the last past five years, do you have increased expenditure for health care for your household? Why and Why not?
- ❖ What opportunities are for electrified households in comparison to un-electrified household in the community in terms of improve education?

- ❖ Is there any case study related to better health and DE in your household?

- ❖ What other things can decentralized electrification contribute to your household other than income, education and health?

Appendix B: Sample of Survey Questionnaire for Community

ကျေးရွာအတွက် ဆာဗေးမေးခွန်းများ

စဉ်။.....

၁။ လူတွေ မေးခွန်းမေးသူ၏ အမည်

၂။ လူတွေ မေးခွန်းမေးမည့် နေ့ စွဲ

၃။ ရွာ၏ အမည်

၄။ ရပ်ကွက်

၅။ မေးခွန်းများအား ဖြေဆိုသူ

၆။ အိမ်ထောင်စု၏ အမည်

၇။ အိမ်ထောင်စု အရေအတွက်

၈။ အိမ်ထောင်စု၏ အဓိကအလုပ်အကိုင်

၉။ အလုပ်အကိုင် အဆင့် - ပိုင်ရှင်၊ ငှားရမ်းသူ၊ အခမဲ့ငှားရမ်းသူ၊ အခြား.....

၁၀။ ရေထောက်ပံ့ရရှိမှု - အများသုံးရေကန်၊ ကိုယ်ပိုင်ရေတွင်း၊ အိမ်ပြင်ဖက်မှ ကိုယ်ပိုင်ပိုက်ဖြင့်ရေရယူခြင်း၊ အိမ်ထဲတွင် ပိုက်ဖြင့်ရေရယူခြင်း၊ မိုးရေများစုဆောင်းခြင်း၊ အခြား.....

၁၁။ စွမ်းအင်အရင်းအမြစ် - နေစွမ်းအင်၊ မီးစက်၊ စွမ်းအင်မရှိခြင်း၊ အခြား.....

၁၂။ မီးထွန်းခြင်းအလေ့အထ - မီးသီး၊ ဖယောင်းတိုင်၊ ရေနံဆီ၊ ဘက်ထရီအိုး၊ အခြား.....

၁၃။ လစဉ် ပျမ်းမျှဝင်ငွေ

၁၄။ ပြီးခဲ့သော ဆယ့်နှစ်လအတွင်း အိမ်ထောင်စု၏ ပျမ်းမျှဝင်ငွေ

- ရာသီလိုက်လုပ်ခများမှ ရငွေ
- လျှပ်စစ်ပစ္စည်း အသုံးပြုခြင်းမှ ရသောဝင်ငွေ
- ညအချိန်တွင် အလုပ်လုပ်ခြင်းမှ ရသောဝင်ငွေ
- အခြားအရင်းအမြစ်များမှရရှိသော ဝင်ငွေ

၁၅။ အိမ်ထောင်စုအတွင်း ဝင်ငွေရှိသူ အရေအတွက်

၁၆။ ညအချိန်မီးလင်းရေးအတွက် (ရေနံဆီ(သို့) လျှပ်စစ်မီး) လစဉ်ကုန်ကျစရိတ်

၁၇။ အိမ်တွင် အသုံးပြုသည့်လျှပ်စစ်ပစ္စည်း - ရေဒီယို၊ ကက်ဆက်၊ တီဗီ၊ ဗီဒီယို၊ ပန်ကန်၊ ရေပိုက်၊ အခြား.....

