THE SELF-RELIANCE ENERGY MODEL FOR A RURAL COMMUNITY : A CASE STUDY OF NONGMAKOK VILLAGE IN NAKORNNAYOK PROVINCE OF THAILAND

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THE SELF-RELIANCE ENERGY MODEL FOR A RURAL COMMUNITY : A CASE STUDY OF NONGMAKOK VILLAGE IN NAKORNNAYOK PROVINCE OF THAILAND

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ABSTRACT

The research objectives were to study, survey and analyze the energy consumption situation in the Nongmakok village of Nakornnayok province, Thailand and to investigate potential internal energy sources. An additional purpose was future policy determination related to internal dependency based on a self-reliant energy model for public sectors or concerned agencies. The conceptual framework was based on a local self-reliant energy model under the philosophy of a self- sufficient economy. The study area was at Nongmakok Village, Banna Subdistrict, Banna District, Nakhonnayok Province. The study explored 134 households with data collection being carried out by a structured in-depth interview, a questionnaire, and participation observation. Analysis and data processing using a mathematical model and descriptive statistics of frequency, mean, and percentage were performed . The objective of the research were confirmed with the results.

The results revealed that the village's energy consumption model had been changed from dependence on local renewable energy sources to non-renewable energy sources. An effect of this change was higher household of expenses . In 2552, Nongmakok village had a total energy expense of 385,794.61 Baht/Month and an average expense of 2,879 Baht/Household/Month. This represented a mass income and total household expense which amounted to 22.12 percent and 48.79 percent, respectively. Today household energy dependence follows four different models with the majority of energy use being a combination of charcoal or firewood with LPG. This combined energy model can be a guide to the development of self-reliant energy use for households in rural communities and near by urban areas because it allows for the ease of purchasing energy. So promoting the understanding of energy use and environmental impact will stimulate public attention and awareness energy of issues and the global warming crisis. The community should be made aware of the risk of commercial energy use alone, and should explore alternative energy sources in the rural community. A policy of suitable energy technologies and sources, based on economic and social community factors should be promoted.

KEY WORDS : COMMERCIAL ENERGY/ CONVENTIONAL ENERGY/ RENEWABLE ENERGY / ENERGY SOURCES POTENTIAL/ SELF-RELIANCE MODEL

รูปแบบการพึ่งตนเองด้านพลังงานของชุมชนชนบท กรณีศึกษา หมู่บ้านหนองมะกอก ตำบลบ้านนา อำเภอบ้านนา จังหวัดนครนายก

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บทคัดย่อ

จากการศึกษาวิจัยครั้งนี้มีวัตถุประสงค์คือ เพื่อศึกษาสำรวจและวิเคราะห์สถานการณ์การใช้พลังงานในชุมชน เพื่อศึกษาศักยภาพแหล่งทรัพยากรพลังงานภายในท้องถิ่น และเพื่อเสนอเชิงนโยบายเกี่ยวกับรูปแบบการพึ่งตนเองด้านพลังงานภายของชุมชนในอนาคตแก่ภาครัฐหรือหน่วยงานที่เกี่ยวข้อง ซึ่งมีกรอบแนวคิดที่ให้ชุมชนพึ่งตนเองด้านพลังงานได้ในอนาคต ภายใต้ปรัชญาเศรษฐกิจพอเพียง ขอบเขตพื้นที่ศึกษาอยู่ที่หมู่บ้านหนองมะกอก ตำบลบ้านนา อำเภอบ้าน จังหวัดนครนายก จำนวน 134 ครัวเรือน ทำการเก็บรวบรวมข้อมูลโดยการสัมภาษณ์เชิงลึกแบบมีโครงสร้าง แบบสัมภาษณ์ และการสังเกต วิเคราะห์และประมวลผลข้อมูลโดยแบบจำลองทางคณิตศาสตร์ สถิติเชิงพรรณนา ได้แก่ ความถี่ ค่าเฉลี่ยและร้อยละ และแปลความเชิงพรรณนา เพื่อรายงานผลตามวัตถุประสงค์

ผลการศึกษาพบว่า การใช้พลังงานของชุมชนการมีการเปลี่ยนแปลงจากอดีต จากการพึ่งพาทรัพยากรพลังงานภายในท้องถิ่น และเป็นพลังงานหมุนเวียน เปลี่ยนมาเป็นการนำเข้าพลังงานจากภายนอก ซึ่งเป็นพลังงานที่ใช้แล้วหมดไปมากขึ้น ส่งผลต่อค่าใช้จ่ายภายในครัวเรือนที่สูงขึ้น ณ พ.ศ. 2552 หมู่บ้านหนองมะกอกมีค่าใช้จ่ายพลังงาน 385,794.61 บาท/เดือน เฉลี่ย 2,879 บาท/ครัวเรือน/เดือน คิดเป็นร้อยละ 22.12 ของรายได้มวลรวม และคิดเป็นร้อยละ 48.79 ของค่าใช้จ่ายมวลรวม โดยมีรูปแบบการพึ่งพาพลังงานในปัจจุบันมีทั้งหมด 4 รูปแบบ ส่วนใหญ่มีการใช้พลังงานแบบผสมผสานระหว่างการใช้ถ่านหรือฟืนกับการใช้แก๊สหุงต้ม ซึ่งรูปแบบการใช้พลังงานแบบผสมผสานนี้สามารถเป็นแนวทางการพัฒนาการพึ่งตนเองด้านพลังงานในระดับครัวเรือนและชุมชนได้ในลักษณะของชุมชนชนบทที่อยู่ใกล้กับชุมชนเมือง และมีความสะดวกในการซื้อหาพลังงานมาใช้ได้ง่าย ควรส่งเสริมความรู้ความเข้าใจเกี่ยวกับสถานการณ์พลังงานและสิ่งแวดล้อม เพื่อกระตุ้นให้ประชาชนเกิดความสนใจและตระหนักถึงปัญหาวิกฤตการณ์พลังงานและภาวะโลกร้อน และสร้างจิตสำนึกของคนในชุมชนให้ลดความเสี่ยงจากการใช้พลังงานเชิงพาณิชย์เพียงอย่างเดียว ควรมีการสำรวจการใช้พลังงานของชุมชนชนบท รวมถึงความต้องการการใช้พลังงานทดแทนและเทคโนโลยีพลังงานที่เหมาะสมศักยภาพแหล่งพลังงาน สภาพเศรษฐกิจ และสังคมของชุมชน

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CHAPTER I
INTRODUCTION

1.1 Background

1.1.1 Energy

Energy is the important fundamental factor for country development and human living. The energy resource is mostly consumed from fossil energy, which is limited and unable to renew. While some countries have limited energy resources and insufficiently meet the demand and country development, they so import a large amount of energy to their countries. Thailand then import the energy accounting for 90% up in total consumption of energy end use and is projected to increase 5.1% as reported from the Energy Policy and Planning Office (Prachachatturakij, 2007 [online]). Thailand has spent much to import energy to sustain the demand with rising from the increase in population and economic growth. The increase in oil price is effected from the limited global reserved energy resources together with state of war and political instability of oil exporters. The dependence on the nonrenewable energy cause each countries face the problems in energy crisis especially for developing countries. Thus, it is important for them to seek for the alternative energy to substitute for fossil energy and to sustain all demand. However, the supply is not only for fulfilling needs but also for using it effectively together with using it at the lowest price, sufficient quantity, disparity, minimized risk, and less impact on environmen. (Energy Policy and Planning Office, 2545 [online]). As far as the current global economic crisis is concerned, Thailand also seeks for the renewable and alternated domestic's energy resources for greater self-reliance.

The exploration or expansion of the new energy resources might be solved symptom due to the people needs are endless. (Wittaya, 2007 [online]. Consequently, the problems should be exclusively executed by exploring of newable supplies and building people awareness in using energy so as to prevent the said recurrence

problems. In the energy sector, energy management is consistent with the Sufficiency Economy Philosophy, which is definitely true management model based on sufficiency both in using and managing resources. The Sufficiency Economy Philosophy focuses on the principle of “morality-led knowledge starting from individual consciousness, rationality, sufficiency together with having wisdom and morality. If the passion ends, the energy crisis will stop as well as the problems in politics, economics, socials, rebellion, seizing resource, natural disaster and so on. Hence, problem has to be eliminated at root cause(needs) and the philosophy of sufficiency economy can absolutely apply to everything and every social level.

1.1.2 Energy and Community

At a community level, it is still difficult for them to illustrate and understand about energy even if the energy is close to their living and used to earn their living and lives. In addition, the rural community’s behavior in energy utilization currently have been changed by mainly based on the non-renewable energy from outside the household and village. Along with the increase in the number of households and the energy demand, community overlooks the potential energy resource derived from nature and available in a community such as from sun, water, air, living labor and biomass. And, those of the aforesaid sources are the first energy sources used to earn the community’s life and living for a long time.

The changes in behavior also leads to the changes in thinking that the public or the relevant parties should be the ones who undertake the actions. Accordingly, the community feels remote from those problems. Therefore, it is important to build the community's understanding of energy by improving its capacity and effectively using the local energy resources. This requires understanding, coupled with wisdom and support from government.

Today the majority of energy problems will focus on rural development as it is a prime mover in developing countries, and there is renewable energy resources scattered in many areas As seen from the promoting of the community’s understanding on energy in community project such as the village energy, community can recognize information of energy at household level, its status, and capacity as well as

consumption plan. Hence, this could help the communities to be self-reliant in energy and to reduce energy imports from outside.

1.2 Statement of Problem

Nong Makok village is a community outside the municipality, Banna District, Nakhon Nayok Province. People in these villages are mainly agriculturists and have low-income. They are currently depended on energy from outside such as electricity and LPG fuel to earn their living and lives. This lowers their quality of life resulting of the suffering from the increase in household expenditure and production costs. They also reduce the consumption of local natural resources of renewable energy and living labors. Although there are some household use, but very little, the majority of renewable energy uses are only firewood and charcoal and only on occasion. The agriculture machines that based on commercial fuel are employed instead of workers or animals. This is projected to unemployment in the village and let them find a job outside the villages or other provinces. Thus, the new generations in the community leave their community to work in the other provinces or in industrial estates. Some are general workers. The migration of young workers then affects the lack of youth workers in the village. The causes of problems may be due to the dependence of energy outside. Secondly, the mislead in using energy of themselves affect to the higher cost of living. Thirdly, there is no community awareness about alternative energy, potential resources of energy including the aggregation of energy uses and lack of knowledge in developing themselves and their community. Fourthly, the community is weak and lack of government support deriving from lack of knowledge and powerful party or leader. Therefore, the promotion of public power is ignored both in providing energy technologies knowledge and community leaders. Finally, the improper adjustment in energy utilization from outside does not get along with the development; the development is more comfortable than the origin. Because the energy utilization isn’t based on the sufficient principle.

From the above mentioned five causes of the problem, the community cannot be self-reliance on energy. So, the researcher interested in studying of a

self-reliance model on energy to find out the appropriate self-reliance model for the villages in the future. And the previous study of independence is the study of the strong and independent community such as factors affecting to independence, potential of self-reliance and self-reliance model. However in this study, the researcher will focus on the patterns of energy self-reliance in the future. The study starts from finding out the problems in Nong Makok village by collecting data of the energy use in the past to the present including how they adapt to the new energy forms instead of the old energy forms. The researcher will study the cost of energy, the use of energy within the community both for commercial and alternative energy in order to analyze the energy uses in current situation, to explore local energy resources, to study the potential of energy resources as supporting data in a form of self-reliance on energy together with in-depth interview to the economic conditions and social community as well as to provide knowledge of the sufficient economy and alternative energy. Hence, the community could share each idea and explore their self-reliance model on energy by applying the principle of sufficiency economy to be consistent with their model created. The new theory then is a practical paradigm.

Even if the community living is different from the past, the researcher expects that this study will be a guideline to build better quality of life in the community by reducing energy expenditures, jobs opportunities creation and increasing incomes, building community unity, reducing environmental problems from household waste disposal, utilizing the most favorable agricultural areas and moving to be an appropriate energy self-reliance model for future communities.

1.3 Conceptual research

This research is aimed at studying of an energy self-reliance model in the rural communities at the household level. The case study of Nong Makok Village, Tambon Nong Makok, Banna District, Nakhon Nayok Province is performed to find out the energy self-reliance model under the various conditions and problems such as, energy prices, household income, knowledge and understanding about energy and

people behavior in using energy for living and occupation. Through the self-reliance model, the philosophy of sufficiency economy as a guideline is applied to this study. The new agriculture theory is considered to be the most appropriate practice to manage energy. It can manage both the demand (users) and supply of natural energy resources from within and outside the community. Although energy resources within the community can be renewable, the uses must be limited at the appropriate rate consistent with the external energy resource, which is unable to renew. So, it is important to balance its supply and demand coupled with exploration of new energy resources. Hence is the primary purpose of a model of energy self-reliance in communities of this study. It is also consistent with energy policy and definitely true developmental or practical patterns, that arising from the cooperation of community and government support, within communities in the future.

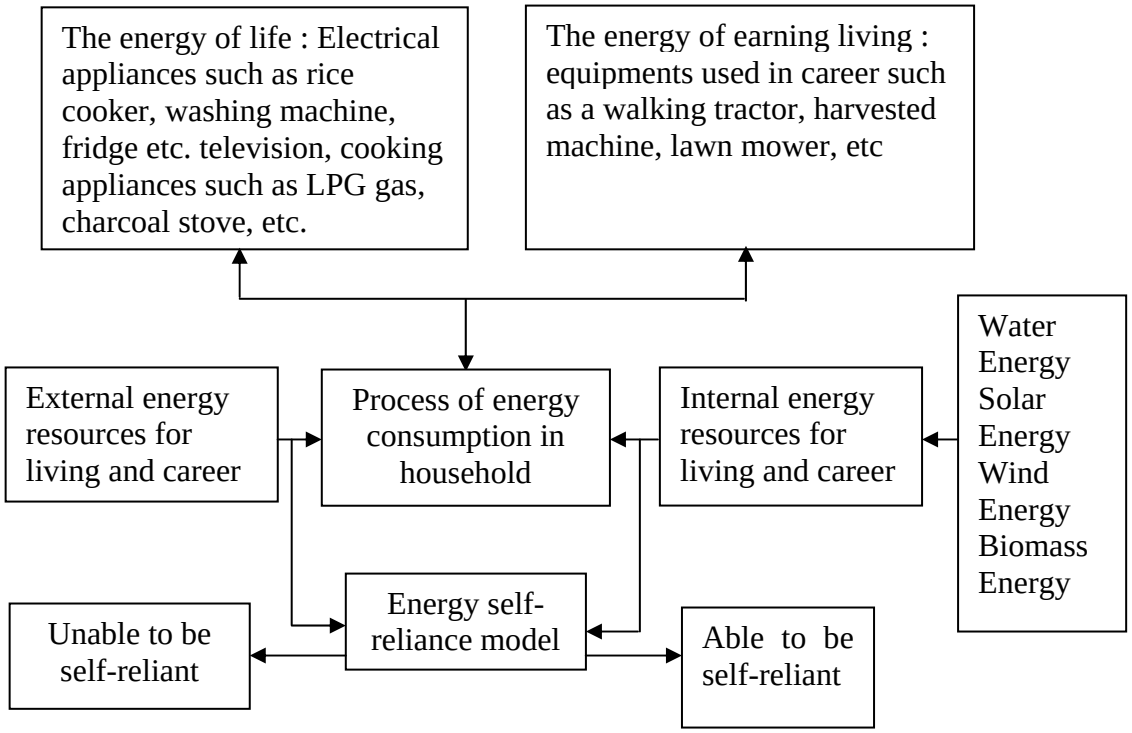


Figure 1-1 : Conceptual Concept

1.4 Research Objectives

1. To study, survey, and analyze the situation of energy consumption in community

2. To study a potential energy resources in local community

3. To propose policy on an energy self-reliance model of local community in future to the Government sector or concerned agencies

1.5 Scope of research

1.5.1 Study Area

The Nong Makok Village, Tambon Nong Makok, Banna District, Nakhon Nayok Province which is located out of municipality is selected for the case study.

1.5.2 Population

(1) Population Group composes of two groups. The first group is the officers with high social status such as community leader, Tambol Administrative Organization (TAO), Community Development District, Nakhon Nayok Provincial Energy Office. The second population group is household that is earn of living from agriculture both main and secondary occupation.

(2) Community's Characteristics and Population Structure

(3) Study on energy consumption pattern in the community for their living and career to obtain energy consumption rate and each household's energy consumption expenditures

(4).Study on energy sources for living and career to obtain community's energy self-reliance status

(5) Study on problem from energy utilization of community

(6) Study on knowledge and understanding of energy consumption, new model of energy technology, alternative energy from internal energy source of community, as well as energy collecting for optimum use.

1.5.3 Context

1.5.3.1 Energy Context

(1) Study on energy situation in the past for recognizing the past trends of consumption pattern including change of energy source of community

(2) Study on the current situation for recognizing the present usage of energy pattern as well as adaptation of energy consumption behavior with modern technology accessories

(3) Study on local energy resources such as energy crop, firewood, animal labor as well as communities' environment for recognizing available local energy sources and additionally appropriate local energy sources

1.5.3.2 Potential Energy sources

(1) Study on Bio-mass energy potential by applying mathematical model

(2) Study on natural energy by applying secondary data

1.5.4 Analysis

1.5.4.1 Analysis on village's energy sources e.g. bio-mass energy sources by applying secondary data and collected field data; raw material of bio-mass (energy crop and dung) employed into mathematical model; and potential natural energy sources by applying secondary data of Rang for comparing energy potential.

1.5.4.2 Data analysis is performed by applying descriptive statistics (Percentage, Frequency, and Arithmetic Mean) to find data characteristic

1.5.4.3 Content analysis is conducted by descriptive interpretation

1.6 Methodology and Step of Research

This research is separated for 3 steps as follows;

1.6.1 Research Steps

Research steps are composed of employing outcome of documentary research for research design and creating primary data collection tools.

1.6.1.1 Documentary Research consists of related secondary data inventory such as

(1) Basic data of study area e.g. physical, economic, population, social, and resources

(2) Data of conceptual frame work and related principles for energy consumption e.g. concept of change, concept of adaptation, substitution pattern, philosophy of sufficiency economy, concept of self-reliance, self-reliance model, alternative energy, renewable energy

(3) Reports, documents, and related researches are studied on details of self-reliance of communities.

1.6.1.2 Research Design

Outcomes of documentary research are employed for study area determination, target population with various points as follows;

(1) Study area is specified for Nong Makok village, Ban Na Sub-district, Banna District, Nakhon Nayok Province.

(2) Target Population

The target population is divided into 2 groups. The first group is officers with high social status such as head of village, Tambol Administrative Organization (TAO), Community Development District. The second population group is household head or representative.

(3) Sampling Method

Multi-stage random sampling technique is applied for this research.

1.6.1.3 Data Collection Tools Design

Survey data collection tools compost of 4 types that are applied for specific population

(1) Energy consumption census form for household head or representative; is applied for data collection on basic data, energy consumption activities, tools & equipment, household expenditure for energy consumption.

(2) Structured in-depth interview form is applied for the officers with high social status informant and household head or representative. Key and minor issues are determined for answers concerned with research objectives.

(3) Observation is performed in participatory manner that is applied together with deep structure interview technique.

1.6.2 Steps of Primary Data Collection

Primary data collection will be conducted as follows;

1. Survey Data Collection; preliminary data of every household energy consumption is collected by census applying designed energy consumption census form.

2. Qualitative data collection; social status persons are interviewed on energy status of communities, problems & obstacles on energy subsidies, knowledge & understanding of each household on energy consumption. Designed questions are separated into 2 parts e.g. the first for the officers with high social status and household samples. All information is recorded.

Those two types of data are processed and analyzed for modification and final report preparation.

1.6.3 Steps of Data Processing, Analysis, and Synthesis

Data collection form is created by applying data from Energy consumption census form and are described on collected survey data by applying descriptive statistics. In addition, an assessment on bio-mass energy source and natural energy source potentials are analyzed by mathematic, therefore, numerical results can be clearly interpreted. Such interpretation can be grouped and classified by applying content analysis associate with interpreted qualitative data collection. All analysis is taking into account for report preparation which is subsequently submitted to expert. After reviewing, research outcome is revised and discussed as well as concluded and recommended. So final report is completely conducted.

1.7 Research definitions

Commercial energy means new energy form that is obtained from fossil energy e.g. electricity, fuel, LPG etc.

Conventional energy means old energy form that is existed in nature. Such energy form has been used from ancient time by community both living and career such as fire wood, labor, animal labor, hydro energy, wind energy, and solar energy.

Renewable energy means unlimited energy resources such as natural energy (Solar energy, hydro energy, wind energy and bio-mass energy including bio-mass energy composed of energy crop or agriculture residual and dung that can be renewed.

Energy sources potential means bio-mass energy source and natural energy source that is sufficient for energy production in terms of quantity and quality for development to meet demand.

Self-reliance model on energy means activity pattern or a guideline for independence on outside energy resource. Such model is derived from knowledge learning on problem of energy use, community's energy resource potential including knowledge dissemination on bio-mass energy technology as well as brainstorming on finding of activities and guideline for self-reliance energy model development.

1.8 Result of Research

1. Energy consumption situation of local community is recognized and could be applied for village's energy utilization forecast in the future.

2. Alternative energy resource of local community is explored and could be basic information for other communities application. It is crucial information for country development.

3. Self-reliance model on energy of community in the future is obtained. Although, such model has not yet been confirmed whether it is sustainable use of local energy or not. At least, it would be a guideline for further study in this aspe.

CHAPTER II
DOCUMENTARY RESEARCH AND LITERATURE REVIEW

The researcher shall conduct documentary research and literature review by analyzing data from several resources such as technical papers, research document, text book including internet to acquire the substantial extent and core context covering the study objectives. All are necessary to describe research result of analysis as detailed following :

Part 1: Related Context

1.1 General Characteristic of Nakhon Nayok Province

1.1.1 Topography

In general, the topography of Nakhon Nayok Province is plain in the North. The East is steep mountain located in Khao Yai National Park. For soil characteristics, the soil is sandy loam and clay suitable for paddy farming, fruit orchard and for living. Divided into 4 districts, 41 sub-districts and 408 villages, the local government administration affiliated with are 28 government and public administrations of regional government administration and there are 33 government and public administrations affiliated with central government administration. Specifically, local government administration is separated into 1 Provincial Administrative Organization, 5 municipalities and Tambon Administration Organization with total population of 253,632 people and 1,326,250 rai. The adjacent boundaries are as following

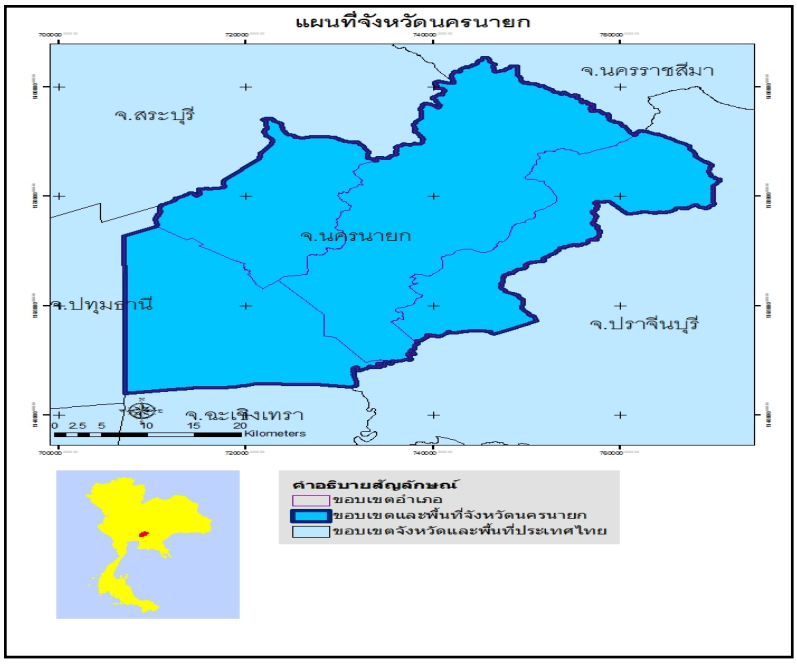


Figure 2-1 : Nakhon Nayok Province Map

North	borders Sraburi and Nakhorn Ratchasima Province
East	borders Nokhom Ratchasima and Prachinburi Province
South	borders Chachoensao and Prachinburi Province
West	borders Pathumthani Province

1.1.2 Energy Consumption

Most of energy consumption of Nakhon Nayok Province is external energy with following details.

- Energy consumption/GPP unit equally 5.08 kgOE/10^3
- Electric Energy consumption/population equivalent to 106.46 kgOE/people or 3,716.55 Baht/people
- Energy consumption/ per capita population equally 334.45 kgOE/ population
- Energy end use/population equally 334,450.53 ktoe
- Energy end use equivalent to 83.11 ktoe is divided into

(a) Commercial energy end use equals 81.86 ktoe

(1) Refined fuel is energy end use equivalent to 55.41 ktoe with fuel consumption to 222.97 kgOE/people or 269.23 litre/people i.e. Automotive diesel oil and Biodiesel 40.55 ktoe, Gasoline 91 10.32 ktoe , Gasoline 95 0.98 ktoe, Gasohol 91 0.28 ktoe Gasohol 95 3.28 ktoe

(2) Electric consumption equals 26.46 ktoe

(b) Renewable energy end use equivalent to 1.25 ktoe

(1) Biomass renewable energy consumption i.e. charcoal 0.73 ktoe, firewood 0.42 ktoe, biogas 0.10 ktoe

(2) Potential of renewable energy equivalent to 20,916.90 ktoe i.e. biogas 3.50 ktoe, water 0.01 ktoe, solar energy 20.913.39 ktoe (Energy Research and Development Institute, Ministry of Energy(MOEN), B.E. 2550. [online])

1.2 General Characteristics of the Study Area

1.2.1 Nong Makok Village Background

Situated in Tambon Administrative Organization, Nong Makok village is situated in fertile area where the villagers have been located for agricultural occupation i.e. paddy farming, gardening and livestock raising. As the place has water resources where the cultivation could be done all year long. Harvesting of Hog Plum(*Makok Nam*) or scientific name -Spondias bipinnata Airy shaw & Forman,could be done and commercially distributed that why the village is called “Ban Nong Makok or Nong Makok Village” till present.

1.2.2 Location

Nong Makok village is totally 2,250 rai with bordering: North borders Pa Kha subdistrict, South borders Phikul Oark subdistrict, East and West border Banna subdistrict. Most areas are the flat plain suitable for paddy farming and backyard gardening with natural canal along the village boundary.

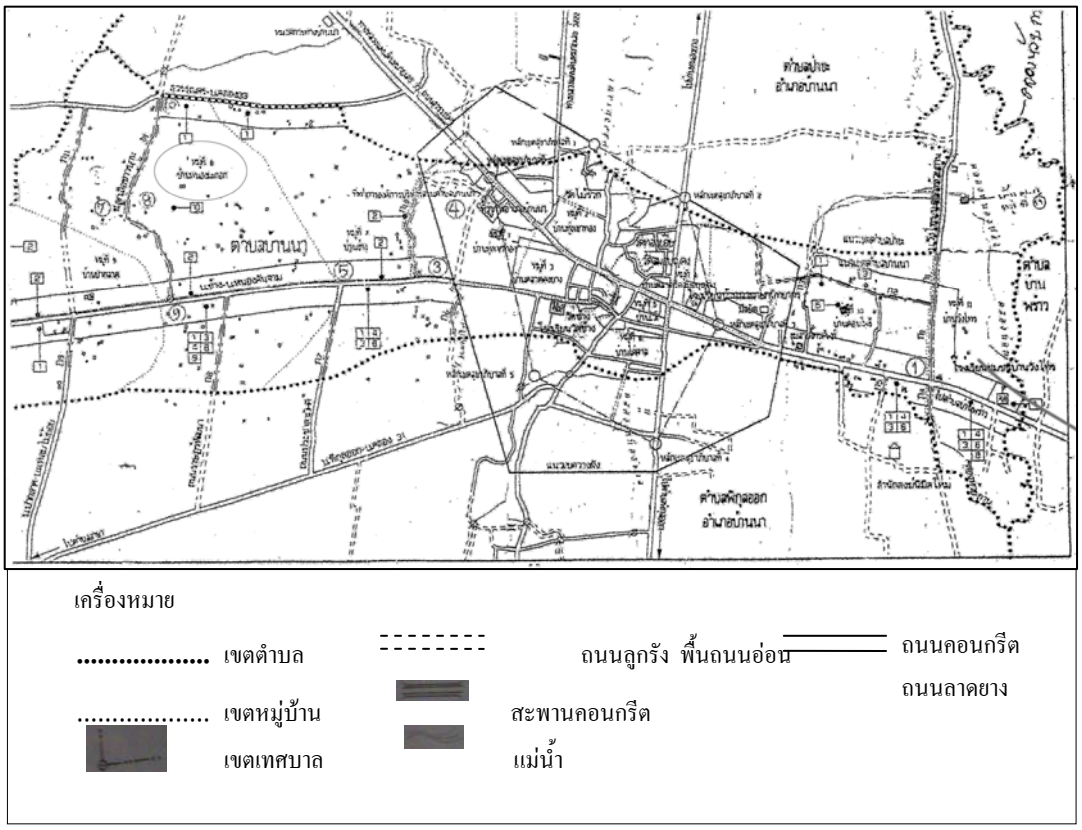


Figure 2-2 : Nong Makok Village Map

1.2.3 General Condition

Far from Banna District 4 km., Nong Makok Village is located at Moo 8, Banna Sub-district, Banna District, Nakhon Nayok Province with total area of 2,250 rai. There are 134 households with 498 populations: 235 men and 263 women. With 9 households, the members do agriculture occupation i.e. paddy farming, vegetables gardening, orchard gardening, livestock raising. With 29 households, the members do semi-agriculture occupations i.e. agricultural work for hire, agricultural commerce. 49 households are general workers. With 4 households, the members do household industry i.e. straw mushroom cultivating, foot scraper weaving. With 2 households, the members do agricultural work for hire. With 21 households, the members work in the government service and 21 households do other occupations.

1.2.4 Land in Possession and Land Utilization

In considering of land in possession and land utilization excluding residence, most people have less than 10-20 rai equally 52.30%. Most of them are agriculture area that is equivalent to 2,000 rai. Paddy farming area is totally 90% out of the overall agricultural area and seasoning crop for 10%. Specifically, the paddy farming area is categorized into own-land for 44 households equivalent to 32.8 % and gardening 8 households equally 5.8% ; vegetable gardens and fruit orchards, deserted areas and pastoral for livestock feeding for 4 households equivalent to 3%.; agricultural area for rent which is mostly paddy farming for 25 households with 18.7%. As a result of large agricultural areas, a number of agricultural residues can be found, especially paddy husk and rice straw as well as animal dung led to potential energy sources.

Figure 2-3 : Land Utilization of Nong Makok Village

1.2.5 Economic Condition

Most population do agriculture i.e. paddy farming, gardening, orcharding, livestock raising. Duck and chicken are popular for raising in order to make dishes in household. Secondary occupation is work for hire. Overall households income equals 1,744,149 Baht/month, averagely 13,016.04 Baht/household/month. Population consolidation is Saving-Truth Group(*Satja Orm Sab*) and Village Fund.

1.2.6 Education and Religion

None of educational institutes are located in the village. But there are 2 primary schools situated outside the village namely : Wat Chang Kindergarden School, Thong Janya Primary School and 2 Child Development Centers located in Wat Chang Kindergarden School, Thong Janya Primary School. There is 1 village newspaper kiosk. Everyone in the village is Buddhist. Three temples are the center of their mental support : Chang Temple is situated at Moo 7, Phikul Temple at Moo 1 and Ekachat Temple at Moo 10 in Ban Phrik Sub-District.

1.2.7 Public Health

There is a public health center and a district hospital.

1.2.8 Public Facilities

Electricity service to Makok Village is spread for 100% with road access to every household. There are 2 alphas surface roads and 2 concrete roads which are private roads. For telephone services, there are 5 public telephones in the village.

1.2.9 Public Utilities

For water resources of domestic use, there are 5 artesian wells, 2 rural waterworks and 30 private wells. Water resource for agriculture is mainly depended on rainfall with 2 canals namely Hua Na Canal and Kra Done Canal. None of irrigation canal in the study area.

1.2.10 Energy Consumption Condition and Supply of Energy Sources

Delivery of electricity by Provincial Electricity Authority (PEA) had spread throughout the village. Supply of energy sources comprises 2 parts : internal village and external village. Fuel oil for transportation and agricultural sector is provided from energy source of internal village. That are 3 shops in the village and 2 tube petrol stations where provide service for gasoline (generally known in Thailand "Benzene") and reformulated gasoline (RFG) with 33 Baht/liter and general petrol service station. Fuel oil price is reasonably subject to the current world's price. Fuel for cooking consists of, firstly, LPG fuel bought from the two village's shops with 290 Baht/tank and the shop outside the community; secondly, charcoal supplied from the shops in community and those with charcoal making. Some household do charcoal kiln themselves by using scraps of wood in the neighboring area and twigs from tree trimming.

1.3 Energy related Concepts and Theorem

1.3.1 Law of Energy Conservation

Law of Thermodynamics becomes the most important law of energy to be understood. The law is key system for policy making and energy planning. The practice includes appropriate energy conservation then. The first law of Thermodynamics states that energy can neither be created nor destroyed in the universe. Generally known as the Law of Conservation(of Energy), the energy has never been lost. In the other words, the total amount of energy in an isolated system constant over time (is said to be *conserved* over time). The second rule states that the energy can be transformed from one state to another. In lost of energy transfer for heating, there will usually be a net exchange of heat between them unless or until they are in thermal equilibrium. The rule is commonly known as the Law of Entropy. Such as the function of electric generator starting from thermal energy pressurized steam which is transformed for generating kinetics energy to drive the turbine of electric generator in electricity generation. In brief, the process can change the kinetic energy to electric energy with every stage of thermal loss. In thermodynamic processes, any

consumption and transformation of energy, even the energy remains constant over time, it becomes thermal energy with low temperature after any forms of energy are transformed. With low quality, transformed energy will spread into the atmosphere and being non-renewable. In this regard, energy crisis is thereby emerged and inextricably linked to energy resource conservation.

1.3.2 Changing pattern of energy utilization

Changing pattern of energy utilization may be resulting from changing of an economic development. Such impulsion forced preindustrial society to urban and industrial manufacture. The community was formed to industrialization emphasized on industrial manufacturing other than self sufficiency purpose. According to David C. McClelland and Everett E. Hagen and Max Weber with their principles based on theory of social transformation. The initial social change originates from economic development resulting changing pattern energy utilization of community and way of life from the ancient time. Most people in the past depended on the natural energy in trial and error. The effect has been accumulated for knowledge and wisdom so as to be invention and discovery of natural energy of which the approach is resorted for daily life and earning a living. Natural energy in the past is mentioned to solar energy, water, wind and biomass including energy from human and animal power. Moreover, the ancient way of life was often referred to simply living with self sufficiency way of life, generousness. Then discovery of new energy, fossil energy, is substituted of natural energy. The substitution begets invention of technology for energy development in terms of scientific and modern technology practice for human comfort, rapid system and modernity e.g. electric appliances, vehicles, farm machines etc. Therefore, way of life and earning of living are more complicated. Human must learn and adapt their behavior for modern energy pattern in replace of conventional energy pattern. The practice session of energy adaptation has been led to commercial competition causing community disharmony. Adversely, people concerned their personal interests rather than public interests.

1.3.3 Adaptation of energy utilization pattern

Human have learnt energy utilization in support of devices and materials found in the neighboring area of their community with adaptation of work. For example applying biomass i.e. wood, scraps of wood, dry leaves or torch as fuel of cooking, light and warmth; using stones for three-stone stoves for igniting; using sunlight for food preservation and clothes drying; applying human labor for cultivation etc. The precedent activities are series of conventional energy utilization. Human living was mainly depended on nature. People's way of life in the past had pursued living with careful use of energy and environmental concern other than the people in the present time. Such as establishing of "*San Phieng Ta*"(temporary joss house) to protect the forest in order to prohibit anyone to cut wood as the action might offend the spirits in the forest. In cutting wood, the ceremony would be raised for permission etc. The admirable performing is to adapt themselves to sustain of their life and nature together with natural resources conservation to the next generations.

Discovery of fossil energy provides the change on primary pattern of energy consumption as previously mentioned. Certainly the adaptation is in parallel with a variety of changes. Adaptation refers to adapting with knowledge body and behavior of use of fossil energy towards modern technology of new energy pattern. While adapting with environment is presumably less. In the other words, human being is more selfish in natural resources exploitation so as to provide conform to themselves but ignoring resources conservation or augmentation and substitution as ever been in the past. Intensively adhering of any energy is risk of energy fluctuation; no matter what electricity, fuel oil and LPG for cooking. Otherwise, unknowing effect of misuse of energy would cause tremendous upheaval beyond resolving. As seen from deterioration of environment, energy source depletion, increasing oil price, global warming problem. These are a part of adaptation from misuse of energy which is closely related to the world's climate variation. The great problems affecting human's way of life would lead people to strive for problem tackling. They have to find out the solution by adapting of energy use, specifically depending on alternative energy which is environmentally friendly, domestically acquired to independent to external energy; electricity saving by turning the devices off when out of use etc. The practice is in accordance with theory of a variation of living adaptation for survival in

the changing environment in several patterns. The diversity of changing is relatively occurred according to severe intensity or cruelty of natural hazards in each area.(Manus, 2530)

1.3.4 Succession of energy pattern

Generally, theory of succession is focused on biological succession which may be initiated by a living form with another living form. In the research, the succession is specifically referred succession of energy of which the pattern may be initiated by conventional energy with new energy led to adaptation of changing of energy utilization. The setting would constitute convenience of development in several aspects and survival of actual society changing from self-sufficient agriculture to economic competition with domestic and international trading system. Conventional energy utilization is completely substituted with technology of modern energy. For example human labor is previously applied for cultivation, no matter what plot preparation till harvesting. But in the present time, farm machines and labor-saving devices using fossil fuel are replaced of living labors. For daily life activities needed the light and cooking food, people in the ancient time applied wood and torch for fuel. While the people in the present time use electricity and LPG fuel as well as electric appliances to provide convenience in their daily life for succession e.g. electric fan, washing machine, refrigerator etc. In addition, another technologies are invented to ease convenience of a variety of communication ways. All are based on consumption of non-renewable energy.

Such energy dependency for mainstream overdevelopment results serious depletion of energy sources. Thereby, the energy is in shortage and has been affecting the global environment. Alternative energy is currently produced from conventional energy i.e. wind, solar energy, water and biomass, beings its retaking crucial role and partial succession of fossil energy at micro and macro level; such as electricity generation from biomass, solar energy, fuel production from energy crop etc. Development of energy pattern would be sustainable depending on appropriate management and cooperative of the stake holders.

Even though human could adapt themselves to social changes. While materials have been developing incessantly, in succession of conventional life pattern,

with searching for what could be replaced by and what make daily life and earning for life much more convenient. The augmented requirement is relatively increasing judging by unaware development with extravagant consumption of natural resources. The neglect of natural conservation and its challenging succession form generations to generations is now on the wane for key natural resources abatement. To step on modernization, even deterioration and abatement of natural resources, in particular what are non-renewable energy such as energy alike the supply transformed by machine in accordance of demand. Insufficiency results enormous problems. The philosophy of sufficiency economy is a vital guideline to support development in parallel with sustainable natural resources consumption in the world of globalization.

1.3.5 Summary of Related Concepts and Principles of Energy

The investigation of related concepts and principles of energy in terms of changing, adaptation and succession is the guideline for studying the energy situations in community from the past till present. The incidents are applied to analyze and describe the beginning, background and causes of unbalancing energy utilization of the community reflecting from household expenditures. The activities lead for providing internal energy of the community and being a guideline of energy management to be independent to external energy sources at community level to national level. The threshold is operated according to Law of Energy Conservation in support of local wisdom for innovation or energy technology by any institutes to transform an energy form into the other energy form useful for earning for life and subsistence; for example electric generation from wind energy and water energy. The process includes local wisdom in energy conservation as the energy has never been lost i.e. conservation of used charcoal in a jar and reuse it the next time.

1.4 Related Concepts and Principles of Self-Reliance

1.4.1 Philosophy of Sufficiency Economy

The philosophy of sufficiency economy is the principle of balanced way of life for living and practicing of people at all levels from the family to the community

and to the country. The theory is also applied for national development and administration in moderate practice, especially in pursuing economic development in keeping with the world of globalization. Self-Sufficiency refers to moderation, reasonableness and the need of properly self-immunity system for protection from impact arising from internal and external changes. In addition, a way of life based on omniscient knowledge, prudence and caution is indispensable to integrate academic matters form planning and implementing at every steps. Meanwhile, the approach is to build up the spiritual foundation of all people in the nation, especially state officials, scholars, and business people at all levels, so they are conscious of moral integrity and honesty and they strive for the appropriate wisdom to live life with possessing a good conscience, honesty, being appropriately omniscient, pursuing a decent life with forbearance, perseverance, diligence, wisdom. In this way, the concept enables to maintain balance and be ready to cope with rapid physical, social, environmental, and cultural changes from the outside world."(Somphorn, B.E. 2549) According to Witthaya Suharuedamrong, It may be said that philosophy of self economy could be applied with every problem such as natural resources, financial issue, and way of life; no matter what levels.(B.E.2550.[online]) In other words, the philosophy is likely neither for the principle for resources management in neighboring household or land subsistence, nor the farmers but for populace at all levels and everyone in the world. With simply principle, the practice would be contrarily performed with difficulties. Therefore, whoever applying the philosophy to cope up with problem tackling must be the person or group of persons possessing the mentioned characteristics.

Implementing the philosophy of sufficiency economy to solve the problem of independency of external energy is very suitable. The practice substantially involves in energy resource management to increase energy efficiency, development of energy equilibrium in parallel with environment conservation and participatory civil society sector. These are the key objectives of Ministry of Energy in finding solutions of energy problems in support of philosophy of sufficiency economy emphasizing on the community. For the reason that country development basis is founded on following 3 principles and 2 conditions.(Thosaphan, B.E. 2551. [online]).

1. Moderation Principle To encourage Thai society for energy consumption in worthy, moderate and self-sufficient to own demand manner. The

practice provides optimum benefit to the community likely the energy demand management or with Demand-Side Management (DSM) of their own or with community

2. Reasonableness Principle To enhance primary energy supply from internal source of the country or internal village prior to consideration of alternate sources in the future based upon middle way, rejecting extreme perspectives, not too strain for each side or the other side.

3. Reinforce of Self-immunity Principle To be self-reliant with encouraging new developments from villagers' local wisdom including appropriately technological development towards environmental conditions of the country sufficient.(This principle is for protection from impact arising from internal and external changes.)

Knowledge Finding –Based Condition To search for new knowledge to study feasibility of new energy sources acquiring for adaptation of Thai way of life and continuous development of energy.

Virtue-Based Condition To proceed all steps of energy aspects with the manner of honesty by taking optimum benefit of Thai citizen into account upon implementing.

1.4.2 The New Theory

The new theory is a substantially practical guideline of the philosophy of sufficiency economy of which its ideological framework is even a wide indicator for pursuing the concept. For implementing the process, people must commence from household resource management which later expand to the community in order to strengthen the community for maintaining unity and developing in learning self-reliance based process that stems from a stable foundation. The practice involves efficiently and carefully sustainable management of local natural resource and environment as much as possible. According to the theory, with stable foundation of subsistence production on self-sufficiency, the land is divided into four parts with a ratio of 30:30:30:10 : Based on this ratio, the land is set aside for pond 3 rai with 4 m. of depth(about 30% of the area), for rice cultivation 4 rai(about 30% of the area), for growing perennial trees and fruits as well as vegetables 5 rai(about 30% of the area),

and the remaining for housing, raising animals and other activities 2 rai(about 10% of the area) (Principles and Approach of Sufficiency Economy [online].) Each part is required energy for managerial process. But the main principles are based on sufficiency, frugal basis and know how to take energy materials from the community to produce energy at their own emphasizing on at own power for common activities. The cooperative to strengthen the unity of household member and community. For instance, using scraps of wood from pruning fruit or perennial trees for wood fuel or firewood; or own power for plot preparation, cultivation, plot conservation and harvesting etc. In this regards, some fuel patterns beyond their production are external energy, such as fuel oil of vehicles for transportation or some kind of machines.

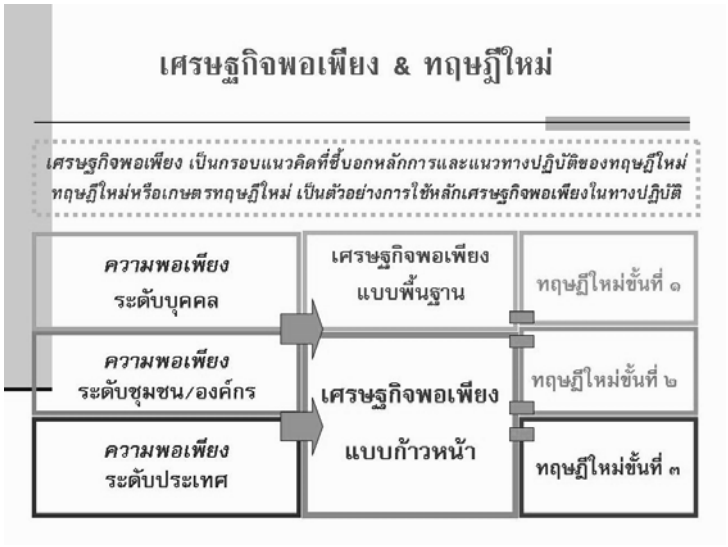


Figure 2-4 : Relativity between Sufficiency Economy and the New Theory
Reference : Sufficiency Economy and the New Theory Initiated under the Initiation of His Majesty the King

1.4.3 Concept of Self-reliance

1.4.3.1 Background of self-reliance

The self-reliance used to be a key feature of Thai society and culture. In the past, the economy of Thai society was in a sufficient provision or self-reliant economy. The village was relatively independent of state control. And, the past self reliance was included the self-reliance of the individual, the people in the village

and the activities of the village. Thus, the self-reliance formerly meant the self- reliant ability of people under the village provision.

The ancient people could be self-reliant because the raw-materials of essential consumer goods used in daily life were available locally. They were the production factor, didn't primarily focus on trade including the influence of marketing didn't expand into many villages. In addition, the cultural traditions, contributing the collaboration in the village, the abundance of resources needed for subsistence production and the self-reliant concept of the ancient people in the village could maintain self-reliant communities and cultures through the decades as well as accumulate and transfer of skills to further produce those things in their village, community or network. These could also inherit the ideology of this self-reliant manner.

Therefore, the concept of self-reliance has been coupled with Thai people for a long time. Upon the Industrial Revolution, the lives of Thai people have been changed together with the technology, economy, society, psychology and resources, leading to the inability of self-reliance of Thai people. Through four decades of development to modernization and bubble economic crisis in Mid 1997, the concept of self-reliance has recurred by the Royal Initiative of His Majesty the King about the Philosophy of Sufficiency Economic which focused on the principle of important self-reliance in order to be a secure foundation for further development. His Majesty the King focused on the development to strengthen the village in terms of self-reliance and applied the word of "explosion from within" to outside, meaning not move the development or people from the outside into the village. And he has defined the meaning of "self-reliance that "To produce enough things, don't buy another and be self-reliance. Some translations in western languages that "To stand on own legs", which is strange for someone who thinks whether anyone may stand on our leg or another leg may stand on our own. We may be angry. The ones standing on their own leg are not steady and must fall or fall down. This is a thought that might be a little fertility. But, as he called 'stand on its own legs (which means self-reliance), this means the ability of two legs that can steadily stand on the ground by our own legs not by others". (The King Royal Discourse as of the King's Birthday, 5 December B.E. 2541).

1.4.3.2 Definition and Concept of self-reliance

The definition and concept of self-reliance are concluded as follows.Kanjana Kaewthep (B.E. 2530) has classified a self-reliant model into 2 groups, including by individual and by collective. Upon the individual model, self-reliance means all activities that executed by individual and by household to achieve the living security. For the collective model, the self-reliance means the group or society that organized for members to meet their self – fulfillment by themselves associated to collaborating with others in similar situations. Hence, the truly self-reliant people should have the freedom to set goals and operation to achieve their efforts and capacity. The level of self-reliance has been illustrated in the below chart.

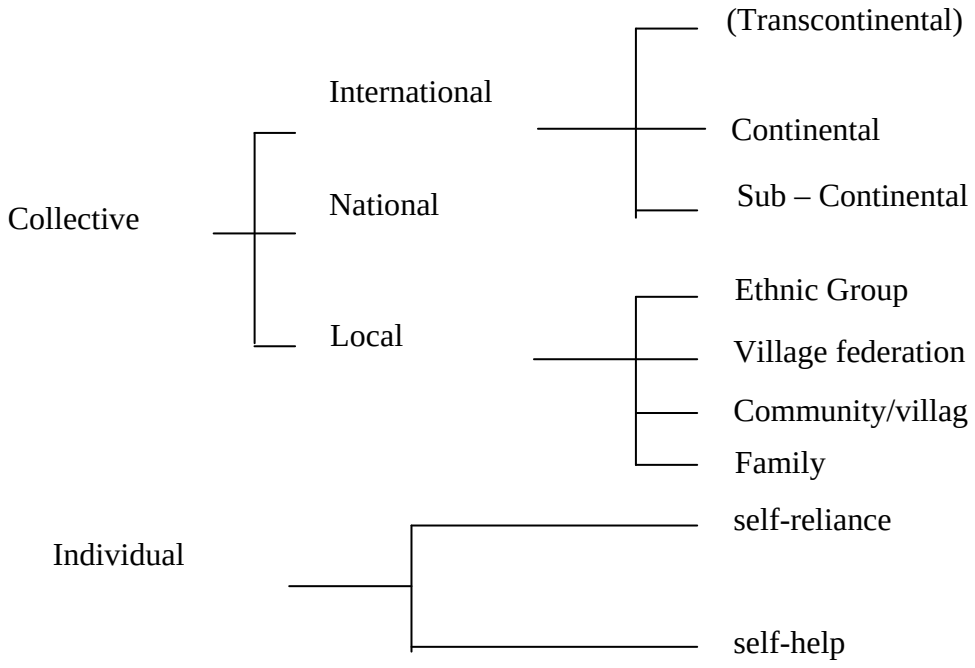


Chart 2-1 : Level of Self-Reliance

Sanya (B.E. 2539) said that the village self-reliance will be comprised of 5 parts. First, the Natural Resources Self Reliance indicates that the village can take advantage and preserve of natural resources. Unless there are resources, the village cannot be independent. Second, the Economic Self Reliance is the ability of village to survive in the economic life. The villagers can earn their living and have sufficient income to buy the basic necessity for their living. Third, the Technological Self Reliance is the ability of the village to earn living effectively. There are technology tools for manufacturing products and services including

communication with outside. Next, the Psychological Self Reliance is a village with mental strength people. This ensures that they can be self-reliance, can struggle to obstacles, and can earn a living and progressively improve their lives. Last, the Social-cultural Self Reliance is the ability of village to closely unite together under social-cultural factors, education, communication, mutual broad-mindedness and strong leadership.

Direk Ruekrai (B.E. 2535) said that the self-reliance of people in rural development was important and acceptable. Before being self-reliance, both government and village sector must accompany with each other to support the people, who ensure that they can initially help themselves.

Praves Wasee (B.E.) viewed that self-reliance is the strength, which must be basically built from Thai culture. Hence, the culture is exclusively the ways of life whether belief, value system, occupation, eating, living, dressing, customs and traditions, arts or trouble shooting. The health treatment or medical folk also require the holistic knowledge to build the strength. In addition, there is simultaneously linkage between the economy, mind, society, culture, environment and politics.

Sangsit Piriyarungsan (B.E. 2541) focused on the village economic self-reliance approach. The two-way economic philosophy during crisis analyzed the global economic theory, which dominated Thai socio-economy for a long time. This approach mentioned to the new liberalism that focused on trade, investment and free services among countries. It also focused on the importance of "money" or "capital" but ignored all about each "person". The other approach is the individual economic self-reliance. It said that under current economic crisis, there is only the individual economic self-reliance that can secure the farmers production and living. By this approach, the farmers will not only have "enough living and eating" in the early stager but also have "good living and being" in the next phase.

From the conclusions at the Seminar regarding "The Direction of Social Development Master Plan for Self-Reliance and Role of Private Sector development "organized by the study of alternative development. The Social Research Institute, Chulalongkorn University, during the 27-28 December B.E. 2538, defined the meaning of self-reliance in terms of a power of decision. That is, it is the ability of

self-thought, perspective in viewing issues and making decisions, which is the wisdom process of its village.

The self-reliance is a relative approach of an independence without Dependence or Dependency. The relative self-reliance is to be independent while dependent on others; therefore, it is not lead to the dependence on social development. The self-reliance reflects the awareness of the people potential against the dominated system, to pursuit of new alternative confinement including simple life satisfaction and pride of good cultural traditions. The truly self-reliance is the equitable dependence of each other and peace, the promotion of the value and the dignity of the perfect human.

Therefore, the self-reliance, which is not absolute, means not only the self-reliance upon the dependence on others but also Interdependence rather than dependence. The self-reliance is composed of the following components.

1. Self-determination : People have self-conception and self-determination.

2. Everyone has potential and can apply its advantage to himself and village.

3. People can participate in activities.

4. It thought that that "Everyone is valuable and prestigious of human beings. (Chomsamon Leuakosol, B.E. 2531 referred to Priroj, B.E. 2545) Journal of Development Administration, National Institute of Development Administration (NIDA), Year 42 vol. 3/2002).

Bunch (1995) said that the state of the building and the existence of Dependency is caused by give-away matter and the creation of things is took from doing give-away things. When the villagers boost both development, they will be more comfortable and easier. This demonstrates their inability in development themselves, insufficiency and inability in trouble awareness and shooting.

Rahman (1993) discussed in the context of Jointed Natural Resources Self Reliance. He indicated that the mental status is the honor of themselves and resources are the primary sources of production. Those resources are then used in any purposes to meet not only the goals and objectives but also meet their initially uses of resources.

From the abovementioned definitions and concepts of self-reliance can be summarized that the self-reliance is any activity or action of collective or individual having the goal of sufficient living and earning under the internal factors and external factors. The internal factors are the village potential on the availability of natural resources, economy, technology and psychology resulting in the self-reliance. Coupled herewith are the external factors such as the public and private support in providing knowledge to village, capital and technology and suggestion. However, the external factors shouldn't be interfered by any process until the village has more dependent on outside. The village itself must have internal immunity from the impact of external party. That is, the village must analyze its village situation and the changeable external situation to adjust the process or fix the problem under the changes in the situation. Thus, both factors should proceed in equilibrium.

The Idea or concept of self-reliance is currently more practical. As a key strategy in developing countries especially the third world, these countries should fully take advantage from their existing resources such as people, natural resources and capital. Even if the goal is based on the destination from individual potential. self-fulfillment, self-trouble shooting and self-improvement of the available resources, this is to explore the benefits and reduce the external dependency. (Pranee, B.E.2534).

1.4.4 Concept of Self-Reliant Model

The Self-reliance of village has been pursued for a long time as aforesaid discussion. If we want to sustain the self-reliance and strengthen the village, it is necessary to set up the self-reliance model to be a prototype and practical approach. Thailand Institute of Scientific and Technological Research (B.E.2538) said that there are 5 key elements of the rural self-reliance containing Technology Economic, Resource, Mind and Society or calling in short as TERMS MODEL.