၁၈။ ကလေးများအားလုံး၏ ပညာရေးအဆင့်

၁၈ (က)။ မိသားစုဝင်များ၏ ပြီးမြောက်ထားသည့် ပညာအရေအချင်း အဆင့်အတန်း

၁၈ (ခ)။ အိမ်ထောင်စုရှိ ကလေးများ၏ လက်ရှိပညာရေး အခြေအနေ

ကလေးအမည်	ကျောင်းအပ်နှံမှု	အတန်း	ပြီးခဲ့သည့်လအတွင်း တက်ရောက်ခဲ့သည့် ကျောင်းတက်ရက်အရေအတွက်
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၁၈ (ခ)။ ကျောင်းအပ်နှံမှု - ကျောင်းတစ်ခါမှ မနေဘူးခြင်း၊ အရင်ကနေဖူးခြင်း၊ လက်ရှိကျောင်းတက်ရောက်နေခြင်း။

၁၈ (ဂ)။ ပျမ်းမျှညစာကြည့်ချိန် နာရီ

၁၉။ အိမ်ထောင်စုအသုံးစရိတ်

လျှပ်စစ်မီးအတွက် ပျမ်းမျှလစဉ်သုံးငွေ

ပညာရေးအတွက် ပျမ်းမျှလစဉ်သုံးငွေ

ကျန်းမာရေးအတွက် ပျမ်းမျှလစဉ်သုံးငွေ

၂၀။ မည်သည့်လုပ်ငန်းများအတွက် အိမ်ထောင်စုက လျှပ်စစ်မီးများ လိုအပ်သနည်း။ လျှပ်စစ်မီးကို ဘာအတွက် အသုံးပြုသနည်း။

Appendix C: Codes used in the paper for the interviews

Thesis code	Who?	Gender	Where?	When?
ID 1	Private Sector – Ye Mon	Male	Yangon	20 June 2012
ID 2	Private sector – Sun Power	Male	Yangon	20 June 2012
ID 3	NGOs –Ream Pauk	Male, Female	Pauk	22 June 2012
MT-FG1	Mon Taw -FG 1 – SC	Male, Female	Mone Taw	23 June 2012
MT-FG2	Mon Taw FG 2 – EH	Male, Female	Mone Taw	24 June 2012
MT-FG 3	Mone Taw – FG 3 - NE	Male, Female	Mone Taw	24 June 2012
MT 1	Mone Taw-ID- E 1 Charging		Mone Taw	24 June 2012
MT 2	Mone Taw- ID- E 2*mango		Mone Taw	24 June 2012
ID4	Health worker	Female	Kan Phyo	24 June 2012
ID 5	Mone Taw- ID – E3- Teacher	Female	Mone Taw	25 June 2012
MT3	Mone Taw – ID – E 4– Charging	Male	Mone Taw	25 June 2012
MT 4	Mone Taw – ID- E 5- Diesel	Female	Mone Taw	25 June 2012
ID6	Phayartaung – DE - ***	Male	Payataung	25 June 2012
ID7	NGO- REAM – Pauk	3 Male, 3 Female	Pauk	26 June 2012
MT5	Mone Taw- ID- E – Shop	Male	Mone Taw	27 June 2012
MT6	Mone Taw- ID- E-	Male	Mone Taw	27 June 2012
MT7	Mone Taw- ID- NE-		Mone Taw	27 June 2012

MT8	Mone Taw – ID-		Mone Taw	28 June 2012
ID8	Mone Taw – KI – Monestry	Male	Mone Taw	28 June 2012
MT9	Mone Taw – ID- E ***		Mone Taw	28 June 2012
MT10	Mone Taw – ID- E Ma Hla win soe		Mone Taw	28 June 2012
MT 11	Mone Taw- ID – E-shop		Mone Taw	28 June 2012
MT12	Mone Taw – ID – NE- Battery	Male	Mone Taw	27 June 2012
MT13	Mone Taw – ID- NE		Mone Taw	28 June 2012
MT 14	Mone Taw – ID- NE		Mone Taw	28 June 2012
MT 15	Mone Taw –ID- NE- Cretavity	Female	Mone Taw	28 June 2012
MT 16	Mone Taw- ID- E - **Skynet	Male	Mone Taw	28 June 2012
MT 17	Mone Taw-ID- NE		Mone Taw	28 June 2012
MT 18	Mone Taw- ID- E		Mone Taw	28 June 2012
MT 19	Mone Taw –ID –E		Mone Taw	28 June 2012
MT 20	Mone Taw- ID – NE		Mone Taw	28 June 2012
ID9	Oxfam – Pauk	Female	Pauk	29 June 2012
ID10	Oxfam – Pauk	Female	Pauk	29 June 2012
ID 11	GAA – Pauk	Female	Pauk	29 June 2012
PKP_FG1	PKNP – FG1 – SC - E	Male,Femal e	Paykhwinit Pin	30 June 2012
ID12	PKNP – ID- Teacher - E	Female	Paykhwinit Pin	30 June 2012
PKP 1	PKNP – ID – E 2 U Pay Ye, solar own		Paykhwinit Pin	30 June 2012
PKP2	PKNP – ID- NE 1 *house move		Paykhwinit Pin	30 June 2012