1. The technology including basic equipment and tool of the village is appropriated to the rural conditions. It is also modern but able to control as well as research and develop within the country.

2. The Economic of rural village is able to build its village. The economic system has continuously developed the demand-supply capacity for

effective external competition. Then, the saving ability and investment are able to cooperate for manufacturing and marketing as well as planning for the future.

3. The Resource of the rural village should be abundant or taken in balance to the ecosystem and renewable.

4. The Mind of people in the village should be the self-reliance-minded, knowledge-minded and improvement-minded. People also have knowledge, ability in application, quality, vices controlled and perseverance.

5. The Society of the rural village should have good leadership, highly social contribution, strong social organization as well as updated knowledge and information to trick the external globe.

These 5 elements are correlated with each other. However, each element has its individual function, some functions would evenly affect other elements and lead to a stronger village and truly self-reliant village such as the “Saja Ormsab Group” (Saving Cooperatives). This saving is invested in the village for earning their lives, having income and bargaining power in trade. It would then affect the technology selected to support the self-reliance, respectively. If any element is missing, the others cannot be considered into the truly self-reliance.

Table 2-1 Show the aspect of the rural self-reliance

Aspect	Inside Self-Reliance	Outside Development
Technology	Local Technology	Advance Technology
Economy	Occupation	Trade
Resources	Natural Co-existence	Natural Application
Mind	Mental Virtue	Mental Development
Society	Tradition oriented	Modernization

Source : Thailand Institute of Scientific and Technological Research (TISTR), B.E. 2538

Chatthip Nartsupa (1986) has proposed 6 conditions for self-reliance as follows:

1. Collective development. The villagers shall live together as the community and village, but shall not live independently.

2. Mutual aid. The self-reliance depends on the villagers' mind and their willing to do so (development activities).

3. Consciousness. It must be created repeatedly. That means it must be re-created obviously and continuously.

4. Gathering in any types of union. The people must gather in groups in sub-units as villages, and these villages can get together in a union. The union must be developed in a boundary. The boundary should have barns, rice mills, schools, and culture center, and have power to negotiate with the outside institutions such as the merchants and the state. This task should be given precedence so as to create the village network.

5. Culture integration. The villagers should integrate their own culture or activities with that of the other groups in the society.

6. Relation with natural environment. The community should have proper relation with the natural environment, and they should also be the natural environment conserving community.

Wannee Kaemket (2002) has concluded the self-reliance model and development process of the family and community who can rely on themselves in various regions of Thailand. They classified into 2 parts as follows:

1. The self-reliance model and development process of the family with the following 5 key activities.

1.1 Study to understand their own situation. The family being able to rely on themselves is resulted from their learning about themselves, analyzing the situation both inside and outside the family, and planning or changing their occupation or living to be better.

1.2 Earn more income for the family. To earn more income from the increased products or additional careers by using the resources available and with different situational opportunities of the family depends on self-adapting and good planning.

1.3 Reduce the family's expenses. While the cost of living of every family tends to increase with limited income, the solution of each family is to save and try to reduce the expenses, for example to use something that they can produce or repair by themselves, try to benefit from the local intellect, try to change their way of life, reduce or stop the extravagant expenses, try to use the available things worthily and at the maximum benefits, and try to use the raw materials in the production procedure of the family.

1.4 Gather in groups to carry out the activities of saving and additional earning. The saving is the way to accumulate the capital of each family for use in necessary opportunity. In case that the saving takes place in the village, the revolving capital will be available with security. The opportunities are available to give help to the other members with more power to negotiate the production and distribution of the products. Apart from the saving, the people could gather for additional earning such as textile weaving, and basketry.

1.5 Learning process. The learning process is greatly important in the self-reliance process including the learning for self-reliance on technology, health, economy, natural environment, mind, culture and society as well as learning the new technology related via the training, study visit, and news or working and living experiences. The learning can be achieved through the mass media, in particular from the television, newspaper, and through the medium such as technicians, village headman, community leader, and through the educational system from the descendant and relatives who have more knowledge and experiences. In addition, learning is achieved on the basis of trial and error.

2. The self-reliance model and development process of the community with the following 9 key activities.

2.1 Problem analysis and self learning. Searching for self-potential is an effort of the community for self-learning to know their condition as well as social capital and the community's problems. Self-learning of the community is from the individual learning of the families in the community one part, and whole community learning the other part, which needs mutual vision to accumulate and enable thinking strength that they can use to analyze the problems or to follow the idea to solve the problems and various obstacles.

2.2 Vision and village development strategy. The village with self analysis can foresee the future stepping forward to dangerous condition, so they can join hands to build up new future imagination as the visional change target which can bring the society back to the track laid down. However, the vision which is the community goal will be possible depending on the other factors, for example, capital administration, human development, co-consciousness of the people in the village or the community, etc. The end goal must be apparent and adjustable when the time is changed.

2.3 Seeking the source of funds for capital development means the seeking of monetary funds which are important for self-reliance, and show the security for the way of life and the earning of living of the community. The accumulated monetary funds are to give help as the loans to the community members for their status improvement, which include the establishment of voluntary saving groups in different forms, for example the "*Sajja Ormsab*" Group(Saving Cooperatives) , village funds, fertilizer group, and occupational group, etc. The raising of these funds in the community aims to develop the personnel in the community to be those who are of good quality, moral excellence, responsibility, managerial capability, keen of keeping their own rights and working collectively.

2.4 Human development based on the grouping procedure. The self-reliance community will reflect the unity of occupational grouping. But if the aims for self-development of the community are analyzed, it will be found that the community's grouping is not regarded as the development destination to measure the development level from the number of the occupational groups. But the grouping is used as a tool to develop the community members to be further of good quality.

2.5 Occupational group establishment and its development approach. The self-reliance by creating additional occupations and gathering into groups is to be able to stably develop their occupations, and to have negotiation power and opportunities to request supports from various sources of funds both inside and outside the community. This will result in many occupational groups in each village. Some villages face the problems of group establishment which may be caused by a wide variety of villagers' occupations. As a result, the grouping is difficult because of rather different culture, seasons, and timing, especially the village having high

proportion of civil servants and merchants. The reasons may be that the merchants work everyday whereas the civil servants are self-reliant with secure occupation, and they can rely on the government service system. Then, this may cause them to feel that building up the occupational security is not so necessary. The other reason is that the people with different points of view will be gathered into the same convention of rules. And there are many people wanting the grouping benefits but not wanting to jointly operate the group's activities.

2.6 Learning procedure of the community. The learning may comprise the knowledge of the way of life, earning a living, outside world, technology, and many other areas. The learning process or learning procedure is the accumulated experiences derived from living and earning a living, learning of both inside and outside the system such as the trial and error, educational learning by the descendants, learning from the other persons' more experiences, learning from the different types of mass media, and combining the knowledge they have learned with their original intellect, linking it with their problems, seeing through their own trick, and applying it appropriately.

2.7 Village administration systematization. The village systematization and organization are a kind of organizational arrangement which is likely to enable the systematic and efficient development of the village. That is, the system construction would rather be a method for more sustainable development. The management may encompass the system of public relations, covering both inside and outside the village because it is an important mechanism for making communication available for each other understanding on the ideas, policies, and practices of different matters in the self-reliant village.

2.8 Consciousness for self-reliance. Most of self-reliant villages motivate the village/community members to raise their consciousness for community self-reliance development. This process is of vital importance as it will be the crucial force to drive the people to try seeking the proper ways and participate in the activities to show their sacrifice and their attempt to further develop themselves and the community. In consciousness development, some villages apply the cultural idea as the driving force while some villages let the problems they are currently facing

to stimulate the members to see the problems and raise their consciousness to prevent the problems to be followed.

2.9 Request for supports from the outside. The community development needs not only the community force but also the support from the outside for successful achievement. The supports from the outside include the co-working of both public and private sectors. The villagers have to take part in the starting process or to supply additional resources which may be physical and ideological strength, capital power, and equipment & materials. The supports from the outside agencies may be ideological assistance, knowledge and understanding construction methods or consciousness stimulation for self-reliant potential development. The other types of supports include financial support, budgetary arrangement, fund raising or loan raising, etc.

1.4.5 Conclusion on the ideas and principles related to self-reliance

Self-reliance model which is the way and prototype of self-reliance for the community who tries or has ideas to develop the quality of their life needs the components of technology, economy, resources, society, mental, and factors both inside and outside the community to find out their self-reliance model on any components. Importantly, the proper way and proper model of self-reliance must be based on the community, depending on their social problem situation, intentional mind for self-reliance of the community, proper resources for the development, technology and knowledge. The self-reliance model will be flexible due to the dynamic change occurring in the community which requires the seeing through the trick, and the ability to adjust the self-reliance to the situation for its sustainability. This research is to find out the energy self-reliance model, the concept idea of which includes the principles of sufficiency economy and new agricultural theory, and the idea of self-reliance and self-reliance model. It is also in conformity with the Energy Village Project of the Ministry of Energy, which wants to present the way for energy self-reliance of the village where the available renewable energy available is taken for use as the alternative energy as much as possible.

1.5 Roles of local administrative organizations for energy

The government has the policy to decentralize the service authority to the local areas for the development throughout the local level with the administration medium so as to be in compliance with the local development policy, which is the local administrative organizations, according to Section 78 (3), in the division of the Government Policy legislating that the government shall decentralize the authority to the local administrative organizations for their self-reliance and decisions made to the local activities. The local administrative organizations are promoted to take part in the implementation according to the basic government policy, to develop local economy and public utility system, as well as the basic infrastructure throughout the local areas and equally nationwide, and to develop the readiness provinces to be the large-scaled local administrative organizations by taking into consideration the intention of the people in the provinces. The stated legislation shows that the local administrative organizations will play the important roles in the daily life of the local people in the future in all areas of socio-economy, society, public health, education, culture, and environmental management (Dirok and Kobkul, 2009). The government shall give them the independence for administration under necessary and proper supervision for the sake of people's benefits.

In addition to the local development policy that the government decentralizes the authority to the local administrative organizations for the development of economy, society and culture, and environmental management, the other important policy is the energy policy in the community level which involves directly and indirectly the living of the local people. The energy policy is also the basis for the development of all areas to build up the prototype focusing on the original culture and living basis of the villagers as the main principle for energy management for self-reliance in the village. It is also applied with the philosophy of sufficiency economy (Ministry of Energy). The subdistrict administrative organization is the local government agency with the duty to coordinate and promote the knowledge on energy conservation and alternative energy, support the alternative energy technology, promote the energy network in the local area, and make the energy plan together with the community for the the sake of their energy self-reliance.

Part 2 : General information on alternative energy and biomass energy

2.1 Alternative Energy

2.2.1 Definition of alternative energy

The alternative energy is interestingly defined as follows:

Malee Banchuen (B.E.2525) defined the alternative energy as the energy derived from the sources inside and outside the country for consumption in replacement of the fuel oil which is imported from the foreign countries so as to avoid the energy shortage and high-priced energy. The various kinds of alternative energy include natural gas, Liquefied Petroleum Gas (LPG), coal, lignite, alcohol, oil shale, water energy, solar energy, wind energy, geothermal energy, biogas energy, and nuclear energy, etc.

Siri Hamsupo (B.E. 2536) stated that the alternative energy is the energy derived from the process in which the human exercises their scientific knowledge and technology to study, develop, and apply the methodology and equipment to process more conveniently the more useful energy for the longest period of consumption and in replacement of the energy limitedly available.

The Ministry of Energy stated that the alternative energy is the energy which can be utilized in replacement of the fuel oil.

From the above definitions, the researcher agrees that the alternative energy is developed on the scientific and technological basis to replace the fossil fuel which is the non-renewable resources.

2.2.2 Types of alternative energy

The energy utilized in replacement of the fuel oil can be categorized, according to its original sources, into 2 types comprising the alternative energy from non-renewable sources or called consumable energy, for example, coal, natural gas, nuclear, oil shale, and oil sand, etc., and the alternative energy from renewable sources

or called renewable energy, for example, solar, wind, biomass, water, and hydrogen, etc.

The alternative energy is a way to solve the current problems of energy consumption. It is the clean energy and could be supplied within the community. The production of some kinds of alternative energy requires the expertise, efficient technology, and high capital. Some kinds of alternative energy could also be efficiently produced with the people's local wisdom. According to the energy conservation plan and goal during the period of B.E.2550-2554 which was approved by the National Energy Policy Council (NEPC) in the meeting held on 28th September B.E.2550 and 16th November B.E.2550, it is expected that the consumption of renewable energy and alternative energy such as solar, wind, water, biomass, bio-energy (excluding NGV) will replace the consumption of commercial energy increasingly from 3,274 thousand tons equivalent to the crude oil, to 6,688 thousand tons equivalent to the crude oil, or from 5.1% to 9.2% of the energy demand as of B.E.2554 (Bangkok Business, B.E.2550). Due to the global and national energy crisis, the alternative energy will play a vital role. This research will mention the alternative energy which could be recycled by focusing on the biomass energy because it is available abundantly in the local area, the important base for alternative energy production of the country.

2.2 Renewable Energy

The renewable energy is not consumable but could be recycled. It is derived from the energy sources available in the nature, for example, solar energy, wind energy, geothermal energy, tidal energy, wave energy, etc. These kinds of energy are available in large quantities and can be utilized unlimitedly. Moreover, it includes the biomass energy which could be recycled, for example, various kinds of plants, agricultural residues, and animal dung. The energy which is not consumable and can be recycled is as follows:

2.2.1 Natural Energy

2.2.1.1 Solar Energy

Thailand has a high potential of solar energy because it is located near the equator where the solar energy is regularly available all through the year. From the study of the Department of Energy Development and Promotion, it is found that the average solar energy value in Thailand is approximately 18.2 MJ/m^2-day. And it is also found from the assessment of solar energy potential that Thailand has the potential up to 554,070.60 thousand tons equivalent to the crude oil, approximately 10 times more than the country's demand. The utilization of solar energy with regard to the thermal is approximately 332,442.40 thousand tons equivalent to the crude oil, for example water heater, dryer, and furnace, etc.; the electricity 83,110.60 thousand tons equivalent to the crude oil, for example electricity generator and electronic appliance, etc.; and the mechanical energy 74,799.50 thousand tons equivalent to the crude oil, for example air conditioner and water distilling apparatus, etc. But it is currently found that the solar energy of only 4.40 thousand tons equivalent to the crude oil is utilized in Thailand (Pipat et al, B.E.2552). And from the report on wind energy potential of the Ministry of Energy, it is found that Nakhon Nayok Province receives the solar radiation averagely 18.48 MJ/m^2-day per year, and Banna District 18.55 MJ/m^2-day averagely all through the year (Ministry of Energy (n.d.)) with the solar energy potential of up to 20,913.39 thousand tons equivalent to the crude oil. But the development of solar energy into different kinds of energy requires high capital and good technological knowledge.

2.2.1.2 Water Energy

The water energy is the energy derived from the nature and utilized for electricity generation by constructing dams to rise high water level on the basis of moving from high to low. In Thailand, there are many water energy sources where dams can be constructed for electricity generation because of the country's geographical condition that there are the mountain ranges in the northern and western regions originating the sources of many rivers running into the Gulf of Thailand, for example, Ping, Nan, Yom, Pai, Kwai Yai, Kwai Noi, and Mae Klong. The rivers in the north eastern region include Mun and Chi, and in the southern region are Pattanee, Langsuan and Saiburi River etc.

The water energy potential in Thailand is approximately 1,540.70 thousand tons equivalent to the crude oil. But the utilization of water energy will cause the problems of environmental damages, and the country people resist the large-sized water energy technology. In Thailand, totally 6,040 GW of water energy or 1,338 thousand tons equivalent to the crude oil is currently utilized, but Nakhon Nayok Province has the water energy potential of only 0.01 thousand tons equivalent to the crude oil (Pipat et al, 2009).

2.2.1.3 Wind Energy

The wind energy has been utilized in Thailand for a long time, mostly for agriculture such as wind turbine for pumping (reciprocating type or water wheel type) to draw the water into the paddy field or for salt farming. The wind energy potential in Thailand is relatively low, especially in comparison with the European Union countries where the wind energy potential is high, and the wind turbine can be installed at megawatt level. The wind energy in Thailand is mostly classified into Class 1, and that higher than Class 1 is available only in some areas of the country, mostly in the southern region such as the Gulf of Thailand's coastal plains in Nakhon Srithammarat Province and Songkhla Province with about 140 kilometers along the coastline and average wind velocity of 5m/sec. At 50 meters high, the wind velocity will increase to 6.4 m/sec. upward. The wind velocity utilized for electricity generation usually starts at 4m/sec., but will reach the breakeven point at 7m/sec. It is found from the assessment that Thailand has the potential for wind turbine installation to generate the electricity up to 1,600 MW. But at present, the installed capacity is only 0.55 MW (Pipat et al, B.E.2552). Nakhon Nayok Province has the wind energy of Class 1 (Department of Energy Development and Promotion (n.d.)).

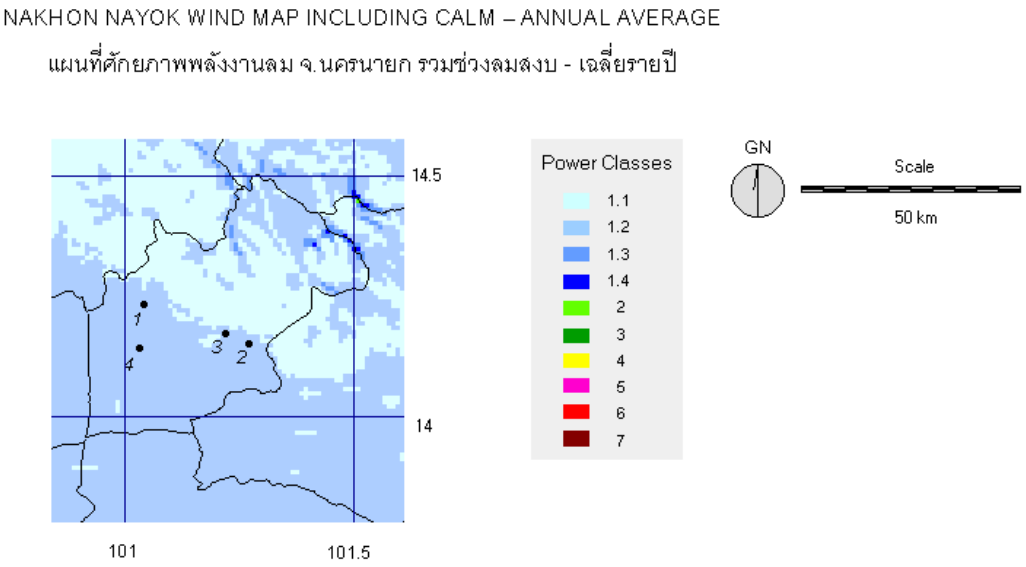


Figure 2-5 : Wind Energy Potential in Nakhon Nayok Province

Source : Department of Energy Development and Promotion (n.d.)

Table 2-2 : Wind Energy Potential in each district of Nakhon Nayok Province

No. / District	LONG	LAT	CLASS
1. Ban Na District	101.04	14.23	1.2
2. Pak Phli District	101.27	14.15	1.2
3. Muang Nakhon Nayok District	101.22	14.17	1.2
4.Ongkha Rak District	101.03	14.14	1.2

Source : Department of Energy Development and Promotion

2.2.1.4 Energy from human and animal power

In the old days, the human utilized the natural energy for earning a living and working. When we stepped forward to the agricultural society, the human and animal labour became the most important power of food production process for a living and transport. But after the industrial revolution, the agricultural society for a sufficiency living was changed to the capitalism concentrating on economic development. The capitalism has started in B.E.2504 (Worapon, B.E. 2548), when the various types of fossil fuel, for example, coal, crude oil, natural gas,

oil shale, and oil sand etc. were technologically processed to facilitate the human to utilize the energy, for example, vehicle, agricultural machinery, LPG, and electric appliance, etc. Then, it results in the change of a living mainly based on the human and animal labour to the living with convenience and rapidity, and finally brings about the era of energy crisis.

The solution to the energy crisis by applying the sufficiency economy philosophy to manage the energy in the community is to bring back the living based on the human and animal labour, together with the local wisdom and local resource utilization for the self-reliance such as integrated farming or new agricultural theory which systemizes the agricultural activity by utilizing appropriately the resources available in the field such as soil and water for the maximum benefits with continual environmental balance, and increased fertility of natural resources. The focus is made on using the human labour, decreasing the jobless problem, saving the energy for the agricultural machinery, and increasing the energy efficiency. The animal dung can also be utilized to produce the energy and fertilizer (Mixed Farming and Economy, B.E. 2552), which is regarded as another sample of sufficiency economy practice.

2.2.2 Biomass Energy

Biomass energy is the energy accumulated in the living organism which can be utilized, such as trees, branches, or agricultural or industrial residues like chaff, straw, bagasse, saw dust, wood residues, bark, animal dung, as well as household waste or garbage. The human has utilized the biomass energy for a long time. Until the present time, they keep utilizing it at a certain proportion, especially in the developing countries as our country. The Thai people in rural areas still utilize the firewood or charcoal as the energy for cooking. The biomass is the organic substance derived from plants and animals such as wood residues, garbage, and agricultural residues, which is the major source of energy available in the country, particularly in Thailand as the agricultural country producing a large quantity of agricultural products, for example, chaff, straw, bagasse, palm waste and shell, and cassava rootstock, etc. The biomass can be burnt to get the thermal power for use in the electricity generating process.

2.2.2.1 Biomass energy utilization

The biomass energy is derived from many sources such as wood residues, straw, seeds, and various wastes. Some kinds of biomass are easily decomposed whereas the other kinds are decomposed with difficultly, and can be kept for long. Therefore, the utilization of biomass energy sources is varied with the following related processes.

1. Direct combustion or co-firing, for example, wood residues and leaves which may be used as the co-firing for the power plants generating the electricity from coal. The energy is mostly from coal combustion (85-99%), and the rest from biomass combustion.

2. Biomass gasification is the process where the biomass is conversed from solid to gas. Then the biomass gas will be delivered further to gas turbine for electricity generation.

3. The physical biomass transformation before the combustion such as selection, grinding, and drying.

4. The improvement of the biomass energy quality by the chemical and thermal processes such as pyrolysis, gasification, and liquefaction.

5. Biogas production process, for example, anaerobic digestion and fermentation, etc.

2.2.2.2 Biomass energy sources in Thailand (Jessada : n.d.)

In Thailand, there are a wide variety of raw materials to be utilized as the biomass energy sources which can be derived from plants and animals, and industrial waste. The biomass energy is available in a very large quantity, and at present, can be utilized in replacement of up to 19% of the energy. However, the biomass energy sources in Thailand are scattered, and if they are to be gathered for efficient utilization, good arrangement is necessarily required.

In general, the alternative energy sources can be classified into 2 sources comprising biological plants and industrial wastewater. But to facilitate the biomass energy study at the community level, the biomass energy sources are divided into the energy crops and agricultural residues as follows:

(1) Energy crops – The biomass energy derived from the energy crops is to take both natural crops and cultivated crops as the energy sources which can be categorized into 2 categories as follows:

1.1 Woody crops – They can be generally found, especially in the forest. The forest helps reduce carbon dioxide in the atmosphere excellently. It is said that during the growing period of a tree, the quantity of carbon dioxide absorbed by that tree from the atmosphere for photosynthesis is nearly the same as or equal to the quantity of carbon dioxide emitted from the burning of that tree. Therefore, to utilize a natural tree as the fuel will not cause any environmental pollution. But the pollution occurred in the atmosphere is caused by the human who utilizes the energy from the other sources, especially from the fossil that emits the poisonous gases to the atmosphere. Those energy sources cannot self eliminate the waste as the trees can do. So, the waste is then emitted and accumulated in the atmosphere.

1.2 Agricultural crops – At present, the agricultural crops, like sugarcane and corn, are cultivated to be widely used as the energy sources.What is of actual global interest is to produce the liquid fuels from these plants. In addition, the other agricultural crops are cultivated to extract the oil from the seeds such as sun flowers, jatropha or beans. And the oil from these plants can also be transformed to biodiesel oil that can be utilized in replacement of the diesel oil derived from the crude oil refinery.

Such the energy sources from agricultural crops are more advantageous that from the woody crops or grove wood because the cultivation is simpler and the land use for cultivation is more flexible because the cultivation and harvest cycle of these agricultural crops are shorter.

(2) Energy Sources from Wastes – After the woody crops or agricultural crops are utilized, the wastes, like wood residues, saw dust, plant cobs or barks, and animal dung obtained from the livestock, are left and can be another type of biomass energy source. The wastes are available from the level of households, communities, and industrial factories, which can be classified into the following types.

2.1 Wood residues are the solid biomass energy sources, a large number of which is derived from the forest industry. Mostly used is the wood, and the leftover including unusable leaves and branches, and saw dust from the wood transformation process can be used as the sources of thermal power and electricity generation.

2.2 Agricultural residues consist of wheat straw, corn, bagasse, and chaff. In each year, the quantity of these residues is altogether of billion tons, and equivalent to approximately 40 m TJ of energy. In the past, the straw would be burnt off since it was still in the field or farm causing the pollution. But over the past ten years, the straw burning in the field is prohibited in the European countries. The straw is then moved to store in the dried areas, and after having been dried, it will be further transported to the electricity generating sources. Since the straw energy density is 15 GJ per ton, and a ton of straw has the volume of 6 cubic meters, its transport and storage expenses are the problems. Then, in order to solve such the problems, the new industry occurs in which the straw is compressed as tightly as paper compression to reach the density of approximately 1 ton/m^3. This can help reduce the expenses and facilitate the utilization of straw as the energy. The bagasse which is derived after pressing the sugarcane in the sugar refinery can be utilized as the fuel to generate the electricity for use in the factories. In case the produced bagasse is plentiful, the amount more than needed can be sold by delivering through the transmission system. At present, the sugar refineries worldwide have the total electricity generating capacity of approximately 50 GW.

2.3 Animal waste – Each day, the animals will pass out the waste, more or less depending on the animal size. Especially, in the animal husbandry farms, a great deal of waste can be sufficiently gathered for use as the energy source. Primarily, the waste may be utilized as the animal manure which is regarded as the return of energy to the nature because the plants can absorb some nutrients for their growth. However, in the animal manure production process, methane will be emitted and affects the environment because methane is a gas causing the greenhouse effect. Currently, many countries worldwide utilize these energy sources to generate commercial electricity, and some power plant may have the electricity generating capacity up to 40-50 MW.

2.4 Municipal waste – or generally called as the community garbage. Left from the human consumption is the garbage consisting mostly of used paper, cullet, metal scraps, and a lot of others. One of these interesting kinds of garbage is the organic garbage degradable with anaerobic digestion, and the output is mostly methane utilized as the energy sources. The other kinds of garbage may be sorted out for recycling, for example, metal garbage or garbage with metal compounds, etc. Moreover, the remaining garbage can also be the fuel source for the combustion, or buried by the landfill method. With this method, after many years long, the landfill gas (LFG) will be produced and utilized as another energy source. Additionally, it can be utilized as the fuel for electricity generation.

2.2.2.3 Biomass energy potential of Thailand

The biomass energy potential of Thailand can be categorized into 5 groups, including agricultural residues, biomass energy from garbage, biogas, biodiesel, and ethanol (Pipat et al, B.E.2550). It is found that Nakhon Nayok Province has biomass energy potential from biogas 3.50 thousand tons equivalent to crude oil.

(1) Agricultural residues

Since Thailand is an agricultural country, waste and biomass residues derived from the agricultural products are highly potential for being energy sources. The potential of biomass energy and the quantity of biomass derived from the agricultural residues produced in the country will be varied depending on the quantity of the agricultural products of the country. The actual potential of Thailand is totally 17,100 thousand tons equivalent to the crude oil. It is mostly derived from the sugarcane peak and leaves equaling 7,360 thousand tons equivalent to the crude oil. The potential of rice straw and bagasse are second respectively to the sugarcane as shown in Table 4.