ID 13	PKNP – KI – E- Village Head	Male	Paykhwinit Pin	1 July 2012
PKP3	PKNP – ID- NE 2 - ** Climbing	Male,Female	Paykhwinit Pin	1 July 2012
PKP4	PKNP – ID – NE 3 no list		Paykhwinit Pin	1 July 2012
PKP5	PKNP – ID – E – 3 light problem DHK 77		Paykhwinit Pin	1 July 2012
PKP6	PKNP – ID – NE 4 health		Paykhwinit Pin	1 July 2012
PKP7	PKNP – ID – E 4 goat animal husb		Paykhwinit Pin	1 July 2012
PKP 8	PKNP – ID – E 5 new house		Paykhwinit Pin	1 July 2012
PKP9	PKNP – ID – E 6 goat,trade		Paykhwinit Pin	1 July 2012
PKP10	PKNP – ID – E7 LL		Paykhwinit Pin	1 July 2012
PKP11	PKNP – ID – E 8 LL *** Two interview		Paykhwinit Pin	1 July 2012
PKP12	PKNP – ID – NE no notes		Paykhwinit Pin	1 July 2012
PKP13	PKNP – ID – E 12 LL 24		Paykhwinit Pin	1 July 2012
PKP 14	PKNP – ID – NE 5 *		Paykhwinit Pin	1 July 2012
PKP15	PKNP – ID - NE		Paykhwinit Pin	1 July 2012
PKP16	PKNP – ID – E 11 – health		Paykhwinit Pin	3 July 2012
PKP17	PKNP – ID – E 12* no notes		Paykhwinit Pin	3 July 2012
PKP_FG2	PKNP - FG – Mix – Loan		Paykhwinit	3 July 2012

			Pin	
PKP18	PKNP – ID – E 13- Teacher	Female	Paykhwinit Pin	3 July 2012
PKP19	PKNP – ID – NE 6		Paykhwinit Pin	3 July 2012
PKP20	PKNP – ID – E 14 *		Paykhwinit Pin	3 July 2012
PKP21	PKNP – ID – E-15 Video	Male	Paykhwinit Pin	3 July 2012
PKP22	PKNP – ID- NE - Library	Male	Paykhwinit Pin	3 July 2012
PKP23	PKNP – ID – NE		Paykhwinit Pin	3 July 2012
PKP24	PKNP – ID – NE no notes - health		Paykhwinit Pin	3 July 2012
PKP25	PKNP – ID – E no notes		Paykhwinit Pin	3 July 2012
PKP26	PKNP – ID – E no notes- Road side		Paykhwinit Pin	3 July 2012
ID14	Township Authority	Male	Pauk	4 July 2012
ID15	NGOs – RDE -YGN	Male	Yangon	14 July 2012
ID16	NGOs – REAM - YGN	Male	Yangon	16 July 2012
ID17	Private Sector – SP show room	Female	Yangon	18 July 2012
ID 18	Ministry of Electricity_Pauk	Female	Pauk	2 July 2012
OB 1	Solar Shop 1	Female	Pauk	4 July 2012
OB 2	Solar Shop 2	Female	Pauk	26 June 2012
OB 3	Solar Shop 3	Female	Pauk	29 June 2012

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