Table 2-3 : Biomass Energy Potential Classified by Agricultural Raw Material Categories

Kinds of plant	Product (10^6kg)	Residues	Residue quantity	Thermal value (MJ/kg)	Energy (TJ)	Equivalent to oil (MT)	Electric power (WW)
Sugarcane	60,013	Bagasse	3615.00	14.4 52	52,056.04	1.23	764.21
Rice	26,514	Chaff	3,006.42	14.27	42,901.65	1.02	566.83
		Rice straw	8,106.60	10.24	83,011.61	1.97	1,096.78
Palm oil	4,089	Palm cluster	1,022.05	17.86	18,253.88	0.43	241.18
		Fiber	80.55	17.62	1,419.21	0.03	18.75
		Palm shell	7.41	18.46	136.85	0	1.81
		Branch & leaf	10,647.76	9.83	104,667.44	2.48	1,382.91
		Male bunches	952.74	16.33	15,558.20	0.37	205.56
Coconut	1,396	Shell	300.68	16.23	4880.11	0.12	64.48
		Coconut shell	84.43	17.93	1513.83	0.04	20
		Cluster	57.66	15.4	888.03	0.02	11.73
		Leaf	254.11	16	4065.71	0.1	53.72
Cotton	36	Trunk	116.35	14.49	1,685.94	0.04	22.27
Millet	145	Leaf and stem	117.64	19.23	2,262.18	0.05	45.14
Wood residues	10,268	Branch	2,669.68	14.98	39,991.81	0.95	528.39
Total waste			48,293.26				
Total energy					721,935.91	17.1	9,630.18

Source : Department of Alternative Energy Development and Efficiency, B.E.2546

(2) Biomass Energy from Garbage

Thailand has potential for generating totally 95.5 MW of power from the garbage, divided by the following regional potential; the power generating potential in the northern region is 15 MW, the northeastern region 25 MW, the central region and Bangkok Metropolis 47 MW, and the southern region 8.5 MW. But, actually in Thailand, only 4 MW of power is currently generated from the garbage. Since there is the problem of garbage gathering and separating, the total garbage potential cannot be fully utilized.

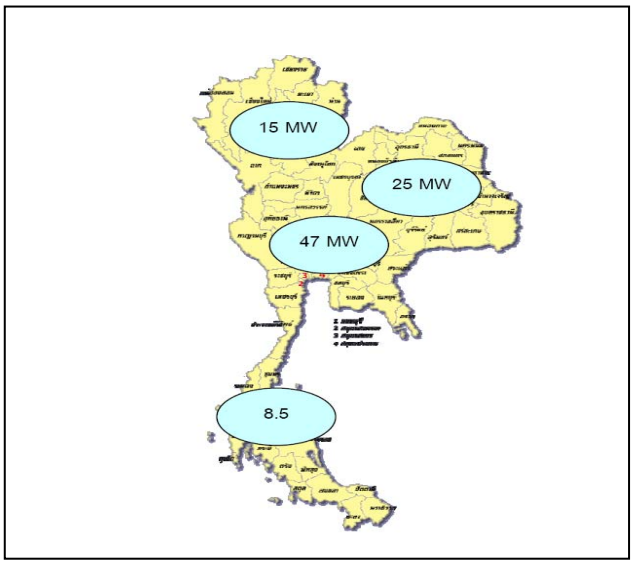


Figure 2-6 : Potential of Power Generation from the Garbage

Source : Papat et al, B.E.2550

(3) Biogas

Biogas is derived from the anaerobic process of organic substance decay. Methane (CH_4) approximately 50-80% is the main component of biogas, and the rest is carbon dioxide (CO_2) with a little bit of H_2S, N_2, H_2. So, it can be utilized as the alternative energy. It is found from the assessment that Thailand has the energy potential approximately 537.90 thousand tons equivalent to the crude oil, but only 47.50 thousand tons equivalent to the crude oil is utilized. At present, the organic substances preferably taken to decomposition process and emitting the biogas is the industrial wastewater with high potential for biogas production. 16 industrial categories, for example, tapioca production factory, palm oil production factory, and

slaughterhouse have potential for producing the biogas of approximately 1.5 million cubic meters/day.

(4) Biodiesel

In Thailand, the potential of raw materials for biodiesel and ethanol production is rather highly dispersed in various regions of the country as shown in the Figure.

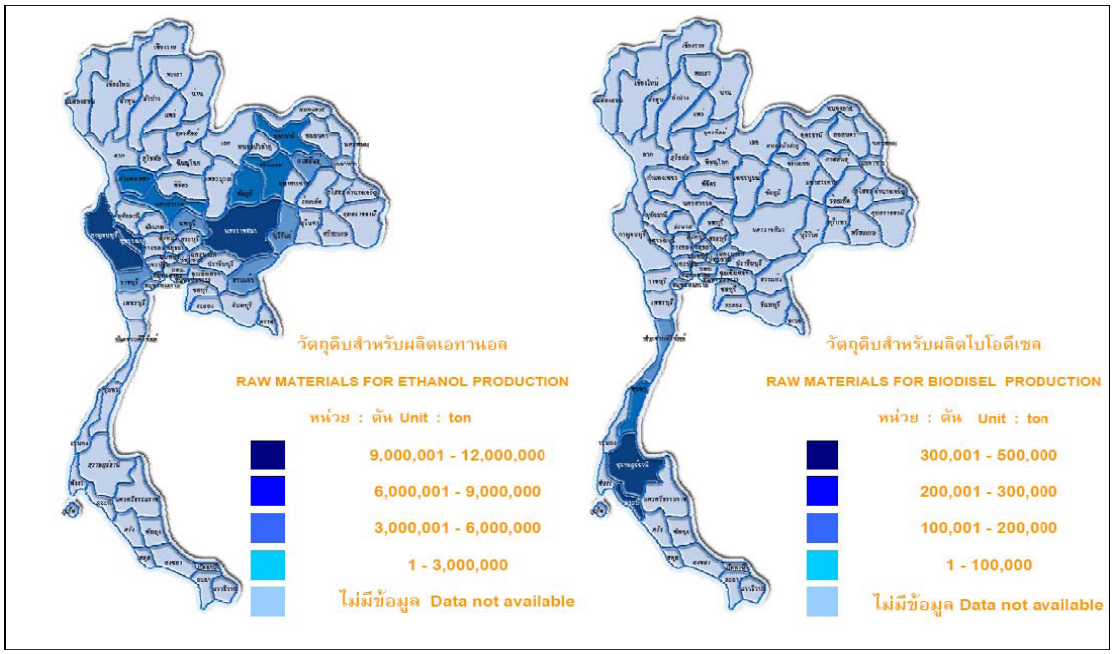


Figure 2-7 : Dispersion of Raw Materials for Biodiesel and Ethanol Production
Source : Pipat et al, B.E.2550

Currently, the standardized biodiesel of approximately 1,040,000 liters per day is produced in Thailand, divided by the production factories as follows:

Table 2-4: Biodiesel Production Capacity

Factory	Installed capacity (liter per day)
Bio-Energy Plus	10,000
Pathum Vegetable Oil	80,000
SUKSOMBOON ENERGY CO.,LTD	50,000
A.I. Energy Co., Ltd.	500,000
Bangkok Renewable Energy Co., Ltd.	200,000
Green Power Corporation	200,000

Source: Department of Alternative Energy Development and Efficiency, B.E.2546

As for the service station, approximately 640 B5 service stations are currently available as of June, B.E.2550 (151 of PTT, 449 of Bangchak, and 40 of Shell). Palm oil is the major raw materials for biodiesel production, and its surplus in B.E.2549 is up to 170,071 tons, and it is expected to increase to 309,000 tons in B.E.2550 (if not exported). Thus, the quantity of palm oil is totally 479,000 tons or equivalent to 500 million liters of produced biodiesel. In June B.E.2550, the quantity of distributed B5 is equal to 44.94 million liters, averagely 1.5 million liters per day, equivalent to biodiesel (B100) of 74,879 liters per day.

(5) Ethanol

The gasohol consumption in Thailand is now approximately 3.5 million liters per day with the total 3,500 service stations. The ethanol is produced averagely 743,000 liters per day. When the factories to be completely finished in B.E.2550 are included, the ethanol production will reach 980,000 liters per day. From the latest data collection in December B.E.2549, it is found that the actual ethanol production capacity is equal to totally 1.72 million liters per day (1,463,000 liters per day from molasses, and 260,000 liters per day from cassava). Up until now, there are totally 45 licensed factories producing ethanol in Thailand, 8 of which are in operation; consisting of Porn Wilai International Group Trading Co., Ltd., Thai Alcohol Public Limited Company, Thai Agro Energy Co., Ltd., Thai Nguan Ethanol

Co., Ltd., Khon Kaen Alcohol Co., Ltd., Petrogreen Co., Ltd., Thai Sugar Ethanol Co., Ltd., and K.I. Ethanol Co., Ltd. (Pipat et al, B.E.2550)

2.2.3 Assessment of Alternative Energy Source Potential

In the assessment of alternative energy source potential, the energy sources which are available in the community and can be utilized to produce the alternative energy will be taken into consideration. From the secondary data of energy source potential study and the math model-based evaluation from the document study and related researches, it is found that the alternative energy sources mostly available in the village consist of biomass energy, for example, animal dung and agricultural residue. The quantity of biomass produced will vary and depends on the quantity of agricultural products, which can be assessed from:

2.2.3.1 Assessment of biomass energy potential

The average agricultural products in each year, the proportion of biomass to average agricultural products, and the thermal value derived from the measurement in fresh condition, can be utilized to assess the biomass energy potential as follows:

1. Assessment of biomass energy potential of biogas from the agricultural residues

The biomass energy potential derived from the agricultural residues can be assessed by means of survey data and data collection (Dussadee, B.E. 2549) as follows:

The quantity of agricultural residues = Residue to Product Ratio x Quantity of such Agricultural Products in a Calendar Year (Calendar year of cultivation or production).

The quantity of agricultural residue which can be utilized as the energy source = Quantity of the Agricultural Residue (1) x Energy Factor. (1)

Table 2-5 : Agriculture Residue Ratio

Kinds of plant	Agricultural residues	Residue ratio to products	Factor of materials not utilized	Thermal value (MJ/kg)
Wet season rice/Dry season rice/upland rice	Rice (rice straw)	0.447	0.684	10.24
	Rice stubble	0.550	0.684	11.30
	Chaff	0.230	0.493	14.27
Corn	Corncob	0.273	0.670	18.04
Millet	Leaf and trunk	1.252	0.648	19.23
Cassava	Branch, leaf	0.088	0.407	18.42
Sugarcane	Bagasse	0.291	0.987	16.28
	Peak and dried leaf	0.302	0.987	16.23
Coconut	Shell	0.362	0.595	17.93
	Coconut shell	0.160	0.378	25.40
	Flower, blossom	0.049	0.843	15.40
	Coconut stem	0.225	0.809	16.00
	Empty bunches	0.428	0.584	17.86
Palm	Fiber	0.147	0.134	17.62
	Shell	0.049	0.037	18.46
	Frond	2.604	1.000	9.83
	Male bunches	0.233	1.000	16.33
Wood residue	Branch	0.260	1.000	19.23
Peanut	Shell	0.323	1.000	12.66
Soybean/mung bean	Trunk, leaf and shell	2.663	0.760	19.44
Cotton	Trunk	3.232	1.000	14.49

Source : Energy Technology Transfer and Dissemination Bureau, B.E. 2547; Department of Energy Development and Promotion, B.E. 2542; Agricultural Information Technology Center, B.E. 2544; Department of Energy Development and Promotion, B.E. 2539.

2. Assessment of biomass energy potential of biogas from animal dung

The biomass energy potential of biogas from the animal dung will be assessed by the quantity of dung from each kind of animals, number of animals, and dung ratio (Dussadee, B.E. 2549) as follows:

Quantity of Biogas from Animal Dung (m^3)

= Number of Animals (N) x Average Quantity of Fresh Dung x Collected Dung Ratio (F1) x Volatile Solid Ratio (F2) x Gas Ratio (F3)

$$Q = N * M * F1 * F2 * F3 \quad (2)$$

Table 2-6 : Ratio of Biogas from Animal Dung

Kinds of animal	Quantity of fresh animal dung (kg/animal/day)	Collected animal dung ratio	All solid ratio	Volatile solid ratio (%)	Produced biogas ratio (m^3/kg.) Volatile solid
Buffalo	8.00	0.50	17.77	13.64	0.286
Beef cattle	5.00	0.50	17.44	13.37	0.307
Milk cow	15.00	0.80	17.44	13.37	0.307
Swine breeder (female)	2.00	0.80	35.22	24.84	0.217
Swine breeder (male)	2.00	0.80	35.22	24.84	0.217
Piglet	0.50	0.80	35.22	24.84	0.217
Pig fed	1.20	0.80	35.22	24.84	0.217
Native pig	1.20	0.80	35.22	24.84	0.217
Chicken	0.03	0.80	33.99	22.34	0.242
Duck	0.03	0.40	26.82	17.44	0.310
Elephant	40.0	0.50	26.64	21.61	0.241

Remarks : The thermal value of biogas is equal to 21.6 MJ/m^3

Source : The Institute of Biotechnology (n.d.), referred to in Dussadee Khamroeng, B.E.2549; Department of Agricultural Promotion(n.d.); and Department of Energy Development and Promotion(n.d.)

Part 3 Relevant Researches

3.1 Energy

Thienchay Keeranan (B.E.2525) studied on households' energy consumption behavior of people in Bangkok for finding an appropriate countermeasure that can be applied for changing their behavior on households' energy consumption in more efficient way. It was found that household economic condition was a determinant factor of their behavior on energy consumption model. It was called purchasing capability.

Wattana Wongkietrat (B.E.2541) studied on households' energy consumption in urban area by surveying of trends in consumption of which the finding is rather high in Bangkok especially electricity consumption for cooling system such as electric fan, air conditioner, and LPG use. LPG was popularly used due to easy acquiring and convenience. Moreover, it was also found that the determinant factor of decision making on LPG application was safety.

Rungnapa Rattanapanya (B.E.2547) studied on automobile use behavior of civil servant. The result showed that all of them used private motor car for travelling to offices. Most of motor car which was used by civil servant was sedan car. Second rank was pick-up truck. The major reason of using private car was convenient, comfortable and rapid travelling. Secondly public transportation service did not provide at their resident area. An average travelling distance was found 2 figures;11-15 Kilometers and 16-20 Kilometers. Monthly fuel cost per household was 1,000-2,000 THB and 2,500-3,000 THB.

Opas Sukwhan (B.E.2548) studied on development of specific energy index of electric energy consumption in residence. The structural and behavior factors were taken for consideration. It was found that behavior factor was determinant factor e.g. life style pattern, awareness on energy efficiency practice, and knowledge and understanding on electrical energy. Research's outcome could be applied as a tool for each standard behavior determination on electrical energy consumption in residence as well as an enhancement and public relation were performed for knowledge on

electrical energy use dissemination. Attitude correction on energy saving that could be substantially developed for real practice.

Dusadee Kumboonrueng (B.E. 2549) studied on survey and use of energy as well as energy providing at village level for sustainable energy self-reliance consumption. Such survey research applied questionnaire as research tool for data collection which was composed of 2 parts; household basic data and data on energy. All data were taken into account for analysis on energy use pattern and assessment on alternative energy sources.

It was found that village's energy consumption was 171,251 kgOE/yr. Determinant factors of energy consumption were career, income, and households' member. Concerning energy use, an average energy use per household per year was equivalent to 1,094.49 kgOE/yr that could be divided into 3 categories: electrical energy (93,897.3 kWh/yr), commercial energy (17,059.0 kgOE/yr), and alternative energy (146,117.3 kgOE/yr). Potential of energy which was generated from agriculture residual and animal dung was 154,576.2 kgOE/yr. Village's bio-mass energy consumption was estimated for 82.57% of total village's energy consumption. The analysis of relationship among total energy consumption (E_T), household member (N), and household income (I) was presented in equation of $E_T = 21.899\ N + 1x10^{-3}\ I + 532.750$ with $R^2 = 0.981$. Result from energy consumption technology analysis of sample village presented that it should be focused on bio-gas generating from animal dung and green fuel producing from agriculture residual.

Patpong Kanjanaroj et. al (B.E.2530) monitored a change of social and economic after applying local resources to be alternative energy for farmers in Nakhon Pathom Province. The research was descriptive research with data collection by applying interviewing and observation technique according to questionnaire that was prepared and pretested.

Result of study was found that applying material was fresh fuel (green fuel), fuel from other agriculture materials (rice straw or hay, water hyacinth etc.), rice husk, green manure, and bio-gas distributed percentage of 1.2, 25, 8.3 and 2.4 respectively. 98 % of farmers applied local materials for alternative energy at least 1 type. And 80 % of farmers preferred green manure to other local materials for plantation. Economic status was relatively changed by applying local materials.

Tuan and Thierry (1996) studied on households' energy consumption in 4 provinces of Vietnam. The result was revealed that energy sources for households' consumption in urban area of Hanoi City consisted of electricity (13.4%), coal (62.4%), kerosene (2.49%), bio-mass from wood (20.1%), and agriculture residual (1.61%) comparing with households' energy consumption in rural area of Hanoi city; electricity (6.6%), coal (34.6%), kerosene (2.39%), bio-mass from wood (28.8%), and agriculture residual (27.6%). It can be noted that energy consumption percentage from agriculture residual in rural area was higher than in urban area. Moreover, it was also found that household's income was determinant factor for influencing to energy consumption on system structure of households energy .

3.2 Self-reliance Model

Wannee Kamkead (B.E.2545) studied on indicator development for self-reliance capability of household and rural community. The result was found that household self-reliance model consisted of 5 activities e.g. 1. understanding situation of themselves 2. increasing household income 3. reducing household expenditure 4.consolidating for saving activities and enhancing secondary occupation 5. developing their learning process.

Concerning community self-reliance model consisted of 9 activities e.g. 1. problem analysis and learning about themselves 2. enhancing vision and strategy for development 3. Seeking funding for the development of own capital 4. Create a group process to create a people group 5. establishing occupation group and finding a guideline for group development 6. providing community learning process 7.arrangeing management system for village 8. awareness building on self-reliance concept 9. Requesting community external support.

Jamnien Boonmak et. al (n.d.) studied community development for sustainable self-reliance of Ban Teen Tad, Pa Hnai Sub-district, Phrao District, Chiangmai Province. The result was found that community's debt occurred from 1) insufficient income to cover expenditures 2) loss from agriculture occupation 3) high non-farm expenditures 4) over farm expenditures. This consequence encouraged

accumulative community's debt. Therefore, concept for debt reduction was expenditure reduction and income augmentation.

existing occ The road map for increasing community income was to develop the upation group for increasing its performance and encouraging community strengthening in sustainable way. Furthermore, community should develop community saving group for encouraging more potential saving to be fund source for village development.

3.3 Energy Self-reliance

Department of Alternative Energy Development and Efficiency (DEDE) Ministry of Energy (B.E. 2550) performed survey, study, processing data, and held seminar on energy village at Ban Pra Dok Moo1, Muenwai Sub-district, Muang District, Nakhonratchasima Province. The result presented that total village income was approximately 27,610,800.00 THB/yr and energy expenditure was 580,795.22 kgOE/yr equivalent to 12,068,389.00 THB/yr. After project of energy saving technology promotion has been launched. Energy expenditure could be saved of 141,654.01 kgOE/yr equivalent to 1,270,038.82 THB/yr and energy consumption index was reduced from 2,111.98 kgOE/yr/HH. to 2,034.17 kgOE/yr/HH. That provided energy expenditure index reduction from 43,885 THB/Yr/HH. to 43,165.58 THB/Yr/HH.

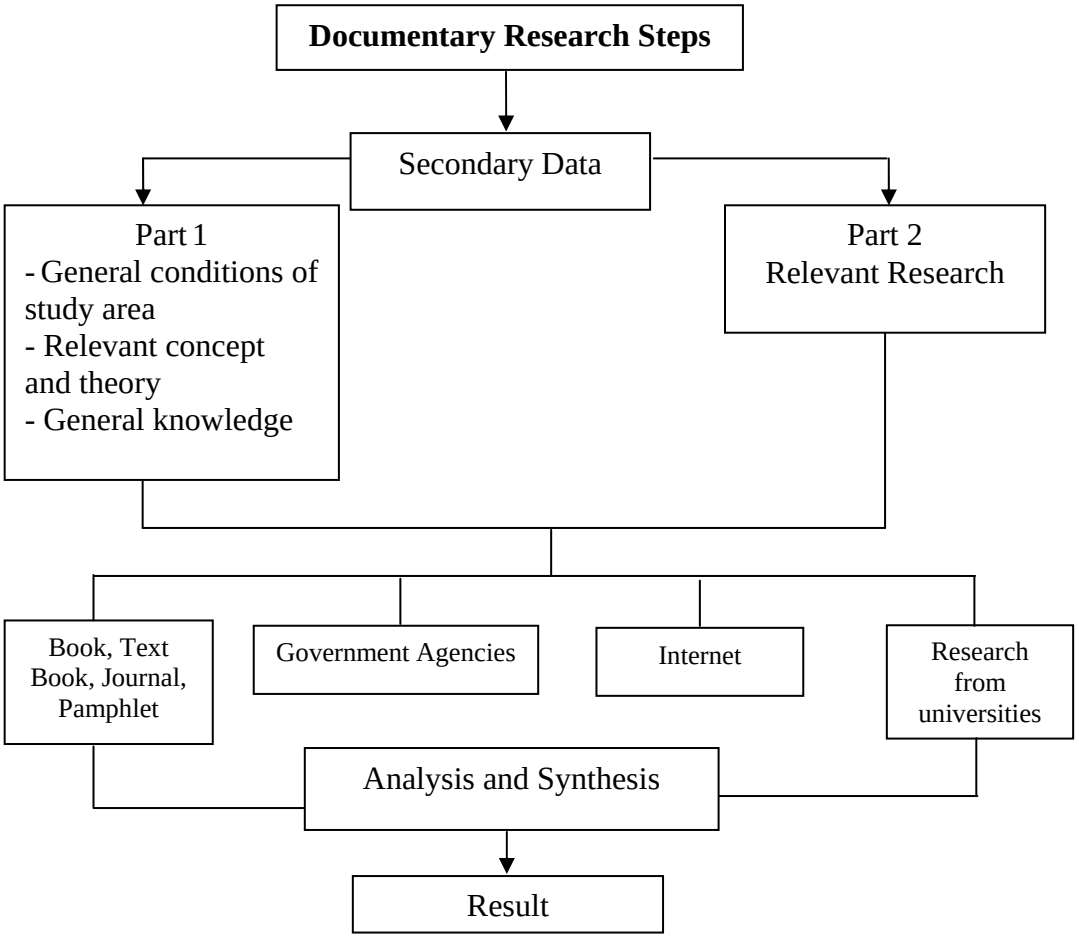
Bureau of Energy Technology Transfers (BETT), Department of Alternative Energy Development and Efficiency (DEDE) (B.E.2547) established rural energy village on Mai Reang Sub-district, Nakornsrithammarat Province. This village was established for prototype model of the southern region. The result of operation was found that annual energy (electricity, fuel oil, fuel gas) expenditures could be saved approximately 48,000 THB. Knowledge on efficient energy use of electric and fuel oil technique was provided by officer. In addition, the village energy revolving fund establishment for every village was widely encouraged.

Department of Alternative Energy Development and Efficiency (DEDE) (B.E.2546) studied on energy use pattern of household in Thailand. It was found that

in B.E.2544, household energy consumption was counted for 13,200 Kiloton of crude oil with 52 % of energy consumption deriving from bio-mass. The remaining (48%) was commercial energy. Concerning energy sources was found that 27 % of total households was capable to find bio-mass energy. Regarding source of bio-mass energy, 80 % can be found within household boundary.

Part 4 Result of Documentary Research

4.1 Documentary Research Steps



Chat 2-2 : Documentary Research Steps

4.2 Conclusion of Documentary Research

From literature review by collecting relevant data from text book, related research, journal, and information on internet provides researcher more understanding in research. Such acquired information is basic knowledge and theory that can be used for explanation and research discussion. A part of literature review encourages researcher to conclude point for being guideline of this research. Details are shown below;

1. Problem and situation on current energy status is consequence from rapid growth of population including impact by energy crisis on every level of development from national level down to household level such as high price of fuel oil.

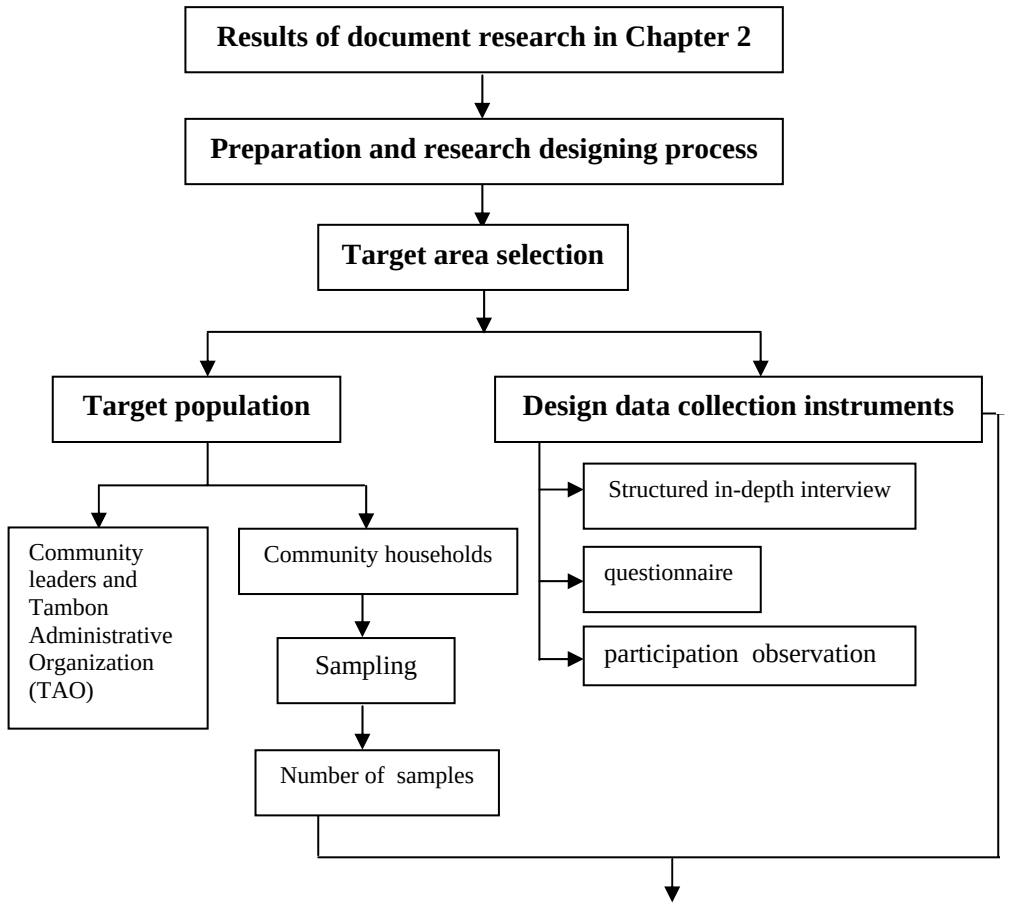
2. Energy Management Oppression of global energy crisis impact awake all countries. That is the cause for encouraging every country to study for finding problem solving guideline as providing an alternative energy that is renewable energy, environment friendly, locally supply and sufficient to meet demand.

3. Energy demand and supply management by applying philosophy of self-sufficiency economy initiated by His Majesty the King being a guideline for encounter energy problem. It should be focused on base of country development (Grass root) that is village level.

People-based development is the goal of this approach through enhancement for learning and understanding problem as well as energy situation. They should know how to apply local resources beneficial for them including problem solving by themselves. This practice focuses on their performance development and middle way for life without or less interference from the Government. So community is strengthen and performs activities complying with philosophy of self-sufficiency economy. It seems to be appropriate way to access concept of self-reliance. This research aimed at finding energy self-reliance model for community based on belief that community has potential for self development and natural resources development.

CHAPTER III
RESEARCH METHODOLOGY

The objectives of the research on energy self-reliance of Nong Makok Village, Banna Subdistrict, Banna District, Nakhon Nayok Province, are to study, survey and analyze the energy consumption situation of the community, local energy sources, and options appropriate with the energy sources so as to obtain the proper energy self-reliance model for the sample community. It is the survey and qualitative research where the data is collected by utilizing data collection form, interviewing form, structured in-depth interview, and group discussion. The samples of this research consist of Nong Makok agricultural village, community leaders: village headman and government agencies. The data is additionally searched from the documents and relevant researches with the following implementation processes.



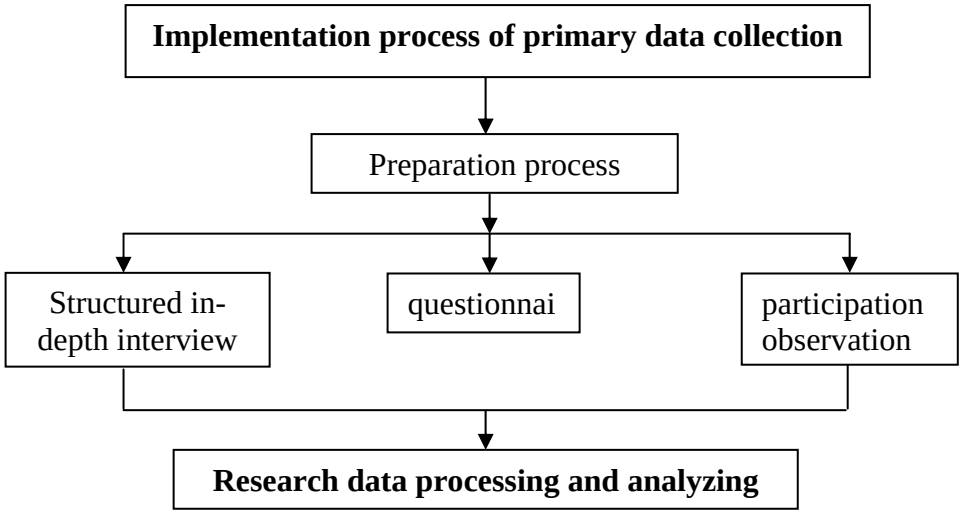


Chart 3-1 : Research Methodology

3.1 Preparation and research designing process

3.1.1 Target area

The target area is Nong Makok Village. The reason why this target area was selected is that it is located outside the municipal area. Most of the village people earn their living mainly as agricultures such as paddy farming, gardening, livestock raising, and straw mushroom cultivating, etc., and the agricultural area can indicate biomass potential. Unfortunately, this village has never been given any support from the agencies involved even though it has close relationship with the government agencies and is located close to Banna District. The other reason of selecting this village is that the researcher find it convenient place to travel and collect the data by her own; also he could have easy access to every household in the community.

3.1.2 Target population

In determining the target population of this research, the researcher classified them into 2 groups as follows:

Group 1: Community leaders and government agencies

Group 2: People. Since the research focuses on the study of local community, the target population is the households located outside the municipal area, comprising heads of the household or household representatives of 134 households from the total 154 households as it was found from the real survey that 141 households are inhabited. The researcher established the criteria for selecting the households to be the sample population of this research that they must be the households having the land in their possession and utilizing their own land both for residence and not including residence. There are 6 households renting the residence and the land for earning their living, and 1 household renting only the residence, but not having the land for earning a living.

3.1.3 Sampling

The researcher categorized the target population sampling into the following 2 methods.

3.1.2.1 The purposive sampling was applied to the sample population of Group 1: the community leaders and the government agencies including the village headman, Tambon Administrative Organization(TA), district development office, and provincial energy office.

3.1.2.2 The multi-stage random sampling was applied to the sample population of Group 2 with the household as the selecting unit as follows:

Step 1: Census sampling to survey the energy consumption of the community by applying the designed survey form.

Step 2: Cluster sampling. The researcher took the data gained from the energy consumption survey to develop the sample population grouping criteria. The sample population was grouped according to their energy consumption model. Then the proportional sampling was applied to each cluster again for the structured in-depth interview.

3.1.4 Design and develop the data collection instruments

The instruments applied in this research comprise the energy consumption census form, structured in-depth interview, observation, and group discussion.

3.1.4.1 Energy consumption census form

The interview was applied as an instrument to survey the energy consumption data which would support the consideration on the community's energy consumption categorized for living and working, for example light, cooking, and agriculture, etc. together with the background economic and social information of the community. In designing the interview, the researcher took the research objectives to set out as the interview objectives; 1. to study the energy consumption for working and living in the community, 2. to acknowledge the local energy source potential. Also, each objective will be taken as the main topic for questioning, which will be described later, to obtain the data covering what is needed for the analysis until achieving the study objectives. The researcher carried out the field survey and collected the data on local energy source potential and energy consumption in the community. Therefore, the interview was divided into 3 parts as follows:

1. Background information of the households
   - Household characteristic
   - Household occupation
   - Household members
   - Education
   - Income
   - Land in possession and land utilization

2. Data on energy consumption, which was divided into 4 sectors, includes the data on agriculture, alternative energy, commercial energy, and energy sources. The questions of each data sector will be categorized into the energy consumption for living and the energy consumption for working.

   1) Data on electricity consumption
      - Electrical devices used for entertainment
      - Electrical devices used for facilitation
      - Electrical devices used in consumption
      - Electricity bill / month

   2) Data on fuel oil and liquid petroleum gas consumption
      - Equipments driven by commercial energy
      - Types of energy consumed (gasoline, diesel)

- - Fuel cost

3) Data on alternative energy consumption

- Equipments driven by alternative energy

- Agricultural residue utilization

- Biogas consumption such as for cooking, light, and electricity generation

4) Agricultural data

- Livestock raising such as the number and fuel consumed for raising

- Cultivation such as kinds of cultivated plants, crop quantity, fuel consumed in each process, labor, and harvesting devices

3. Data on energy sources such as agricultural residues and animal dung, and energy consumed for both living and working.

3.1.4.2 Structured in-depth interview

It is the qualitative data collection. After obtaining the complete background information on the community and the energy situation in the community, the researcher applied it as a guideline for developing the research instrument and as a proper energy approach for the community which was derived from the opinions of the village headman, Tambon Administrative Organization, district community development office, and people in the study areas who answered the questions in the energy consumption census form. The question topics of the structured in-depth interview were categorized into 2 parts as follows:

Part 1 The question topics of the structured in-depth interview for the officers with high social status

Topic 1: The community's acknowledgement of their energy situation

Topic 2: Support on the energy development given by the public sector

Topic 3: Energy development projects at present and in the future

Topic 4: Problems and obstacles of energy development in the community

Topic 5: Possibility of energy self-reliance development

Part 2 The question topics of the structured in-depth interview for the heads of household

Topic 1: Knowledge and understanding of energy consumption

- Knowledge and understanding of electricity consumption
- Knowledge and understanding of fuel oil consumption
- Knowledge and understanding of liquid petroleum gas consumption
- Knowledge and understanding of alternative energy consumption

Topic 2: Opinions on energy self-reliance

- Opinions on electricity self-reliance
- Opinions on fuel oil self-reliance
- Opinions on liquid petroleum gas self-reliance

Topic 3: Recommendations on energy self-reliance

3.1.4.3 Participation Observation

The researcher applied the participating observation by interviewing directly the sample population to observe the energy resource raw materials in the local area and energy consumption behavior of the sample population both for their living and working.

3.2 Implementation process of primary data collection

3.2.1 Survey process

3.2.1.1 Primary data pre-survey The researcher carried out the household survey by applying the energy consumption census form to get the background information of the community, the energy utilizing devices, and energy consumption model according to the topics mentioned above. The survey results are shown in the annex.

3.2.1.2 Primary data post-survey The researcher carried out the community survey again to obtain the complete data in accordance with the objectives, consisting of energy survey, structured in-depth interview, and group discussion.

(1) The process of data collection from the energy consumption survey. The researcher improved the data on energy consumption survey from the pre-survey to obtain the complete data on energy consumption of the households in accordance with the objectives. For example, the background information of the community is clearer, and the energy consumption model and energy cost of each household could be categorized.

(2) The process of data collection from the structured in-depth interview. In this process, the researcher interviewed the heads of household or the household representatives and the officers with high social status according to the topics specified above by starting to introduce herself and explaining the research implementation in order that they could understand the objectives of the research. The researcher collected the data by using the interviewing devices such as the tape recorder and the note book. After that the data were rearranged to obtain the complete data.

(3) The process of data collection from the observation.
During the interview, the researcher questioned the interviewees directly, took their pictures and took notes in the book.

3.3 Data analysis process

The data analysis is to process the pre-survey and post-survey and to take the processing results to analyze and synthesize the theory in Chapter 2.

3.3.1 Analyze the energy consumption situation from the past to the present to explain the change of energy consumption from the past to the present by using descriptive statistics such as percentage and mean.

3.3.2 Analyze the potential of local energy source to evaluate the potential of supplying alternative energy source in the village, and consider taking the resources available in the local area as the alternative energy. This information is also used for energy potential development in the future by applying the secondary data and math model.

3.3.3 Analyze the energy self-reliance model in the future to propose as the future policy determination. The energy self-reliance model was analyzed, based on the results of energy consumption survey and structured in-depth interview. The philosophy of sufficiency economy was used as a frame for the content analysis.

CHAPTER IV
RESEARCH RESULTS

This is to study the energy self-reliant model of rural village in Nong Makok Village, Amphur Banna, Nakornnayok. The objectives of this case study are presented as follows. 1. To study explore and analyze the energy consumption in the village. 2. To study the potential of domestic energy resources 3. To propose the future energy self-reliant model of the village. As a result, the researcher has studied and collected the quantitive data by questionnaire and the qualitative data by structured in-depth interview including the secondary data to analyze the following data.

4.1 The Study Result and Analysis of the Energy Consumption Situation in the Village.

The study of energy consumption situation in the village is the study of changes in energy utilization from the past up to now by studying the secondary data and interview data concerned to the village. The resercher has studied from B.E. 2475 to B.E. 2552, when Thailand had been changed from the absolute monarchy system to democratic system in B.E. 2475 and the first constitution day was set on December 10, B.E. 2475 in Thailand since then. At that time, Thailand had approximately 200,000 people while simultaneously set up the electricity business called the Provincial Electricity Authority of Thailand and expanded to domesctics. Hence, one of the provinces, where the electricity business set in, was Nakornnayok and Nakornnayok, at that time, had only 100,000 people. However, Nongmakok village had still used the natural energy with less than 100 households. Currently, this village has approximately 134 households (from survey). After the political revolution through during and after the Second World War, Thailand has continuously renewed and developed the energy focusing mainly on electricity and fuel oil in energy business

and in exploration of energy resources in order to sefeguard the country development. Many National Economic and Social Development Plans have been launched until now, especially the first National Economic and Social Development Plan which pursued to the capitalism in developing country since then until B.E. 2552. The energy consumption situation has totally been studied for 47 years, containing 2 Phases as the Phase before the National Economic and Social Development Plan (B.E. 2475-2503) and the Phase during the National Economic and Social Development Plan (B.E. 2504-2551) as the following illustrations.

Table 4-1 The Energy consumption situation in B.E. 2475-2552

Phase 1 The Pre-Phase of the National Economic and Social Development Plan in B.E. 2475-2503

Year (B.E)	Key Situation	Community Energy Consumption
2475-2503 2475-2503	- This period was the rising trend of energy. There was an energy development mainly in electricity and fuel oil to renew and build up country. - In B.E. 2475, there was an expasion of the electricity business around the country. Nakornnayok was one of the selective provinces where the electricity business or the Provincial Electricity Authority was established in B.E. 2475. - There was an announcement of Forest Act (B.E. 2484).	1. Thermal Energy was applied from the nature such as solar energy for drying clothes, products and preserving food,biomass energy from charcoal and firewood for cooking food, warming, chasing the mosquitoes and insects. The village also has various kinds of effective high-heat firewood and charcoal which made from rubberwood, *Sakae* wood (Combretum quadrangulare Kurz) and *Krabok* wood(Irvingia malayana Oliv. ex A. Benn.) 2. Light energy in the past was born from nature learning by applying the existing local materilas to make light such as torch and kerosene lamp. 3. Energy from human and animal powers in earning an agricultural living. Rubber Tree was announced to be the forbidden wood. The households who used torches were declined accordingly and turned to use kerosene lamp instead.

Table 4-1 The Energy consumption situation in B.E. 2475-2552 (cont.)

Phase 2 The Phase during the National Economic and Social Development Plan (Vol. 1-10)

The National Economic and Social Development Plan	Key Development	The energy consumption situation in the village
The first development plan B.E. 2504-2509 The Second Development Plan B.E. 2510-2514	- Set up the central plans from "top to down" pursuant to the Concept of Development with Growth under the capitalism. - Focused on basic infrastructure (transportation, a dam for the irrigation and the electricity including, Project-oriented approach) - Focused on the development in electricity by mainly promoting of hydro energy in generating the electricity, improving the distributed rate of electricity to promote the energy consumption in industry and utility together with electric household rate. - To promote the electricity at province, district, sanitation cooperated with external private sector, government project located far away and at frontier. - There was a lot of import of petroleum fuel from other countries.	Electricity service hadn't yet reached through the village. People still used the existing energy form.

Table 4-1 The Energy consumption situation in B.E. 2475-2552 (cont.)

Phase 2 The Phase during the National Economic and Social Development Plan (Vol. 1-10)

the National Economic and Social Development Plan	Key Development	The energy consumption situation in the village
The Third Development Plan B.E. 2515-2519 The Fourth Development Plan B.E. 2520-2524	- There was the continuous development in the basic infrastructure focusing further on the rural development - There was a constantly focus on the electricity energy and a progresive policy pursued to the First and Second Development Plan - There was the oil crisis in B.E. 2516. The global economy has been swang particularly in B.E. 2522. The crude oil price in the world market has increased double many times and severely affected to Thai economy. - There was a continuously increasing in energy demand	- There was various public utility and construction firstly come into the village such as village road in 2517 B.E., which was the change in the village energy consumption. - The cooking gas consumption was introduced ,however, there was still utilized of the charcoal and firewood. - There was a motorcycle in 2522 B.E. and approximately 5-6 years later, there were also usable cars, personal cars and farm machines. - The electricity was firstly introduced into the village in B.E.2523 and could be applied to 20 households. - There was still made use of the charcoal and firewood for cooking.
The Fifth Development Plan B.E. 2525-2529 The Sixth Development Plan B.E.2530-2534	- Reduce the energy utilization and the energy importation from foreign countries. - Produce the domestics alternative energy by using more natural gas, lignite and hydro energy. - Promote and support the proper energy procurement to meet the rural energy demand in parallel with the poverty alleviation. - Appropriately manage the energy consumption rate by consideration on the major environmental impact. - The need of comercial energy has promptly increased.	- The economic and social status in the village had been changed more. There was the comfortable facilities for earning a living and lives, the incremental of electric appliances and farm machines. - There was the utilization of charcoal and firewood for cooking. - There was initially the promotion of biogas production from swine dung, however, noone disregarded except for the demonstrated household of the village headman.

Table 4-1 The Energy consumption situation in B.E. 2475-2552 (cont.)

Phase 2 The Phase during the National Economic and Social Development Plan (Vol. 1-10)

The National Economic and Social Development Plan	Key Development	The energy consumption situation in thevillage
The Seventh Development Plan B.E. 2535-2539 The Eighth Development Plan B.E. 2540-2544	- The oil price in the world market has greatly instability and affect to the country financial status. - Focus on the energy procurement to meet the demand by developing the domestics resources in pallarel to cooperation with neighbouring countries. - Promote the development of the alternative energy and the domestics alternative energy together with reducing the dependency on overseas energy.	- The community uses more alternative energy such as NGV and gasohol. - The number of households using charcoal and firewood has declined.
The Nineth development plan 2545-2549 B.E. The Tenth Development Plan B.E. 2550-2554	- Focus on the economic development in parallel with the social development under the Philosophy of Sufficiency Economy. - Strengthen the village. -Strengthen the security of resources and environmental base. - The development of the natural resources administration system had the topmost efficiency beneath the participatory process. - Increase the effectiveness in energy utilization and develop the alternative energy to sustain the domestic demand.	- The villages still required the commercial energy. - The model of natural energy consumption was declined such as disregarding in burning charcoal and firewood. - The village has more energy expenses (interpreted in “Current Energy Situation”

From the energy consumption situation in the village, the electricity has been introduced approximately 30 years into Nakornnayok before having the First National Ecomomic and Social Plan. However, the living of Nongmakok village has depended mainly on the natural resource energy. Through the folk widom, the energy has beens produced within household such as charcoal, rubberwood oil, using the energy from human and animal powers in family on farming. Until B.E. 2504, the First National Economic and Social Development Plan was announced, this development plan has significantly changed the country by capitalism leading to be the strategy in developing economy and society. Nevertheless, the development was mainly emphasized economy and basic infrastructure by means of the government centralization of administrative powers, starting from the urban to rural development, Meanwhile, it was the commencement of changes in community energy consumption, starting from earning for living by applying of external energy. When the villagers were used to the emerging equipment and machinery together with the government intervene in development, these; therefore, made the village weaken, lack of power and self-relaince due to being intensely capitalism. As far as economic crisis and energy matters are concerned, the following strategic economic and social development will be underlined in consistent with the Philosophy of Sufficiency Economy. The Ninth and the Tenth National Economic and Social Development Plan have expedited the effectiveness in human resource management, science enhancement and administrative management to promote the village strength and self-reliance. These are to experience the problems of external factors of which the problem solving depends on various cooperation with public and private sectors.

4.1.1 The current energy consumption situation of the village in B.E. 2552

The energy consumption behavior and its model has now changed from the past following to the cahnages of the emerging economic and social development in village, but, the use of natural resources as charcoal and firewood has remained. As a lot of growth came into the village such as energy utilities and energy tenologies during the economic development, these affected to the easiness and changes in

village's way of life. Therefore, the village, that even depended on the domestics natural resources, conversely depended on the outside energy or commercial energy more and more. From the study, there are 134 households having mass income and total households expense amounting to 1,744,149 Baht/Month and 790,659.91 Baht/Month, respectively. The average expense is 5,900 Baht/Household/Month or at 45.33 percent of total income and total energy expense is 385,794.61 Baht/Month. From the preceding, the one of expenses within the household is from energy expenses amounting to 48.75 percent of all expenses within the household and energy expenses is 22.12 percent of mass income , which are classified into the following types.

Table 4-2 Energy Type for Household Consumption

No.	Energy Type	Number of household in energy consumption (household)	Percent
1	Electricity	131	97.76
2	Fuel Oil	126	95.52
3	Liquefied petroleum Gas (LPG)	114	85.07
4	Charcoal	107	79.85
5	Firewood	69	51.49
6	Biogas	1	0.75
7	Solar Energy	1	0.75

Note : Survey

From the table, it indicates that the household in the village has depended on external energy more and more by using electricity , fuel oil, and the LPG gas at high ratio. Regarding the charcoal and firewood, they have evenly consumed at the likely high ratio as well. This is indicated that the village can be self-reliant on LPG. Besides , some households use the biogas and the solar energy to produce the warm water, which community energy consumption can analyse from all expenses of the household and from energy expenses as follows.

1. Electricity Consumption. There are 100 percent of electricity coming into Nongmakok village but three household or 2.24 percent of total

household haven't yet consumed it, according to those households are far away from roads and have no budget for cable connection. The electrical appliances with batteries applied in the household can be devided into 6 categories as follows.

- Lighting Equipments. Each household has averagely 8 light bulb/household. Most of the light bulbs used in the household is long and has 20 and 40 watts. As interviewed, it found that the bulbs have installed at the main location such as in the house, in front of the house, in the bathroom, in the kitchen and in the bedroom. The average life of light bulbs consumed is about 2-5 hours depending on the use of each household.

- Cooking Equipments Each household has averagely 4 equipment/household. These include the rice cooker, hot flask and microwave. Some homes have electric stove and other accessories such as fruit juice blender, toaster, electrical pan, etc. From the interview, it found that the rice cooker is applied at a small size of 1-2.5 liters rating at 450-1050 watts and cooked 1-2 times / day. Some homes have heated up the rice before consuming while the others have heated throughout the day. Most of the hot flask size is 2-3 liters rating at 600-720 watts electric and is used 1 time / day on the average. However, some families have put on it throughout the day due to having 0-6 year infant.

- Cooling equipment including refrigerator or freezer. Each household has averagely 1-2 devices/ household at the size of 5-10 queue rating at 50-145 watts.

- Air conditioning equipment including fan and air conditioner. Most of the households have big desktop fans and floor fans. Some homes have wall fans. Each household has averagely 3-4 fans/household at the size of 12-16 inches rating at 48-70 watts. As interviewed, it found that fans have applied at 1-2 hours on the average. There are 17 households using the air conditioner at the size of 12,000-24,000 BTU rating at 1,000-2,500 watts and turn on average at 2-3 hours.

- Clothing Equipments include washing machine and iron. Each household has averagely 1-2 devices /household. Most of the washing machines have two-cylinders including clothes dryers at the size of 3,000 watts. The time consumed for the washing machine is on the average of 30 minute -1 hours. The iron has simple

application at the size of 1,000 watts and time consumed on the average of 30 minute -1 hours.

- Electronic Equipments. Each household has averagely 5-6 devices/household including television, electrical radio, desktop computer, notebook computer, printer, audio set. DVD / CD player, mobile phone, etc. Some households run their own business by using fasimile. The common electronic appliances used in households are television, radio, mobile phone. The color television using is at the size of 14-29 inches rating at 60-125 watts and radio using is rating at 15 watts. From interview, it found that the time consumed of radio and television is on the average of 1-2 hours per day while charge cycle of cell phone batteries is mostly in average of 2-3 days.

- Other Equipments include electrical water pump, wet cell flshlight, dried cell flashlight, electrical drill , electrical sewing machine, etc. The electrical water pump is greatly used in dry season crop. The pump will be used averagely 2-3 days / times at the size of 1-1.5-inch while other devices will be used occasionally within the household.

The number of electrical equipments has increased according to more village procurement power and resulting in higher energy costs unconsciously. This study found that the energy expense of households is totally 62,526.03 Baht / Month on the average of 466.61 Baht / Month, representing of mass income and total household expenses amounting to 3.58 percent and 7.91 percent, respectively. And in proportion to 16.21 percent of total energy expenditure. However, these should be based on the energy consumption behavior of each household as there are 33 households accounting to 24.63 percent have no electricity expenditures at the interview month and before the interview consecutively.

2. Fuel Oil Consumption. The development of road infrastructure has facilitated more interative travelling and allowed vehicles to influence more on the life and occupation inferior to electricity. This affect the expansion of oil service station within and outside the village accordingly, in order to meet fuel oil demand. There is only one oil service station in Nongmakok Village, which is the tube petrol station in front of the grocery. There is also a similar station in the neighboring village. The oil used in the village includes gasoline and diesel

fuel used by vehicles and agricultural machinery. If they require additional type of oil, they will get into three oil stations in the district, which is not likely far away from the village, such as the state enterprise station namely PTT and the private station namely ESSO and the agricultural cooperatives station. From interviews, the villagers mentioned that the agricultural cooperative used to sevice the biodiesel, but there are problems with the engines and not popular to the villagers; therefore, the biodiesel was withdrawn. As far as the development of road infrastructure has facilitated more interative travelling, the vehicles will influence more on the life and occupation inferior to electricity since they take less time and could be the indicator of the household economic status resulted in the cancellation of bicycles in some households. Nongmakok village has possessed most motorcycles of 89.6 percent, followed by usable vehicles of 35.1 percent and personal cars of 15 percent. Nevertheless, there are 9 households, representing to 6.7 percent of all households, still travel by bicycles and never use fuel oil both in vehicles and in earning their living. In addition, there are agricultural machinery used in farming such as tractors, medical blowing machines, water pumps, lawn mowers with 90.3 percent, which mostly are walking tractors and lawn mowers. The household in the Nongmakok village will use machinery in occupation and life on average of approximately 3 Machine / Household.

Figure 4-1 : Fuel Oil Consumption in living and occupation

The number of engines used in the household has increased from the past in order to facilitate lives and occupations. Therefore, the fuel costs of the village have increased since gasoline and diesel are utilized mostly. The study found that the fuel oil cost of household ist totally 304,651.67 Baht / Month. Each household spends on fuel oil on the average of 2,273.52 Baht / Month per Household, representing of mass income and total household expenses amounting to 17.47 percent and 38.53 percent, respectively. And in proportion to 78.97 percent of total energy expense.

3. Liquefied petroleum gas (LPG) Consumption In Nongmakok village, there are 87.07 percent of all households used LPG fuel., and some households use charcoal and firewood as fuel. They also use both electrical and LPG stove because they live as a relative group, containing parents home, children home namely extended households. And, 19 households or 14.18 percent of all households produce biogas consumed in their households for cooking about 1-3 month/tank. In addition, 18 households or 15.78 percent of all households using LPG have reserved LPG tank representing the great LPG demand, which can easily procure due to this village is near the market and can also procure in the neighboring village. Upon the interview, some households used only LPG without coal and firewood since it is quick and easy to use and transport, less time consumed and unsullied to vehicles. Moreover, the study found that the total LPG expenses of the studied households equal to 17,649.48 Baht / Month with the average LPG spending of 131.71 Baht / Month, representing of mass income and total household expenses amounting to 1.01 percent and 2.23percent, respectively, And 4.57 percent of total energy expenses, repectively. The savings of LPG consumption would likely depend on the village behavior of the energy consumption. Considering to the time consumed of LPG, some households take 3 month/tank while other households take 4-6 month/tank. This means the villagers are able to save the LPG consumption. But, few households use LPG within 1 month or less as they trade on food. Besides, the villages apply charcoal and firewood for food required long cooking time. They also won’t discharge the LPG strongly and seldom cook because of living near the market.

4. Alternative Energy Consumption. In Nongmakok village, there are 3 types of energy: renewable energy including energy from biomass and natural energy.

(1) Wood Biomass

The charcoal and firewood consumptions in the households are 79.85 percent and 51.49 percent of all households respectively. And, 24 households, representing 17.91 percent of all households do not use charcoal and firewood. Then, 41 households, representing 30.59 percent of all households use charcoal only. And, 58 households, representing 43.28 percent of all households use both charcoal and firewood. In case of charcoal consumption, some households buy the charcoal while the others make(char) charcoal by themselves. Hence, 43 households or 32.1 percent, representing of mass income and total household expenses amounting to 0.06 percent and 0.12 percent, respectively. And 0.25 percent of total energy expenses, purchase the charcoal. The 81 households accounting for 60.4 percent burn the charcoal themselves. They also find the firewood themselves and apply with the LPG. The burning coal is likely a conical pile derivatived from the ancient times. In the former time, the coal is burnt by using grass, dry straw to cover the wood arranging in the hole with wooden foundation. The villagers called the burning charcoal as “a back filled burning charcoal” or “a ghost back filled furnace”. This is simply built and not meticulous chosen the wood to produce charcoal.. Generally, a ghost hole furnace can produce 10-15 percent of charcoal. Throught the folk wisdom, the villagers then renew the usable charcoal by keeping the left usable charcoal the fuel and then put in the close containers thoroughly and further reuse. This is to fully optimize resources by recyclability. However, only 2 households have switched to a 200-liter burning furnace.

Figure 4-2 : The folk wisdom in burning charcoal of the village “a back filled burning charcoal”

Based on interviews, the households explain that using charcoal and firewood in cooking food can make better food taste, especially steamed and grilled food or long-time cooking food. This is also able to save gas and cleanse the house from scrap stick. From the interview and observation, most villagers have grown fruits in their homes such as banana, guava, marian plum, tamarind, santol, etc. Furthermore, wood from the rim of fields such as forest mango, holy tree, *Sah Kae*(Combretum quadrangulare Kurz) and *Krabok*(Kayu-common name)etc. are used in making charcoal and firewood since these plants have high heat values appropriate to make the charcoal and firewood. For example, the heat value of marian plum and santol is 4,996 and 4,911 calorie per 1 gram of dry weight, respectively. (see “Heat Value” in the Appendix)Most households, that use charcoal and firewood, often have the elderly in their homes and do not use LPG fuel. From household interviews, they explain that they don’t use LPG because they fear of its insecurity, blast and higher price. And, it is convenient to use charcoal and firewood.

Figure 4-3 : Renewable Biomass Consumption Behavior

(2) Biomass Energy from Biogas

There is renewable energy from wood biomass. Some households have produced biogas and used in thier households. From household interviews using biogas, they said that they study from nature themselves and then explore more knowledge from books and actions starting from the biogas production. This can save energy cost and completely replace LPG ful.

(3) Natural energy from the Sun

The households use renewable energy from the sun to produce hot water for taking a bath by using solar collector to transform and maintain heat and then transfer to water. This process then makes hot water at low temperature around 40-70 ^{o}C, which is used primarily for bathing and washing. From the household interviews, they study the earlier mentioned from the book, its method, pros and cons before implementation. This investment may be high but be able to optimize the long term cost and save the electricity cost about 200-300 Baht/ Month.

Based on the survey results and analysis of the energy consumption situation and the household energy comsumption in Nongmakok village, the rising trend of external energy consumption seem to be higher preceded by energy expenditures. As a result, the energy resources within the village, which can be

renewed various external energy under the environmental and material conditions of usable energy, can project to the study of the potential of local energy resources.

4.2 Study Results of Potential of Local Energy Resources

4.2.1 Potential of Local Energy Resources

The energy resources of the village comprise sun light, wind, and water. To evaluate the potential of these resources, the researcher used secondary data instead of primary data. It is because studying primary data needs to have specific instruments and expertise, and it also takes long time. For example, to evaluate the potentail of wind energy, an anemometer shall be installed to collect data for at least 3 years to get adequate data.

Potential of Local Energy Resources could be categorized into the following:

1) Potential of Solar Energy Resource

Solar energy is counted as one of essential factors for living. It is useful for human beings in various aspects, such as for drying clothes, food production, food preservation, lighting houses, and etc. Moreover, using the solar energy does not need any technology or knowledge. Studying secondary data, it was found that the solar energy in the community has very high potential for generating thermal and electric energy when it is comparable to the data of Ban Na District. The Ministry of Energy report on the potential of solar energy is noted that the average annual solar radiation of Nakhon Nayok Province is 18.48 MJ/m^3-day, and of Ban Na District, where is comparable to the studied area, is 18.55 MJ/m^3-day, while the national average annual solar radiation is 18.2 MJ/m^3-day. From interviewing people in the community, it was found that most of them do not know or understand about solar energy. Some have heard about solar energy but do not have any idea about its technology. It is because they are uneduated. 50.1 percents of them graduated primary schools. It is also because they do not aware to use it since the electricity is available, and to install solar cell is costly.

2) Potential of Wind Energy Resource

The Ministry of Energy report on the potential of wind energy is noted that average annual wind power in Ban Na District, where it is comparable to the studied area, is 1.2, while the low wind speed at 10 m. is 2.8 m/s and at 50 m. is 3.6 m/s. From the secondary data study, low wind speed wind turbines can be installed in the studied area since start-up wind speed of wind turbines is usually at 2.5 m/s up. 2 kinds of wind turbines are recommended for this area.(Siamcentraltrade Company, [Online]) One of them is a folk wind turbine invented through Thai folk wisdom in those day to be used to convey water from canals to paddy fields, salt and prawn farms. Materials for building it are available in the community, inexpensive, and suitable for the area's topographical feature. Another one is wind turbine for pumping. It is used to pump water from ponds, swamps, and other shallow water sources for domestic consumption, agriculture, and livestock. Both are quite suitable for this area since the people use water from their own ponds and dredged canals. To substitute electric pumps and mini-tractors to pump water, they can use these wind turbines. In addition, Rajamangala University of Technology has succeeded in developing low speed wind turbine for electric generating. It can be utilized in this area also.

3) Potential of Hydro Energy Resource

According to the topographical feature of Nong Makok village, there is no potential of hydro energy resource. It is because its natural water resources lack of different level, falling, tidal, and current that produce kinetic energy. Most of its water resources are ponds and dredged canals, namely Hua Na and Kradon, which are straight, no current, and unstable volume of water throughout the year. In dry season, they are dried out. Considering to improve them to raise their potential to be hydro energy resourses needs more careful study. It is may not worth investment cost.

Figure 4-4 : Community Dredged Canal

4.2.2 Potential of Resources of Energy from Human Power

From surveying, the actual population living in this area were totally 498 persons divided to 235 male and 263 female. There were 106 small-scale households, each included 1-4 members, which was 79.1 % of the total, while 28 large-scale households of 5-8 members each were 20.9 %.

Table 4-3 Proportion of Ages of Nong Makok Village's Population

Ages	Male (persons)	Female (persons)	Total	Male (%)	Female (%)
0-10	31	21	52	6.22	4.22
11-21	48	42	90	9.64	8.43
22-32	35	45	80	7.03	9.04
33-43	35	44	79	7.03	8.84
44-54	37	44	81	7.43	8.84
55 up	49	67	46	9.84	13.45
Total	235	263	498	47.19	52.81

Remarks : Survey

Studying the Nong Makok village's population structure, it was found that the proportion between male and female was not much different. It was 47.19:52.81 of the total population. It was also found that the proportion between childhood age (0-15 years old), work-force age (15-55 years old), and old age (55 years old up) was almost same. This showed that the increasing ratio of population was low. Hence, the population trends to decrease in the future. The increasing of small-scale households supported this assumption. 143 members of the small-scale households were male, that was 60.35% of total male population, while 174 members were female, that was 66.15 of total female population. For the large-scale households, 92 members were male, that was 39.15% of total male population, while 89 members were female, that was 33.84% of total female population. From those statistic, this community had potential of resources of energy from household's human power. Most households did cultivation as the main and additional occupation. When compare to people in other areas that they did not do cultivation as a main career, only small amount of the work-force populations in the studied area left to find jobs in other areas.

4.2.3 Potential of Bio-mass Energy Resources

Studying the potential of solar, wind, and hydro energy resources, it was found that the potential of solar and wind energy were adequate to produce energy. Anyhow, the community needed to gain knowledge and understanding about energy and technology to be used. Presently, no any agency seriously promotes them to utilize this energy. Moreover, most of its population as well as its leaders do not aware to develop the potential of these enrgy resources. Therefore, the possible developed energy resources in this area is renewal arising from bio-mass energy which is from the by-product of cultivation, especially paddy straw and scraps of wood being main materials , as well as animal dung.

1) Potential of Agricultural Residue Energy Resources

From surveying, it was found that main crop in the studied area is wet and dry season paddy. There are also some fruit trees, such as santols, mangoes, and marian plums, as well as some vegetables. They are cultivated for household consumption and giving shade. From mathemetic model calculation, it shows the potential of agricultural residue energy resources in the following table.

Table 4-4 Quantity of Crop's Residue

Crop	Residue	Ratio of Residue to Produce	Quantity of Produce (kg./yr)	Quantity of Residue (kg.)
Wet Season Paddy	Straw	0.447	93,723.97	41,894.61
	Husk	0.230	93,723.97	21,556.51

Remarks: Other kinds of crops cultivated in this community were fruit trees and seasoned vegetables. Most of the vegetables were leafy which their leaves were collected for household comsumption and sale. Firewood trees were also grown to make charcoal and firewood. Without selection, the people used any kind of trees as they get used to it.

The above table of the quantity of crop's residue shows that some residue cannot give energy. Hence, it shall be multiplied by a factor of the residue which is able to give energy. The result is as follows.

Table 4-5 Potential of Residue Used to Eenerate Energy

Crop	Residue	Quantity (kg.)	Energy Factor	Quantity of residue used to get energy	Thermal Energy (MJ/kg)
Wet season paddy	Straw	41,894.61	0.684	28,655.91	10.24
	Husk	21,556.51	0.507	10,929.15	14.27

From studying, most agricultural residue is from paddy production, i.e. straw and husk. Their quantities are 42 and 22 tons respectively. When assess them into energy to same unit as crude oil, using energy factor as shown in table 4, they can produce thermal energy of 19,898 KgOE/yr totally. This potential is the highest. Anyhow, it is not the real potential because the available of husk and straw might not be adequate. Concerning about husk, most people in the community sells all rice grain to rice mills, some keep some for their own consumption and sell the rest, therefore, the available husk may not be adequate for producing energy. Concerning about paddy

stubbles and straw, some are burnt, some are ploughed over, some are sold, and some are fermented to be fertilizer. To use them for producing energy thus depends on the ability of collect them from agricultural plots.

2) Potential of Animal Dung Energy Resources

From surveying, Nong Makok villagers raise various kinds of animals, such as cows, buffalos, ducks, chickens and swines. Applying the mathmatic model for calculation, the potential of each animal dung to produce energy is as follows:

Table 4-6 Quantity of Solid Dung

Animals	Amount	Fresh dung (kg/1animal/day)	Ratio of Collected Dung	Annual Collected Quantity (kg)	Ratio of Solid Dung (%)	Quantity of Solid Dung (kg)
Cows	130	5.00	0.50	118,625	17.44	20,688
Buffalos	176	8.00	0.50	256,960	17.77	45,662
Ducks	93	0.03	0.40	407	26.82	109
Chickens	340	0.03	0.80	2,978	33.99	1,012
Swines	2	1.20	0.80	701	35.22	247

The above table shows the annual quantity of solid dung of each kind of animals. The quantity of buffalo dung is the highest of 256,960 kg/yr while the quantity of cow dung is 118,625 kg/yr. Analysing the potential of biogas quantity by multiply it to the produced biogas ratio gets the result as follows:

Table 4-7 Potential of Biogas Quantity Produced from Animal Dung

Animals	Quantity of total Solid Dung (kg)	Ratio of Evaporated Solid Dung (%)	Quantity of Evaporated Solid Dung (kg)	Ratio of Produced Biogas (m^3/kg)	Total Quantity of Produced Biogas (m^3)
Cows	20,688	13.37	2766	0.307	849

Table 4-7 Potential of Biogas Quantity Produced from Animal Dung(cont.)

Animals	Quantity of total Solid Dung (kg)	Ratio of Evaporated Solid Dung (%)	Quantity of Evaporated Solid Dung (kg)	Ratio of Produced Biogas (m^3/kg)	Total Quantity of Produced Biogas (m^3)
Buffalos	45,662	13.64	6228	0.286	1781
Ducks	109	17.44	19	0.310	6
Chickens	1,012	22.34	226	0.242	55
Swines	247	24.84	61	0.217	13
Total					2,702

From studying, it was found that buffalo dung had highest potential to be used to produce biogas. It was because, in the community, there were 176 buffalos releasing dung of 256,960 kg/yr producing biogas of 65.91% of the produced total biogas. Cow dung had the second potential since there were 130 cows releasing dung of 118,625 kg/yr producing biogas of 31.42% of the produced total biogas. Calculating the potential of biogas producing in the whole village, it was 2,702 m^3/yr or 2,048.52 KgOE/yr.

4.3 Study Result of depending on energy model Energy of the Community

From studying and analyzing the aforesaid energy consumption data, it was found that the Nong Makok villagers mostly rely on external energy, such as electricity, fuel oil, and liquid petroleum gas which is called commercial energy, especially electricity and fuel oil. It causes high monthly expense ratio. Anyhow, the community is tending to rely on themselves on cooking energy by using charcoal and firewood. To clearifying, the energy consumption characteristic of Nong Makok Village is divided into 4 patterns. Which , can show detail in the table 4.8 , 4.9,4.10 and 4.11

Model 1 : 4 energy consumption, i.e.

1.1 electricity-fuel oil-liquid petroleum gas(LPG)-charcoal or firewood(collected by their own)

1.2 electricity-fuel oil- LPG-charcoal(bought) or firewood

Model 2 : 3 energy consumption, i.e.

2.1 electricity-fuel oil-LPG

2.2 electricity-fuel oil-charcoal or firewood(collected by their own)

2.3 electricity-LPG-charcoal or firewood(collected by their own)

2.4 electricity-fuel oil- charcoal(bought) or firewood

2.5 electricity- fuel oil(kerosene)-charcoal or firewood(collected by their own)

Model 3 : 2 energy consumption, i.e.

3.1 electricity-fuel oil

3.2 electricity-liquid petroleum gas

3.3 fuel oil-charcoal or firewood(collected by their own)

3.4 electricity- charcoal or firewood(collected by their own)

Model 4 : 4 energy consumption that, apart from charcoal and firewood, the renewable energy is also used, i.e.

4.1 electricity-fuel oil-LPG-charcoal or firewood (collected by their own)

4.2 electricity-fuel oil-liquid petroleum gas-solar energy

The table shows overall energy expenses of community

Theble 4-8 Proportion of Total energy expenses per mass income

Mass income (Bath/Month)	Total household expenses (Bath/Month)	total energy expense (Bath/Month)				Proportion of Total energy expenses per mass income (percent)			
1,744,149	790,659.91	Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal	Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal
		62,526.03	304,651.67	17,649.48	966.32	3.58	17.47	1.01	0.06
Total		385,794.61				22.12			

Theble 4-9 Proportion of Total energy expenses per total household expenses of community

Mass income (Bath/Month)	Total household expenses (Bath/Month)	total energy expense (Bath/Month)				Proportion of Total energy expenses per total household expenses of community (percent)			
1,744,149	790,659.91	Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoa l	Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal
		62,526.03	304,651.67	17,649.48	966.32	7.91	38.53	2.23	0.12
Total		385,794.61				48.79			

Theble 4-10 Proportion of Total energy expenses of each kine energy per mass income

Electricity expenses of community (Bath/Month)	Fuel expenses of community (Bath/Month)	Liquefied petroleum gas. (LPG) expenses of community (Bath/Month)	Charcoal expenses of community (Bath/Month)	Proportion of Total energy expenses of each kine energy per mass income (percent)			
				Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal
62,526.03	304,651.67	17649.48	966.32	16.21	78.96	4.57	0.25

The table shows overall energy expenses of each the model

Table 4-11 Energy use models

Energy use Model	Amount of Household (Percents)	Occupation (Household)							Income per Group (Baht /Month)	Energy expenses (Baht)				Total energy expenses (Baht)	Proportion of Total energy expenses (Percents)		
		1	2	3	4	5	6	7		Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal		Per Income per Group	Per total household expenses of community	Per total energy expenses of community
1. Four Energy sources 1.1 Electricity - Fuel – Liquefied petroleum gas – charcoal or firewood. (Available)	63 (47.01)	3	18	11	18	1	3	9	768,047	25,106	156,460	8,108.44	-	189,674.44	10.87	23.99	49.16
1.2 Electricity - Fuel – Liquefied petroleum gas - charcoal (Buy) or firewood.	25 (18.66)	2	1	4	13	1	-	4	356,516	14,655.78	63,620	3,349.97	866.32	82,492.07	4.73	10.43	21.38

Remark: 16 and 3 households not have any amount of electricity expenses in modal 1.1 and 1.2 respectively

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

Table 4-11 Energy use models (cont.)

Energy use Model	Amount of Household (Percents)	Occupation (Household)							Income per Group (Baht /Month)	Energy expenses (Baht)				Total energy expenses (Baht)	Proportion of Total energy expenses (Percents)		
		1	2	3	4	5	6	7		Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal .		Per income per Group	Per total household expenses of community	Per total energy expenses of community
2. Three Energy sources																	
2.1 Electricity - Fuel – Liquefied petroleum	19 (14.18)	1	2	6	6	-	-	4	317,137	15,030	37,050	5,492.32	-	57,572.68	3.30	7.28	14.92
2.2 Electricity - Fuel –Charcoal or firewood (Available)	10 (7.46)	2	3	-	4	-	3	-	68,833	1,979	4,621.67	-	-	6,599	0.38	0.83	1.71

Remarks: 3 and 6 households not have any amount of electricity expenses in modal 2.1 and 2.2 respectively

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

Table 4-11 Energy use models (cont.)

Energy Use Model	Amount of Household (Percents)	Occupation (Household)							Income per Group (Baht /Month)	Energy expenses (Baht)				Total energy expenses (Baht)	Proportion of Total energy expenses (Percents)		
		1	2	3	4	5	6	7		Electricity	Fuel	Liquefied petroleum gas. (LPG)	Charcoal		Per income per Group	Per total household expenses of community	Per total energy expenses of community
2. Three Energy sources																	
2.3 Electricity– Liquefied petroleum – Charcoal or firewood (Available)	3 (2.24)	-	-	-	2	-	-	1	11,583	361.50	-	299.17	-	660.67	5.70	0.17	0.084
2.4 Electricity– Liquefied petroleum – Charcoal or firewood (Buy)	2 (1.49)	-	-	-	-	-	-	2	5,500	-	-	99.58	100	199.58	3.62	0.05	0.03
2.5 Electricity– Fuel –Charcoal or firewood	1 (0.75)	-	-	-	-	-	-	1	2,500	-	1.67	-	-	1.67	0.000096	0.00021	0.00043

Remarks: - In modal 2.5, Kerosene (fuel) use incase of have a trouble on grid connection electricity only. Therefore, the households (one member) have a little amount of energy expenses.

- 2 households not have any amount of electricity expenses in modal 2.3 and 2.4

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

Table 4-11 Energy use models (cont.)

Energy Use Model	Amount of Household (Percents)	Occupation (Household)							Income per Group (Baht /Month)	Energy expenses (Baht)				Total energy expenses (Baht)	Proportion of Total energy expenses (Percents)		
		1	2	3	4	5	6	7		electricity	Fuel.	Liquefied petroleum gas. (LPG)	charcoal		Per income per Group	Per total household expenses of community	Per total denergy expenses of community
3. Two Energy sources																	
3.1 Electricity–Fuel	3 (2.24)	-	-	2	1	-	-	-	140,833	2,843.39	27,500	-	-	30,343.39	1.74	3.84	7.88
3.2 Electricity-Liquefied petroleum	1 (0..75)	-	-	-	-	-	-	1	2,000	150	-	150	-	300	0.02	0.04	0.08
3.3 Fuel – Charcoal or firewood	3 (2.24)	-	1	-	2	-	-	-	18,000	-	2,400	-	-	2,400	0.14	0.30	0.62
3.4 Electricity–Charcoal or firewood	2 (1.49)	-	-	-	1	-	-	1	5,700	300	-	300	-	300	0.02	0.04	0.08

Remarks: - Modal 3.1 have 2 households use electricity stove and 1 household use gas stove with their neighbor.

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

- Modal 3.3, the household can not access to electricity. Modal 3.4 have only one household.

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

Table 4-11 Energy use models (cont.)

Energy Use Model	Amount of Household (Percents)	Occupation (Household)							Income per Group (Baht /Month)	Energy expenses (Baht)				Total energy expenses (Baht)	Proportion of Total energy expenses (Percents)		
		1	2	3	4	5	6	7		electricity	Fuel.	Liquefied etroleum gas. (LPG)	charcoal		Per income per Group	Per total household expenses of community	Per total energy expenses of community
4. Four Energy sources and Renewable energy using (besides charcoal or firewood)	1 (0.75)	-	1	-	-	-	-	-	12,500	500	3,000	-	-	3,500	0.20	0.44	0.91
4.1 Electricity - Fuel – Biogas– charcoal or firewood. (Available)	1 (0.75)	-	-	-	-	-	-	1	35,000	1,600	10,000	150	-	11,750	0.67	1.49	3.05
4.2 Electricity - Fuel – Liquefied petroleum gas - Solar energy																	

Remarks: The household use biogas in modal 4.1 and Flat Plate Solar Collector in modal 4.2.

Occupation Code: 1 = Agriculture, 2 = Semi-agriculture, 3 = Government Officer, 4 = General Labor, 5 = Agricultural labor, 6 = Household Industry, 7 = Personal Business/ Merchandise/ Others

Studying the above 4 patterns of energy consumption, it was found that the energy consumption pattern 1.1 has highest propotion, then pattern 1.2 and 2.1 respectively, while pattern 2.5 has lowest proportion. The reasons why energy consumption proportion is different may be because of quantity of households, income, individual household's expense on energy, pattern of energy utilization, as well as energy consumption behavior. It was also found that the proportion of fuel oil energy consumption is highest since fuel oil is one of the essential parts of living and working of the community. It is also an always fluctuated factor. Anyhow, during the data collecting period, the fuel oil price was increased. Even though the villagers used other self-reliance energy such as charcoal and firewood to decrease the expense on energy, the expense was still high comparing the ratio of household total expense to the expense on energy. It is concluded in the following table.

4.4 Study Result of Structured In-depth Interview

Reporting was categorized by the result of structured in-dept interview with officers with high social status, and the result of structured in-dept interview with heads of household which would be analized in Chapter 3.

4.4.1 The result of structured in-depth interview with officers with high social status, i.e. village headman, TAO, and DCDO, can be catagorized as follows.

1) Community's acknowledgement of their energy situation: From structured in-depth interview with the officers with high social status, it was found that the community is lack of acknowledgement of their energy situation and energy problem situation. They do not aware of causes of problems and how they affect their community. They either do not aware that they consume external energy since they get used to it as a normal thing. The community do not obtain any information on energy and energy advanced technology, or they may get the information, but they do not realize that it is significant. These are factors causing the community to not count

energy problems as their business. Moreover, vision on energy of heads of the community is either not broaded.

2) Support on the energy development given by the public sector: From the structured in-dept interview, it is found that the support on energy development in the studied area is in form of energy consumption problem assist, especially on electricity which Provincial Electricity Authority is in charge. The village headman revealed that "There is no any agency seriously conduct alternative energy support. The TAO does not have any budget for this purpose." This fact conforms to the unavailible strategy or concept of energy development of the TAO. The head of the TAO said that "The strategy on development of the TAO emphasises on the community's well being under the Philosophy of Sufficiency Economy, as well as on public facilities. In terms of energy, we have never planned to develop it since we lack of knowledge and unstanding. Anyhow, if the community requires it, the TAO are willing to support them." In the other hand, the DCDO has a policy on energy development under the Sufficiency Economy Philosophy. It aims at transfering knowledge and understanding on alternative energy to any community. It also cooperates with the Provincial Energy Office to transfer knowledge on biogas generation from animal dung. Anyway, the head of the DCDO commented about the studied area that "The people in the community do not have knowledge and understanding on energy. Its heads are not interested or seriously concern about energy. Hence, the community do not get support from public sector. If they want to develop it, I think that the bio energy in household level, for example biogas, is most appropriate.

3) Energy development projects at present and in the future: It was found that the alternative energy development project is not available in this area. Presently, only the development projects on quality of life and occupation, as well as a campaign on less chemical application in agricultural sector by using animal dung and food residues to make organic fertilizer, are carried out. Energy development projects are expected to be done in the future. Nowadays, the village headman is interested in gasifire stoves supporting charcoal and firewood utilization in the community. He mentioned that "A lot of woods is available in our village; and there are a lot of households using charcoal and firewood. I am, therefore, interested in introducing the energy-saving stoves and 200-liter burning furnace to the community."

The head of the DCDO also has the same idea since he has awared that this community still use energy from charcoal and firewood in large quantity. He thus wants to introduce the *Iwate* stoves to the community to encourage them using charcoal and firewood as an alternative energy. For the TAO, it plans to eradicate and decrease the garbage volume in the community outside the municipal in the future. The garbage will be separated. Food residue will be fermented to be compost or generated biogas. Garbage ininerators is also required to eradicate unrecycled or unselled garbage. Anyhow, a feasibility study should be firstly conducted.

4) Problems and obstacles of energy development in the community: From the structured in-dept interview, the significant problems and obstacles of energy development in the community are as follows.

a. The lack of knowledge and understanding on the energy problem situation: The head headman stated his opinion that the community people do not aware of the information on energy. Hence, they do not realize the importance of energy saving. The heads of TAO and DCDO also agreeed with the village's head.

b. Potential of the leaders: The leaders have great role in directing on development in the area. Anyhow, they do not have any vision on energy. The head of the DCDO stated that one of parts of development must be from leaders' potential. To obtain the support on energy development from public sector, the community leaders must play great role in pushing it on.

c. The convenience of effortlessly obtaining energy : One of obstacles of alternative energy development in the community is the ability of effortlessly obtaining energy. The community, therefore, do not aware the importance of energy development. They get used to consume external energy. The head of the DCDO mentioned that Nong Makok village is located closely to a market. The villagers can afford energy conveniently. They thus do not aware of the importance of alternative energy.

d. The lack of cooperation between the community leaders and public sector: Even though it is interesting for the community, the leaders and public sector do not cooperate with each other on this. The leaders never seek for knowledge transfer from public sector, such as training and study tour on energy network or energy self-reliance communities. From interviewing the community leaders, it is

found that the community people never take a study tour on energy aspect, except on energy-saving stoves which will be applied to be used in the studied area.

e. The community unawareness on energy problem: The community do not aware of the energy problem since they consume external energy untill they get used to it. The village's head stated that living pattern of the community people has changed. They believe that the energy consumtion in the community is being increased since people work hardly to earn their living till their time is limited. Then they use electricity, fuel oil and liquid petroleum gas to facilitate their lives.

5) The possibility on energy self-reliance under the Sufficiency Economy Theory: From interviewing the officers with high social status on the possibility of energy development, it is found that they all agreed that the community concern building shall be conducted. It will stimulate the community people to realize about the importance of problems arisng from energy consumption, and energy saving, as well as the paticipation between the community and public sector. The head of the TAO expressed his opinion that to save energy, the community behavior changing should be the first start. It conforms to the opinion of the head of DCDO. He expressed that the community concern on sufficiency shall be firstly built with a campaign "consume every cultivated things, cultivate every consumed things; use every made things, make every used things." Then the people will spend less and save more, or be dept-free. Potential building to the community leaders or sampling group should be conducted to support them to be success in energy development and energy self-reliance. It will also be one of methods to influence the community. Public sector should support them knowledge, technology and budget. The village's head revealed that the villagers want to work on it, but they lack of knowledge, instrucments, and budget. The head of TAO agreed with this by saying that "The community must be assisted by public sector, such as organizing training and providing budget. It is too difficult, if we have to do it by ourselves."

4.4.2 The result interview of 48 heads of household representing each household with each pattern can be categorized as follows.

1. Knowledge and understanding of energy consumption:

1.1 Knowledge and understanding of energy consumption From interviewing agent household boss .It was found that most heads of household aware that electricity, fuel oil, LPG, as well as natural energy, such as water, wind, sunlight, human and animal labor is energy. Prasit Nu-ngen said that "Energy is any work derived from machine or human. Electricity, fuel oil and LPG is energy," It conformed to Plai Rabkhwamsuk who said that "Water, wind, sunlight, fuel oil and LPG is energy." In the other hand when they were asked about "nonrenewable energy", they do not understand its actual meaning. Anyhow, only a few of them could give some examples. For instance, Bang Ninthalak notified that "LPG is the nonrenewable energy," and Bunsong Prempri said that "Fuel oil and natural gas is the nonrenewable energy." It was same in renewable energy that only a few of them could identify which energy is renewable. Narong Prap-phon gave an exanple that "Water, wind and sunlight is always available, I thus think it is renewable." Bin Wongkuan said that "Water can generate electricity nonstop." Prawit Suksawat added that "Water can generate electricity, sunlight can generate solar energy, wind can also generate electricity through wind turbine." Even some could notify the examples of renewable energy but they did not know its actual meaning. Most of the heads of household misunderstood that electricity, fuel oil, and liquid petroleum gas is renewable. For example, In Chonti said that "It is renewable since we can buy more." Some were still confused about the actual maeaning of renewable energy. Suchat Maithong expressed that "I am still confused about renewable energy. I think that it is what for generating energy, then used to produce other things or recycled."

1.2 Knowledge and understanding of electricity consumption:

A. Resources of electric energy: From interviewing, the household leader's representatives could indicate the resources of electric energy. Most of them told that electricity is generated from water, and learn about energy generation technology. Bang Ninthalak notified that "Water and wind. Wind turbines can bail water and generate electricity. Sunlight can generate solar energy. I wanted to use them but I did not have budget, instrument and knowledge." Anyhow, some of

them learn that wind and sunlight can generate electricity, but they do not know about energy generation technology. For example, Narong Prap-phan revealed that “I know that wind and sunlight can generate electricity, but I do not know how.” Some do not know absolutely, such as Pin Sinthop who said that “I do not know that wind and sunlight can generate electricity. I only aware that sunlight dries clothes and wind brings cool air.”

B. Electric appliance procurement selection: According to interviewing with the heads of household, labels of energy efficiency is one of factors influenced to electric appliance procurement selection. Moreover, size, brand, and price also effect it. Sellers’ suggestion is another influence. Anyhow, most of them do not aware of Thai Industrial Standard symbol or TIS since they do not understand the meaning and significance of the symbol. Concerning about light bulb selection, most of them changed from incandescent ones to fluorescent or compact fluorescent ones. Some households expressed their opinion that compact fluorescent light bulbs are less bright than neon bulbs. Some did not know about energy-saving bulbs.

C. Safety in electric appliance utilization: It is found that all the heads of household have basic knowledge on the safety in electric appliance utilization. For example, when they plug in or switch on electrical appliances, their hands and feet must be dry; after using, electrical appliances must be disconnected; circuit breaker must be equipped and; sockets must be out of reach of the children. Some households use adapter sockets having fuse to cut electric cycle. For households that do not have safety, they unplug all electrical appliances, especially televisions and computers, or turn off circuit breakers when thunderstorm is hitting. Some oftenly inspect and clean their electrical appliances, such as refrigerators, electric kettles, fans, electric wires, etc. Some lined electric wires in iron pipes to better release heat occuring from induction.

D. Methods to save electricity: It is found that most households have good behavior on economical consuming electricity. For instance, they turn on the light as necessary and changed incandescent light bilbs to fluorescent or compact fluorescent ones. They always leave electricity disconnected. They placed heat release electrical appliances, such as refrigerators, televisions, computers, etc., in accordance

with instruction. They also turn off or disconnected electrical appliances after using them. They do not either load hot food to refrigerators.

1.3 Knowledge and understanding of fuel oil consumption :

A. Resources of fuel oil: Most of the heads of household do not know about it. Only a few could tell that fossil is a resource of fuel oil. Phutthachat Phiphatphiriyanon told that "Fuel oil comes from deposited fossil. Then it becomes crude oil."

B. Machinery or vehicle procurement selection: The first factor effecting to agricultural machinery or vehicle procument selection is its brand which is popular or individual preference. Bunma Srisawat revealed that "Only a few people know in details. Most of us bought that brand since others use it. We bought it after others but we do not know how many horse power it has." It conforms with Charuen Sawaengmokatham who said that "We select a popular brand." The second and respective factors are price, size, and horse power. Only a few people concern about fuel oil saving of its engine.

C. Safety in machinery or vehicle utilization: It is found that most households always inspect machinerary or vehicle condition, as well as regularly maintain it. For instance, walking tractors used only in cultivation season. They have to check some significant parts of them oftenly, i.e. boiler, fuel oil, and lubricant. Vehicles are also needed to be examined.

D. Methods to save fuel oil: All household leader's representatives aware the methods to save fuel oil, for example, for short distance travelling, walking or biking can substitute riding motorcycle; phoning substitutes travelling and; driving below 80 km/hr is recommended. They also aware that lubricant, air filter, and others parts of agricultural machinery or vehicle, especially old ones must be inspected regularly. Using alternative energy and setting travelling plan before using vehicle are also awared.

1.4 Knowledge on LPG Utilization :

A. LPG Source From the interview of household leader's representatives, the LPG source could not be identified.

B. LPG Tank Selection From the interview, most of them do not know how to choose LPG tank. Some households made delivery order to their

houses. Only a few can identify how they can choose appropriate LPG tank. For example, choose those are undistorted or swollen, unrusted, identified with manufacture etc.

C. Basic Safety for LPG Utilization From the interview of household leader's representatives, mos of them learn basic safety of LPG utilization. Such as inspection flow of gas from the tank by observing the smell and voice or using moistened sponge with powdered detergent or soap slipping around the flexible tube; Tightly turn off tank's valve each time after cooking; Correct turning off is firstly turn off at the tank prior to the gas stove. There are some who have never known due to none of knowledge and knowledge providers or anyeone who take care of them. For in sance, Mr. In Jultee mentioned that "I didn't hknow how to observe gas leakage. When gas is run out of or gas tank changing, I need my son's hands."

D. LPG Saving From the interview of household leader's representatives, behavior of LPG utilization is mostly economic. For example, turning on without strongly twisting the botton, fininishing food ingredients prior turning on for cooking; including ชurchasing instant food or using both charcoal and firewood to save LPG gas when they have to boil or stew food. Someone rearely use LPG gas. Such as Prayoon Sookpool said that " Rarely use it, only heat up some dishes. Mainly, I cook by charcoal." Some told that gas saving is difficult to do. Charuen Sawaengmoktham mentioned that "It is very difficult to economize. Is everyone economical? Everyone did. But where is the saving line. In a hurry, strongly twisting is a must. It depends on time arranging."

1.5 Knowledge on Alternative Energy :

Based on interview of houshold leader's representative, most of them have known alternative energy information by hearing, viewing and learning from mass media of television or telling from the others about succession of electrical enery, fuel oil and LPG gas by energy technology. But they have not profoundly learnt and realized the process of energy succession.

- Water, wind and solar energy for electrical generation

Natural power could refer to energy technology for electrical generation. Today, there are many who apply water heater by solar energy. Suchart Maithong told that "I have been using solar water heater for 5 years. I asked my friend for installation. He works

for the company of this matter. I assume that it would be good in the future. But I have not an idea of the maintenance care".

- Biogas Most of them have already known the succession of LPG by biogas. But few learnt about succession of electricity by biogas. Mr. Plai Sukawat(interview) said "I knew that biogas can be used for cooking but not known yet manufacturing process" His words match with Sanan Roobsom(interview) "I know biogas. It becomes from compost of dirty solid residues and dung. Only know roughly but never done it" At present, there is a household producing biogas for succession of LPG. Sangob Ekachat(interview) told that "The reason biogas utilization is saving for LPG. Previously, I saw air bubble burst out from buffalow wallow. I sought for books to study by myself. Before this I used for lighting the lamp for ducks. Now I have not raised ducts anymore. So I cease using it"

- Charcoal and firewood Being existing renewable energy, Charcoal and firewood have been using as renewable energy of the community from the past. Some households consume charcoal and firewood switching with LPG or using only charcoal and firewood but none of LPG. Charring charcoal is local wisdom of which the making pattern is adjusted to a 200-liter burning furnace. Subin Wong Kuan(interview) said that "I knew making it from consulting with myself. Gradually adjust it. This furnace can produce beautiful shpae of charcoal. Easy to burn. No materials for covering it". From interview of household leader's representativess using charcoal and firewood switching with LPG, the result is found that charcoal and firewood are used when cooking or stewing foods for a long time that could help LPG saving. From the preceding information, using alternatives energy, the result of the study is found that some household leader's representativess discovered other matterials that can be used in succession of charcaol and firewood. Sukanya Chamnarnphanit(interview) told that "rice husk, saw dust, ashes, muddy soil are mixed in replaced of charcoal. I saw people making it in many sheets expososing in sunlight" In using charcoal/firwood stoves, the local people still use "*Tao Ang Loh*",conventional stove. From the interview, most of them have not known saving energy stove.

- Biodiesel From the interview of household leader's representatives, many of them know biodiesel. Some know that biodiesel can be

produced from both oily plants and used vegetable oil. They can provide examples of oily plants such as bean, palm, *Saboo Dam* or Physic Nut(Jatropha curcas L.) Some have not known oily plants. However, they know that biodiesel is derived from used oil e.g nut, palm, *Saboo Dam* or Physic Nut(Jatropha curcas L.). They have not well up in manufacturing process. *Saboo Dam* or Physic Nut(Jatropha curcas L.) planted in the vacant areas nearby the household are cut because the owners lack of manufacturing process of biodiesel from *Saboo Dam*. *Noi Khaikaew(interview)* said that "I've ever planted *Saboo Dam* but cut it already. As it is unusable, unedible, unsold. So I planted few. But I knew that it can produc oil." Some have not well up in biodiesel at all.

2. Opinion on Energy Utilization

2.1 Opinion on commercial enrgy utilization e.g. electricity, oil and LPG

From the interview of houshold leaders, the study is found that commerical enery utilization could increase daily life convenience according to most of them. For instance, use of vehicles for transportation, farm machines to facilitate rapid manufacturing process. Bai Phan-Ngern(interview) stated that "Previously I used my bike. Suffered from using it, I had backache. When fuel oil is available, firstly, I used my bike and motorbike. After that I quit using bike as it damaged. So I only use motorbike even travelling near, rarely go on my feet."

2.2 Opinion on Energy Dependency

1) Opinion on electrical energy dependency From the interview of household leader's representatives, most of them commented that local resources for electrical energy generation in succession of electricity of public sector is a good idea. But the step of possibility may be in difficulty due to insufficiently agricultural materials, such as electricity generation from rice husk. At present most of local people do farming for commercial purpose. The remaining is very few for consumption. Thereby the rice husk is insufficient for electricity generatoin and no knowledge and understanding of the issue. In addition, the electricity service is widely available in the village.

2) Opinion on energy self-reliance of fuel oil From the interview of household leader's representatives, most of them commented that it is good idea to produce fuel oil in local community. Regarding planting oily plants But they have no knowledge for manufacture, including uncertainty of fuel quality whether the succession of general fuel oil by bio-fuel oil or not. Suchart Mai-Thong(interview) told that "How to plant it? Plant for occupation? It seems that each household save fuel as the price is higher. Is worthwhile for Establishing the factory?" Who will proceed it? In case of planting *Saboo Dam*, how much will be enough. Is it worth? Do our villagers dare to use it? Most of villagers have never thought to plant oily plants. Only few are interested in planting it. Sombat Kosopha(interview) stated that "I ever thought to plant. I saw in TV and read from book. But nobody near my house are intersted in it. There're only 10 *Saboo Dam* trees planted. Seen from TV, people plant it in quanity with 1,000 rai deriving massive yield. Most villagers do not dare to plant as concern unworthy return as calculated expectation of production is of under 1 litre per sack. Integrated management for planting might be possible for further proceeding. " In tracking back for using energy from human and animal power, it would be improbable. From the interview, most commented that using energy from human and animal power takes long time and is not rapid as farming machines.

3) Opnion on energy self-reliance of LPG fuel From the interview, most of household leader's representatives's representatives commented that it is good idea for succession of LPG fuel by local energy resources, in addition to using charcoal/firewood. Anyway, they are lack of knowledge in this issue. They also remarked that using charcoal/firewood is convenient as it could be easily found nearby the house and edge of field. Most of them own local wisdom of making charcoal. Sawat Boonkham(interview) told that "That's good but we haven't enough time for making it. In my point of view, wood is better(than others) as wood is easily found. After work, to cook some dishes, wood can be found surrounding house. "

3. Suggession of energy self-reliance

From the interview of household leader's representatives's representatives, energy self-reliance can be concluded as follows:

1. Provide course training for local community in terms of alternative energy, energy technology, a variety of energy benefits from self-reliance from related agencies.

2. Encourage demonstating group to present the alternative energy could be producible.

3. Consolidate the group for manufacture e.g. supply of manufacturing materials capital, laboring.

4. Require community participatory.

5. Need support of technology and budget.

CHAPTER V
DISCUSSIONS

Documentary research is performed by applying data collection instrument which is applied for processing and analysis correspondent with research's objectives as follows :

5.1 Energy consumption situation of Nong Makok Village

Based on the study of energy consumption situation of Nong Makok Village, Banna Subdistrict, Banna District, Nakhon Nayok Province, the result is found that the tendency of energy demand is increasing with less utilization of natural energy especially energy from human labor and animal power. Instead, they rely on technology and machine that needs external energy sources as most of them lack of knowledge and understanding on energy consumption. Some of knowledge are known but are not extended or opened to public making a chance to develop energy sources in their communities. There are 2 reasons for non-self-reliance on sustainable energy consumption:

5.1.1 personal capability on thinking or seeking knowledge for self-development that is key basic factor for building their capacity, for example some households have raw materials for energy development but lack of knowledge or less pay attention to development. They only wait for the Government subsidies and development. Therefore, communities cannot become energy self-reliant society.

5.1.2 Capacity of raw material, concerning biomass quantity potential can be generated energy but the obstacle is biomass collecting system. The biomass sources are scattered over agriculture area. Management on agriculture residual collecting system has not been studied by applying simple and convenient method including comparative study on return of agriculture residual use and energy

generating has never been conducted. For other natural energy sources, they could be developed but the development depends on feasibility of economic, social, culture, and fundamental knowledge or wisdom of community's member. Social and economic development system focuses on capitalism that provides change of energy consumption pattern of community as well. David C. McClelland, Everett E. Hagen, Max Weber (Theory of social transformation: Online) stated that starting point of social change had come from economic development. . Nowadays, overall energy expenditures of Nong Makok Village are high because total energy expenditures are a half of total expenditures of household. Form the study, the outcome revealed that energy consumption pattern is changed from the past to present consisting of commercial or external energy consumption only and conjunctive use of firewood/ charcoal and LPG. Which pattern can be speech in the heading below

5.2 The depending on energy model of the household in Nong Makok Village

5.2.1 Four (4) Types of Energy Use Model

5.2.1.1 Electricity-Fuel Oil-LPG-Charcoal or Firewood (self preparation)

This pattern is an integrated energy use that LPG is used for main energy source for cooking. While charcoal/firewood is used for long period of cooking such as simmer, grill & toast, and cooking for pet (dog). In case of good smell and taste, firewood/charcoal is also used for cooking as well as it is used while LPG is running out. Charcoal is prepared (charred) by themselves that each household can save some LPG expenditure including firewood/charcoal is used for earning for living such as straw mushroom dehydration. But use of electricity and fuel affects high household expenditure equivalent to 10.87 percent of total household expenditure. Although house size is small but energy demand for life and earn for living is high. Most of them are farmer and general hiring. Daily use of fuel provides increasing energy cost.

5.2.1.2 Electricity-Fuel Oil-LPG-Charcoal (purchasing) or Firewood

This pattern is an integrated energy between charcoal/firewood and LPG for cooking as the first pattern but charcoal is purchased for the reason that household member for charcoal preparation is lacked of time as well as irregular use. The reason for using charcoal is the same as the first pattern. This pattern provides high cost of energy consumption too. External energy expenditure is not only found but renewable energy expenditure is added up. It may cause increasing total energy expenditure. On the other hand, it might be said that this energy use pattern of the household mainly relies on external energy.

5.2.2 Three (3) Types of Energy Use Pattern

5.2.2.1 Electricity-Fuel Oil-LPG

This energy use pattern is only depended on external energy sources due to way of life change and hasty society with insufficient time for using firewood/charcoal. Most of them are civil servant and factories' worker; therefore, external energy sources are more convenient.

5.2.2.2 Electricity-Fuel Oil-Charcoal or Firewood (self preparation)

This pattern presents that charcoal/firewood is used for cooking instead of LPG. It is not integrated use as the patterns no. 5.2.1.1 and 5.2.1.2. The reason for using charcoal/firewood is unconfident, high cost of LPG, convenient and familiar for using as well as low income. So they do not increase household expenditure. Another reason, some household use charcoal/firewood while LPG is running out and LPG tank is not replaced due to pending for purchasing.

Although household head's occupation is general hiring but household cook stays in house that he/she can use charcoal/firewood without time constraint. It is presumed that energy self-reliance consumption for cooking is performed.

5.2.2.3 Electricity-LPG- Charcoal or Firewood (self preparation)

This pattern presents energy self-reliance on fuel oil consumption. Because traveling by bicycle and walking are performed due to elder household members. In the past, they used to drive motorcycle but they quit at present. They depend on their descendent and have low income with uncertain jobs. They are familiar with charcoal/firewood for cooking. The reasons are the same as the patterns no. 5.2.1.1, 5.2.1.2.

5.2.2.4 Electricity-LPG-Charcoal (purchasing) or Firewood

This pattern is the same as the pattern no. 5.2.2.3 but the difference is purchasing charcoal due to elder household member. They live alone that charcoal cannot be prepared by themselves. Their occupation are uncertain and without supporting by their descendent. Firewood/charcoal use pattern is the same as the pattern no. 5.2.1.1 and 5.2.1.2. Therefore, self-sufficiency living pattern and economy concept is performed.

5.2.2.5 Electricity-Fuel Oil-Charcoal or Firewood (self preparation)

This pattern is relied on fuel oil use but it is used for light source such as kerosene in case of black out, anyway it is seldom occurred. They use bicycle in stated of vehicle for travelling. Thereby, they perform some part of energy self-reliance consumption. Furthermore, electricity bill is not charged to households that consume electricity below 80 units per month according to the Government short-term policy on reducing electricity cost of household measure. In addition, such household become self-reliant on fuel for cooking by using charcoal/firewood. Charcoal is prepared by themselves with 200 liters charcoal kiln that provides least energy expenditure. Such behavior could be energy self-reliance.

5.2.3 Two (2) Types of Energy Use Pattern

5.2.3.1 Electricity-Fuel Oil

This pattern is performed without LPG due to applying electric stove instead of LPG. Moreover, energy for cooking is jointly used among main family and extended families. Reason of un-use charcoal/firewood is the same as the pattern no. 5.2.2.1 This type of family confronts high proportion of energy

consumption especially fuel oil due to using vehicle for travelling to work place regularly.

5.2.3.2 Electricity-LPG

This pattern could become self-reliant on fuel oil use that is the same as the patterns no. 5.2.2.3 and 5.2.2.4 but there is none of charcoal/firewood use due to convenient using LPG. Household is small with elder and children; therefore, using electricity and LPG is less.

5.2.3.3 Fuel Oil-Charcoal or Firewood (self preparation)

This pattern could become self-reliant on electricity energy use. The electricity use is substituted by other non-renewable energy such as kerosene, candle, and searchlight. They can live with normal status. The reason that such household with no electricity is constrained by financial limit because their house is far away from road that electricity is come together with road. Furthermore they could become self-reliant on LPG use due to substitution by charcoal/firewood. The reason of charcoal/firewood use is to save household expenditure. Their income is less and they have familiarized with charcoal/firewood application for a long time. Moreover, life style is not in the hasty society. So they can use charcoal/firewood. Such reasons are the same as the pattern no. 5.2.2.2 that provides less total household expenditure but it is more than the patterns no. 5.2.2.3, 5.2.2.4, and 5.2.3.2 (without fuel energy use in period of fuel price fluctuation); for example a family spends 2,000 THB per month for travelling with motorcycle to work place about 30 kilometers.

5.2.3.4 Electricity-Charcoal or Firewood (self preparation)

This pattern could become self-reliant on fuel oil use due to travelling by walk and supporting from their descendent for example one household has ever used motorcycle but he quits at present due to elder and safety for himself. Another family has never used vehicle. They travel by walk. In conclusion, such 2 samples could be self-reliant on energy for cooking.

5.2.4 Four (4) Types of Energy Use Pattern and Other Renewable Energy besides Charcoal/Firewood

5.2.4.1 Electricity-Fuel Oil-LPG-Biogas-Charcoal or Firewood (Self preparation)

This pattern is different from the preceding one. Because LPG is fully substituted by biogas besides using charcoal and firewood. Potential of biogas producing is high due to much raw material (dung). Such biogas is generated by trial that provides energy self-reliance for cooking. And proportion of energy use is less than the pattern no. 5.2.2.2 due to applying only charcoal/firewood. Concerning monthly household expenditure on energy, it is rather high due to high expenditure of fuel oil use.

5.2.4.2 Electricity- Fuel Oil-LPG-Solar Energy

General characteristic of this energy use pattern is considered that is similar to the pattern no. 5.2.1.1, 5.2.1.2, and 5.2.2.1 But the difference on applying solar energy for water heater is added that can save some monthly household expenditure of 200 THB approximately. It cannot be said that such pattern is sustainable energy use pattern because import energy expenditure is quite high that can be noticed from household expenditure record on energy consumption.

5.3 Analyse depending on energy model of Nong Makok Village

Household socio-economic change may affect energy consumption model change of household using external energy sources as a main energy sources e.g. electricity, fuel oil, and LPG. This energy use pattern provides household energy use expenditure that is higher than other pattern e.g. the pattern no. 5.2.1.1, 5.2.1.2 and 5.2.2.1 because such household performing this energy use pattern which has capability on acquiring external energy for consumption (electrical appliances, farm machines, and vehicles) earn their living by general hiring - both permanent and temporary employee. Most of them are factories' workers and civil servants that have sufficient salaries for external energy consumption especially on fuel oil consumption The findings are supported by the study outcome of Rungnapa (B.E.2547) that

monthly fuel oil expenditure of civil servant was ranked of 1,000-2,000 THB and 2,500-3,000 THB. They spent money for fuel of motorcycle, automobile, and commercial pickup truck because of value change. This outcome was also correspondent with the study result of Thienchay (B.E.2525) that household economic condition was determinant factor of their own behavior on energy consumption model. It was called purchasing capability but it was depended on energy use behavior. According to high cost of gasoline and diesel fuel provided fuel oil use behavior of household in communities. By result of communities interviewing, the investigation is found that communities change their fuel use behavior such as using bicycle or walking for short travelling. They make a plan for each travelling route each. Vehicles check up is regularly performed. Business men contact customers by phone instead of travelling. Some households use alternative fuel such as gasohol, LPG, NGV etc. Applying farm machine is a key factor to increase yield per rai due to less damage while harvesting and faster harvesting than human and animal labor. This directly affects increasing cost for production while the return is decreasing due to price depressing. Household expenditures are higher than income and the news reported by Khaosod Newspaper on November 5, B.E.2550 17th year, Vol. 6185 indicated that increasing fuel price had an effect to farmers' income, therefore, households' purchasing capability was decreased at all households' income interval when fuel price was increased.

By comparing ratio of energy consumption, the energy use the pattern no. 5.2.1.1 is the highest portion because households which perform energy consumption the pattern no.5.2.1.1 is the highest portion. Secondly is the patterns no. 5.2.1.2 and 5.2.2.1 Comparing energy expenditure per household of three (3) patterns is found that an average energy expenditure of three patterns are not different due to their behavior on energy consumption are the same. Therefore, the in-depth study should be further carried out on energy use behavior. Result from the pattern no. 5.2.1.2 is shown the highest energy consumption expenditure. In addition to the external energy, the renewable energy consumption and energy behaviour may affect total household expenditure on energy consumption. Moreover, the result of comparing energy consumption of the pattern no. 5.2.4.2 with the patterns no. 5.2.1.1, 5.2.1.2, and 5.2.2.1 is found that energy consumption of the pattern no. 5.2.4.2 is less than others.

If such expenditure is focused on energy consumption per household, expenditure portion is high comparing with household income. Even though solar energy is used for reducing expenditure but external energy demand is not relatively decreased- still remained. Another pattern with high energy consumption expenditure is the pattern no. 5.2.3.1 This is special pattern that applies one external energy instead of another external energy and extended family consumes the same energy sources that can save some household energy consumption expenditure. But the nature of civil servant and factory worker needs fuel oil that is the crucial factor of high energy consumption expenditure. It can be noted that any pattern which includes fuel oil consumption causes the highest expenditure. The percentage of fuel oil consumption is 78.97 percent of the total energy consumption expenditure.

Regarding less energy consumption pattern, the portion of energy consumption expenditure to the total energy consumption expenditure of target households and portion of energy consumption expenditure to total household expenditure is ranked from less to rather high with three (3) types of energy use pattern (except the pattern no. 5.2.1.2), two (2) types of energy use pattern (except the pattern no. 5.2.3.1), and four (4) types of energy use pattern and other renewable energy besides charcoal/firewood. Because the household performing those pattern above is low income household and their occupation is general hiring with daily travelling. These may influence on energy consumption pattern including most of household member - the elders- staying at house all day, therefore, they are less energy consumption person. Some households not using some external energy can reduce some households' energy consumption expenditure. It may be one of many ways of energy self-reliance consumption practice that energy consumption reduction is performed in part of unnecessary activities. But household can survive by using alternative energy both alternative energy by itself such as kerosene, candle, and searchlight or others alternative energy. For instance, the biogas should be applied for sustainable self-reliance practice.

The results of 4 energy consumption models are clearly seen that energy use pattern using biomass energy is the major portion from the past to present. Although these patterns are modified to intergraded use with LPG at present. Biomass energy is a key energy source of community for living both self preparation and

purchasing from local community. The reason for using charcoal/firewood is conventional practice from the past and high price of LPG. Moreover, foods cooked by biomass energy provides good taste. Anyway biomass energy is also used while LPG is running out as well as being unconfident on safety with LPG stove. These reasons are complied with the study result of Wattana (B.E.2541), the determinant factor of decision making on denial LPG is safety. While decision making on LPG acceptation is concerned on the convenience and rapid practice (both practice and transportation) with short-time delivery and not dirty vehicle. This is complied with the study of Wattana (B.E.2541) that LPG is used due to easily and conveniently acquiring for practice. Source of firewood come from the place nearby their houses, own garden area or garden permitted by any owners, and edge of agricultural field; for example mango tree, tamarind tree, Yellow sentol tree, Siamese neem tree etc. Charcoal is prepared by applying local wisdom. If the wood is strength, charcoal property will be good such as Siamese neem tree, Sakae tree (*Combretum quadrangulare Kurz*), and Krabok (*Irvingia malayana Oliv. ex a. Benn*.) etc. Wood for firewood and charcoal making presented that Nong Makok Village is able as a part of energy self-reliance for cooking. Most of stoves are conventional type. In case of replacing with energy saving stove or high efficiency stove, utilization of charcoal or firewood may be more efficient. Concerning agriculture residual (paddy field or livestock farm) could be developed for household consumption by selecting an appropriate technology for community socio-economic condition. The approach should start from household level development based on their potential and the most appropriate energy self-reliance model for demonstration. Such model can be adapted for applying all energy use patterns of Nong Makok Village that is an integrated energy source use pattern such as charcoal/firewood or bio-gas together with LPG application. Because charcoal/firewood which is conventional energy has been used in the community for a long time and such energy is still used in the present. This is the local community way of life but it should be modified to be an integrated use. Concerning bio-gas from animal dung, the activity could be promoted for household with high potential of raw material (animal dung). By assessment of bio-gas from animal dung potential, the product could be produced equivalent to LPG 1,242.92 Kilogram per year or 103.57 Kilogram per month approximately. With 15 Kg of LPG

tank (290 THB without transportation cost) used by one household for two months, the consumption rate is 7.5 Kg/month equivalent to 145 THB/month. It could be seen that fuel quantity from biogas is more productive quantity. So it can be used for cooking 3 meals as well. Moreover it can substitute electricity and fuel oil by engine modification such as farm machines. If such machine is modified to be Diesel Dual Fuel (DDF) System (diesel with bio-gas), Diesel fuel can be reduced by 60-70 %. Moreover, energy crop is promoted for plantation which is a way for enhancing community energy self-reliance such as Physic Nut (*Saboodam*) which can be planted as intercropping pattern with main crop, edge of agriculture field, and some area of garden field. By household interviewing, Physic Nut can be planted in this village.

5.4 Energy development of Nong Makok Village in the future

For energy development, public sector enhancement is indispensable to create energy proficiency as the community lack of knowledge on energy, energy technology and neglect of another kinds of alternative energy. Furthermore, the community way of life depends on external energy to which the villager have been familiar and easily acquired due to the nearby location of urban. In this regard, this might affect the other alternative energy consumption because they have been previously using conventional energy. Hence, knowledge dissemination is substantial issue for local alternative energy development for which the community leaders are the core in operation. According to the government agencies' point of view, the ongoing key obstacle of community energy development is community leader potential and energy knowledge and possibility of energy self-reliance development starting from capacity building of local people awareness. Energy development project may be consequently constituted subject to intensive requirement of the community and development participatory regarding the energy self-reliance.

CHAPTER VI
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The research objectives emphasized on studying, survey and analyze the energy consumption situation in the village and to investigate its potential of internal energy sources and further propose as the future policy determination related internal dependency of energy self-reliance model to public sector or concerned agencies. The conceptual framework was based on local energy self-reliance model in the future under the philosophy of sufficiency economy. The approach explored an appropriate energy consumption of local energy self-reliance model in the future to propose as the policy determination in development of internal energy succession according to its economic, social, cultural and environmental aspects. The study area was at Nong Makok Village, Banna Subdistrict, Banna District, Nakhon Nayok Province. The secondary data of the study area, related concepts and principles of energy and those of self-reliance collected by the researcher are analyzed and synthesized for guidelines of the investigation. Primary data collection was carried out for mathematical analysis with descriptive statistic and interpretation to report result regarding objectives.

The outcome revealed that village's energy consumption model had been changed from the past. Conventional energy consumption in daily life and subsistence being previously nature and local sources dependency for energy production i.e. solar energy, heat and human and animal power was replaced with commercial energy or fossil energy, fuel oil and LPG fuel. The alteration has been changing since B.E. 2500 resulting from public facilities provided in the village starting from electricity, road access resulting electric appliances, vehicles and agricultural machines as well as LPG fuel. As a result, the household energy expenditures were increasing. Village household expenditures were increased to 49.05% of the total household expenditures

of which were categorized into electricity 8.21%, fuel oil 38.49, LPG fuel 2.23% and alternative energy from charcoal 0.12%.

Household energy consumption model of Nong Makok Village was mainly an integrated model with charcoal and firewood. The alternative energy was renewable energy from biomass integrated with LPG fuel. In addition, the biogas and solar energy were applied as well. This might be said that, with integrated energy consumption model, the local people have been pursuing simply living and being self-sufficient though the commercial energy effect. The energy consumption was developed according to the philosophy of sufficiency economy in energy development, moderately frugal basis of charcoal and firewood integrated with LPG fuel. The energy consumption with reasonableness with using charcoal and firewood without LPG fuel including biomass production for household which were local source energy. They were lack of reinforcement of self-immunity system for energy development. As the community was deficient of understanding and knowledge of alternative energy development. Therefore, Nong Makok Village has not yet sustainably depended on energy self-reliance. However, it might be said that the preceding energy consumption model is a guideline for household and community energy development at a level of which the vital operation needs abundance of public sector and concerned agencies participatory.

6.2 Research Application

Based on the result of 4 energy consumption models of Nong Makok Vilage, the fundamental information such as site condition, energy consumption models and potential of energy sources could be applied for based information of similar communities. The important is that the 4 energy consumption models could be applied for further research of several of energy project aspects. The contribution would completely provide a number of benefits in energy self-reliance under the community potential, in particular from biomass energy and appropriate technology energy. The practice is required participation from the local people and government sector and the stakeholders to achieve the goal for reinforcement of energy self-

reliance at household and community levels and disperse the risk of country's energy utilization. To accomplish this, the community's energy learning process is inextricably linked to knowledge base of energy, energy technology and budget including strategic planning and efficient management according to their way of life and environment on own resources in the community under the philosophy of sufficiency economy. The ideology is dispensable to build up energy self-reliance development which is in compliance with government policy of alternative energy promotion in the community. Its policy is to enhance and develop every kind of alternative energy to create the choices for populace regarding the philosophy of sufficiency economy. Furthermore, the system reinforces energy development, production and utilization in line with environmental care and clean energy that are considered the substantial policies.

6.3 Suggestion for Further Study

Suggestion for further study is divided into 2 points:

6.3.1 The research to propose as policy determination on energy self-reliance of household and community.

At present, the energy management tendency for optimum efficiency is proceed at Small Scale Activity. As we could be seen from energy research is mainly emphasized at local and community levels. The study is specialty concern to ease the researcher's convenient for data collection and clear issue response of the particular problems. In case that each aspect of the research which is relatively linked could be integrated for interdisciplinary study, the community's overall perspective would be clearer view. Recommended research in the future should be the research set of community's sustainable energy self-reliance model in the future. The approach is aimed at studying community potential and energy source potential to determine appropriate energy self-reliance model in the household and community adjustable for everyone. The system would suitably lead to strategic planning of household and community according to own economic and social conditions. Systematic implementation would raise more distinctness in energy development at local level,

moreover, role identification in development participation- who should take the crucial role. The research set of community's sustainable energy self-reliance model in the future would comprise of following sub-sets.

- Research Set 1: Feasibility of community energy development involves determinant factors of energy in terms of structure e.g. the study of appliances efficiency and behavior e.g. way of life pattern, energy proficiency, energy saving awareness.

- Research Set 2: The study of community potential in local alternative energy development with SWOT ANALYSIS

- Research Set 3: Feasibility study of energy self-reliance model with (Participatory Action Research-PAR) for the investigation result of effect on performance of substantial self-reliance from brain storming of stakeholders participatory. The approach would be paradigm adjustment of conventional research. The method is primarily carried out to fix an issue and end the process by the researcher.

6.3.2 The investigation of appropriate technology in energy management regarding energy source potential in household and community.

From the study of energy source potential in the community, the result might be provided as fundamental information for energy source development to constitute community's energy self-reliance. In any case, the utilization of energy source potential has to operate in parallel to appropriate technology for efficient energy sources management in compliance with local wisdom and being inconsistent with economic, social and cultural conditions of the community. The study of appropriate energy technology is therefore important. The further study should be conducted on appropriate energy technology and energy source potential of the community and the appropriate technology assessment to develop local energy. The investigation should include comparative study on advantages and disadvantages in terms of efficiency and economics, on the point of view of the community towards energy technology with participatory action research (ACR) on appropriate technology alternatives.

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APPENDICES

APPENDIX A

สัดส่วนการใช้พลังงานแต่ละรูปแบบ

ตารางที่ ภ-1 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม

รูปแบบการพึ่งพาพลังงาน	รายได้รวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
1. รูปแบบการพึ่งพาพลังงาน 4 ชนิด									
1.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน ฟืน(หาเอง) จำนวน 63 ครัวเรือน	768,047	25,106	156,460	8,108.44	-	3.27	20.37	1.06	-
1.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน (ซื้อ) ฟืน(หาเอง) จำนวน 25 ครัวเรือน	356,516	14,655.78	63,620	3,349.97	-	4.11	17.84	0.94	0.24

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-1 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	รายได้รวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมัน เชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2. รูปแบบการพึ่งพาพลังงาน 3 ชนิด									
2.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม จำนวน 19 ครัวเรือน	317,137	15,030.36	37,050	5,492.32	-	4.74	11.68	1.73	-
2.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง ถ่านและฟืน (หาเอง) จำนวน 10 ครัวเรือน	68,833	1,979	4,620	-	-	2.88	6.71	-	-
2.3 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่านและฟืน (หาเอง) จำนวน 3 ครัวเรือน	11,583	361.50	-	299.17	-	3.12	-	2.58	-
2.4 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่าน (ซื้อ) และฟืน จำนวน 2 ครัวเรือน	5,500	-	-	99.58	100	-	-	1.81	1.82

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-1 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	รายได้รวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2.5 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง (น้ำมันก๊าด) ถ่านและฟืน (หาเอง) จำนวน 1 ครัวเรือน	2,500	-	1.67	-	-	-	0.067	-	-
3. รูปแบบการพึ่งพาพลังงาน 2 ชนิด									
3.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง จำนวน 3 ครัวเรือน	140,833	2,843.39	27,500	-	-	2.02	19.53	-	-
3.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม จำนวน 1 ครัวเรือน	2,000	150	-	150	-	7.5	-	7.5	-
3.3 รูปแบบการพึ่งพาพลังงาน น้ำมันเชื้อเพลิง ถ่าน ฟืน(หาเอง) จำนวน 3 ครัวเรือน	18,000	-	2,400	-	-	-	13.33	-	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

: รูปแบบการพึ่งพาพลังงานที่ 2.5 ซื้อน้ำมันก๊าดเก็บไว้ใช้ เมื่อเกิดไฟฟ้าดับ โดยซื้อครั้งละ 1 ปี๊บ ปี๊บละ 20 ลิตร ใช้ได้ประมาณ 1 ปี

ตารางที่ ภ-1 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	รายได้รวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
3.4 รูปแบบการพึ่งพาพลังงานไฟฟ้า ถ่านและฟืน (หาเอง) จำนวน 2 ครัวเรือน	5,700	300	-	-	-	5.26	-	-	-
4. รูปแบบการพึ่งพาพลังงาน 4 ชนิด และมีการใช้พลังงานทดแทนนอกจากถ่านและฟืน									
4.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สชีวภาพ ถ่าน และฟืน(หาเอง) จำนวน 1 ครัวเรือน	12,500	500	3,000	-	-	4	24	-	-
4.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม พลังงานแสงอาทิตย์	35,000	1,600	10,000	150	-	4.57	28.57	0.43	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-2 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายรวมภายในกลุ่ม

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อค่าใช้จ่ายรวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
1. รูปแบบการพึ่งพาพลังงาน 4 ชนิด									
1.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน ฟืน(หาเอง) จำนวน 63 ครัวเรือน	349,861	25,106	156,460	8,108.44	-	7.18	44.72	2.32	-
1.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง ก๊สหุงต้ม ถ่าน (ซื้อ) ฟืน(หาเอง) จำนวน 25 ครัวเรือน	171,804.66	14,655.78	63,620	3,349.97	-	8.53	37.03	1.95	0.50

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-2 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายรวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2. รูปแบบการพึ่งพาพลังงาน 3 ชนิด									
2.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม จำนวน 19 ครัวเรือน	136,110.67	15,030.36	37,050	5,492.32	-	11.04	27.22	4.04	-
2.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง ถ่านและฟืน (หาเอง) จำนวน 10 ครัวเรือน	33,616.65	1,979	4,620	-	-	5.89	5.89	-	-
2.3 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่านและฟืน (หาเอง) จำนวน 3 ครัวเรือน	3,624.67	361.50	-	299.17	-	9.97	-	8.25	-
2.4 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่าน (ซื้อ) และฟืน จำนวน 2 ครัวเรือน	2,000	-	-	99.58	100	-	-	4.98	5

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-2 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายรวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2.5 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง (น้ำมันก๊าด) ถ่านและฟืน (หาเอง) จำนวน 1 ครัวเรือน	1,108.33	-	1.67	-	-	-	0.15	-	-
3. รูปแบบการพึ่งพาพลังงาน 2 ชนิด									
3.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง จำนวน 3 ครัวเรือน	50,833.33	2,843.39	27,500	-	-	5.59	54.10	-	-
3.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม จำนวน 1 ครัวเรือน	1,583.33	150	-	150	-	9.47	-	9.47	-
3.3 รูปแบบการพึ่งพาพลังงาน น้ำมันเชื้อเพลิง ถ่าน ฟืน(หาเอง) จำนวน 3 ครัวเรือน	7,116.67	-	2,400	-	-	-	33.72	-	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

: รูปแบบการพึ่งพาพลังงานที่ 2.5 ซื้อน้ำมันก๊าดเก็บไว้ใช้ เมื่อเกิดไฟฟ้าดับ โดยซื้อครั้งละ 1 ปี๊บ ปี๊บละ 20 ลิตร ใช้ได้ประมาณ 1 ปี

ตารางที่ ภ-2 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายรวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
3.4 รูปแบบการพึ่งพาพลังงานไฟฟ้า ถ่านและฟืน (หาเอง) จำนวน 2 ครัวเรือน	2,500	300	-	-	-	12	-	-	-
4. รูปแบบการพึ่งพาพลังงาน 4 ชนิด และมีการใช้พลังงานทดแทนนอกจากถ่านและฟืน									
4.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สชีวภาพ ถ่าน และฟืน(หาเอง) จำนวน 1 ครัวเรือน	5,500	500	3,000	-	-	9.10	54.55	-	-
4.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม พลังงานแสงอาทิตย์	25,000	1,600	10,000	150	-	6.4	40	0.60	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-3 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายพลังงานรวมภายในกลุ่ม

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายพลังงานรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
1. รูปแบบการพึ่งพาพลังงาน 4 ชนิด									
1.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน ฟืน(หาเอง) จำนวน 63 ครัวเรือน	189,674.44	25,106	156,460	8,108.44	-	13.24	82.49	4.27	-
1.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน (ซื้อ) ฟืน(หาเอง) จำนวน 25 ครัวเรือน	82,492.07	14,655.78	63,620	3,349.97	-	17.77	77.12	4.06	1.05

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-3 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายพลังงานรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2. รูปแบบการพึ่งพาพลังงาน 3 ชนิด									
2.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม จำนวน 19 ครัวเรือน	136,110.67	15,030.36	37,050	5,492.32	-	26.11	64.35	9.54	-
2.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง ถ่านและฟืน (หาเอง) จำนวน 10 ครัวเรือน	33,616.65	1,979	4,620	-	-	29.99	70.01	-	-
2.3 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่านและฟืน (หาเอง) จำนวน 3 ครัวเรือน	3,624.67	361.50	-	299.17	-	54.68	-	45.25	-
2.4 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม ถ่าน (ซื้อ) และฟืน จำนวน 2 ครัวเรือน	2,000	-	-	99.58	100	-	-	49.89	50

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

ตารางที่ ภ-3 สัดส่วนพลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	ค่าใช้จ่ายพลังงานรวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
2.5 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง (น้ำมันก๊าด) ถ่านและฟืน (หาเอง) จำนวน 1 ครัวเรือน	1,108.33	-	1.67	-	-	-	100	-	-
3. รูปแบบการพึ่งพาพลังงาน 2 ชนิด									
3.1 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า น้ำมันเชื้อเพลิง จำนวน 3 ครัวเรือน	50,833.33	2,843.39	27,500	-	-	9.37	90.63	-	-
3.2 รูปแบบการพึ่งพาพลังงาน ไฟฟ้า แก๊สหุงต้ม จำนวน 1 ครัวเรือน	1,583.33	150	-	150	-	50	-	50	-
3.3 รูปแบบการพึ่งพาพลังงาน น้ำมันเชื้อเพลิง ถ่าน ฟืน(หาเอง) จำนวน 3 ครัวเรือน	7,116.67	-	2,400	-	-	-	100	-	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

: รูปแบบการพึ่งพาพลังงานที่ 2.5 ซื้อน้ำมันก๊าดเก็บไว้ใช้ เมื่อเกิดไฟฟ้าดับ โดยซื้อครั้งละ 1 ปี๊บ ปี๊บละ 20 ลิตร ใช้ได้ประมาณ 1 ปี

ตารางที่ ภ-3 สัดส่วนพลังงานแต่ละชนิดต่อค่าใช้จ่ายพลังงานรวมภายในกลุ่ม (ต่อ)

รูปแบบการพึ่งพาพลังงาน	รายได้รวมภายในกลุ่ม	ค่าใช้จ่ายพลังงานแต่ละชนิดภายในกลุ่ม				สัดส่วนการใช้พลังงานแต่ละชนิดต่อรายได้รวมภายในกลุ่ม			
		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน
3.4 รูปแบบการพึ่งพาพลังงานไฟฟ้า ถ่านและฟืน (หาเอง) จำนวน 2 ครัวเรือน	2,500	300	-	-	-	100	-	-	-
4. รูปแบบการพึ่งพาพลังงาน 4 ชนิด และมีการใช้พลังงานทดแทนนอกจากถ่านและฟืน									
4.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สชีวภาพ ถ่าน และฟืน(หาเอง) จำนวน 1 ครัวเรือน	3,500	500	3,000	-	-	14.29	85.71	-	-
4.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม พลังงานแสงอาทิตย์	11,750	1,600	10,000	150	-	13.62	85.11	1.28	-

หมายเหตุ : หมายถึง ไม่มีค่าใช้จ่าย

APPENDIX B

ตารางที่ ภ-4 สัดส่วนวัสดุเหลือใช้ทางการเกษตร (Residue ration)

ชนิดพืช	วัสดุเหลือทางการเกษตร	อัตราส่วนวัสดุเหลือใช้ต่อผลผลิต	แฟคเตอร์วัสดุที่ยังไม่มีการใช้	ค่าความร้อน (MJ/kg)
ข้าวนาปี/ข้าวนาปรัง/ข้าวไร่	ต้นข้าว (ฟางข้าว)	0.447	0.684	10.24
	ตอซังข้าว	0.550	0.684	11.30
	แกลบ	0.230	0.493	14.27
ข้าวโพด	ซังข้าวโพด	0.273	0.670	18.04
ข้าวฟ่าง	ใบและลำต้น	1.252	0.648	19.23
มันสำปะหลัง	ก้าน,ใบ	0.088	0.407	18.42
อ้อย	ชานอ้อย	0.291	0.987	16.28
	ยอดและใบอ้อยแห้ง	0.302	0.987	16.23
มะพร้าว	เปลือก	0.362	0.595	17.93
	กะลา	0.160	0.378	25.40
	ดอก,จั่น	0.049	0.843	15.40
	ก้านมะพร้าว	0.225	0.809	16.00
	Empty Bunches	0.428	0.584	17.86
ปาล์ม	Fiber (เส้นใยปาล์ม	0.147	0.134	17.62
	Shell (กะลา)	0.049	0.037	18.46
	Frond (ทางปาล์ม)	2.604	1.000	9.83
	Male Bunches (ทะลายปาล์ม)	0.233	1.000	16.33
เศษไม้	กิ่งก้าน	0.260	1.000	19.23
ถั่วลิสง	เปลือก	0.323	1.000	12.66
ถั่วเหลือง/ถั่วเขียว	ลำต้น,ใบและเปลือก	2.663	0.760	19.44
ฝ้าย	ลำต้น	3.232	1.000	14.49

ที่มา : สำนักถ่ายทอดและเผยแพร่เทคโนโลยี, 2547 , กรมพัฒนาและส่งเสริมพลังงาน,2542 , ศูนย์สารสนเทศการเกษตร,2544, กรมพัฒนาและส่งเสริมพลังงาน

APPENDIX C

ตารางที่ ภ-5 สัดส่วนการเกิดก๊าซชีวภาพของมูลสัตว์

ชนิดสัตว์	ปริมาณมูลสด (กก./ตัว/วัน)	อัตราส่วนมูลที่เก็บได้	อัตราส่วนของแข็งทั้งหมด	อัตราส่วนของแข็งที่ระเหยได้ (%)	อัตราส่วนก๊าซชีวภาพที่ผลิตได้ (m^3/กก. ของแข็งระเหยได้
กระบือ	8.00	0.50	17.77	13.64	0.286
โคเนื้อ	5.00	0.50	17.44	13.37	0.307
โคนม	15.00	0.80	17.44	13.37	0.307
สุกรแม่พันธุ์	2.00	0.80	35.22	24.84	0.217
สุกรพ่อพันธ์	2.00	0.80	35.22	24.84	0.217
ลูกสุกร	0.50	0.80	35.22	24.84	0.217
สุกรขุน	1.20	0.80	35.22	24.84	0.217
สุกรพื้นเมือง	1.20	0.80	35.22	24.84	0.217
ไก่	0.03	0.80	33.99	22.34	0.242
เป็ด	0.03	0.40	26.82	17.44	0.310
ช้าง	40.0	0.50	26.64	21.61	0.241

หมายเหตุ : กำหนดค่าความร้อนของก๊าซชีวภาพเท่ากับ 21.6 MJ/m^3

ที่มา : สถานเทคโนโลยีชีวภาพ 14,กรมส่งเสริมการเกษตร15, กรมพัฒนาและส่งเสริมพลังงาน16

APPENDIX D

ตารางที่ ภ-6 แสดงข้อมูลพลังงานของไม้ ถ่านไม้ และเชื้อเพลิงเขียว

No.	ชนิดไม้/วัสดุ	ค่าความร้อนของไม้ (Cal/g)	ค่าความร้อนของถ่าน (Cal/g)	ปริมาณความชื้นของไม้ (%)	ความหนาแน่นไม้อบแห้ง (g/cm3)	ความหนาแน่นถ่านก้อน (g/cm3)	ผลผลิตถ่าน (%)	ประสิทธิภาพเตาหุงต้ม: เวลาที่น้ำเดือด (นาที)	เชื้อเพลิงที่ใช้ (กรัม)	ปริมาณน้ำที่ระเหย (กรัม)	งานที่ได้ H2O/Fuel	ประสิทธิภาพการใช้งาน (%)	ปริมาณความชื้นของถ่าน (%)	ปริมาณสารที่ระเหยได้ (%)	ปริมาณจี้ถ่าน (%)	ปริมาณคาร์บอนเสถียร (%)	Conversion Efficiency	คุณสมบัติถ่าน	ข้อมูลจากงานวิจัย
2/2	กระถินณรงค์ A. auriculiformis Cunn.	4.77 kCal	7.47kCal	80	0.57	0.41	46.4	14.8	339	876	2.58	28.63	5.1	24.0	4.0	4.0	61.6		การทดสอบคุณภาพและประสิทธิภาพการใช้งานของถ่านไม้ 11 ชนิด นลุมล ภานุน้ำภา ปี 2532.
18/1	สนทะเล Casuarina equisetifolia Blume.	4.57 kCal	7.89kCal	80	0.80	0.70	40.8	13.0	361	970	2.69	28.02	4.7	13.0	2.5	2.5	69.8		
19/1	สนประดิพัทธ์ Casuarina junghuhniana Miq.	4.62 kCal	7.59kCal	15	0.60	0.45	38.4	15.2	324	753	2.32	25.08	5.0	18.9	3.5	3.5	58.3		
20	สะแก Combretum quadrangulare Kurz.	4.60kCal	6.90kCal	89	0.69	0.40	46.5	13.6	377	1,014	2.69	27.26	5.1	16.2	3.9	3.9	61.2		"
21/1	ยูคาลิปตัส Eucalyptus sp.	4.66kCal	7.35kCal	36	0.62	0.42	43.6	14.4	352	732	2.08	25.98	4.3	16.7	3.5	3.5	59.1		"
22/1	กระถินยักษ์ Leucaena leucocephala (Lam.) deWit	4.58 kCal	7.43kCal	36	0.73	0.44	43.2	14.2	364	818	2.25	25.28	2.8	18.9	2.7	2.7	65.9		"
23	เลี่ยน Melia azedarach L.	4.63 kCal	7.43kCal	39	0.55	0.34	32.3	14.0	348	879	2.53	27.46	3.1	24.1	2.8	2.8	64.2		"
24	นนทรี Peltophorum pterocarpum	4.93 kCal	7.03kCal	36	0.54	0.33	43.5	13.6	366	826	2.26	25.06	4.9	20.5	3.7	3.7	66.5		"
25	โกงกาง Rhizophora sp.	4.58 kCal	7.50kCal	14	0.91	0.49	43.8	13.6	380	948	2.49	27.92	3.8	17.2	2.5	2.5	66.4		"
26	มะกอก Spondias pinnata	4.54 kCal	7.19kCal	167	0.38	0.30	41.5	16.6	338	832	2.49	26.87	4.2	21.6	4.6	4.6	61.6		"
27/1	สีเสียดแก่น Acacia catechu	-	-	-	-	-	-	13.8	389	970	2.5	27.11	-	20.8	4.0	4.0	63.8		"

ที่มา : งานพัฒนาพลังงานจากไม้ กลุ่มงานพัฒนาผลิตผลป่าไม้ สำนักวิจัยการจัดการป่าไม้ และผลิตผลป่าไม้ กรมป่าไม้, 2550

APPENDIX E

นโยบายพลังงานของประเทศ

โดย

นายวรรณรัตน์ ชาญนุกูล

รัฐมนตรีว่าการกระทรวงพลังงาน

วันจันทร์ที่ 12 มกราคม 2552

<u>นโยบายที่ 1 : ความมั่นคงด้านพลังงาน</u> : พัฒนาพลังงานให้ประเทศไทยสามารถพึ่งตนเองได้มากขึ้น โดยจัดการพลังงานให้เพียงพอ มีเสถียรภาพ ด้วยการเร่งสำรวจพัฒนาแหล่งพลังงานประเภทต่างๆ ทั้งภายในประเทศและต่างประเทศ และเร่งให้มีการเจรจากับประเทศเพื่อนบ้านในระดับรัฐบาลเพื่อร่วมพัฒนาแหล่งพลังงาน วางแผนพัฒนาไฟฟ้าให้มีการกระจายชนิดของเชื้อเพลิงที่ใช้เพื่อลดความเสี่ยงด้านการจัดหา ความผันผวนทางด้านราคา และลดต้นทุนการผลิตส่งเสริมการผลิตไฟฟ้าจากพลังงานหมุนเวียนที่มีศักยภาพ โดยเฉพาะโครงการผลิตไฟฟ้าขนาดเล็กและโครงการผลิตไฟฟ้าขนาดเล็กมาก รวมทั้งศึกษาความเหมาะสมในการพัฒนาพลังงานทางเลือกอื่นๆมาใช้ประโยชน์ในการผลิตไฟฟ้า โดย

1) ส่งเสริมการผลิต น้ำมันดิบและคอนเดน-เสทในประเทศ และพัฒนาระบบโครงสร้างพื้นฐานที่เกี่ยวข้อง

2) จัดหาก๊าซธรรมชาติจากในประเทศและต่างประเทศให้เพียงพอและพัฒนาระบบโครงสร้างพื้นฐานที่เกี่ยวข้อง

3) พัฒนากิจการไฟฟ้าให้เหมาะสมเพียงพอกับความต้องการและส่งเสริมการกระจายชนิดเชื้อเพลิง

4) ศึกษาความเหมาะสมในการพัฒนาทางเลือกอื่นๆ ในการผลิตไฟฟ้า เช่น นิวเคลียร์ ถ่าน หินสะอาด หินน้ำมัน

5) แสวงหาแหล่งพลังงานในต่างประเทศ โดยเน้นการทำงานร่วมกันระหว่างภาครัฐและเอกชนผู้ประกอบการไทย

6) ส่งเสริมการพัฒนาอุตสาหกรรมพลังงานและอุตสาหกรรมต่อเนื่องให้มีความเข้มแข็ง

7) มีแผนเตรียมพร้อมรองรับวิกฤตการณ์ด้านพลังงาน

<u>นโยบายที่ 2 : พลังงานทดแทน</u> : ดำเนินการให้นโยบายด้านพลังงานทดแทนเป็นวาระแห่งชาติ โดยสนับสนุนการผลิตและการใช้พลังงานทดแทนโดยเฉพาะการพัฒนาเชื้อเพลิงชีวภาพและชีวมวล (E10 E20 และ E85) ไบโอดีเซล ขยะ และมูลสัตว์ เป็นต้น เพื่อเสริมสร้างความมั่นคงด้านพลังงาน ลดภาวะมลพิษ และเพื่อประโยชน์ของเกษตรกรโดยสนับสนุนให้มีการผลิตและใช้พลังงานหมุนเวียนในระดับชุมชนหมู่บ้าน ภายใต้มาตรการสร้างแรงจูงใจที่เหมาะสมรวมทั้งสนับสนุนการใช้ก๊าซธรรมชาติในภาคขนส่งให้มากขึ้น โดยขยายระบบขนส่งก๊าซธรรมชาติให้ครอบคลุมพื้นที่ทั่วประเทศ ตลอดจนส่งเสริมและวิจัยพลังงานทดแทนทุกรูปแบบอย่างจริงจังและต่อเนื่อง โดย

1) ส่งเสริมการผลิตและการใช้เชื้อเพลิงชีวภาพแทนน้ำมัน เช่น เอทานอล บโอดีเซล

2) ส่งเสริมการใช้ก๊าซธรรมชาติในภาคขนส่ง (NGV) ภาคอุตสาหกรรม ภาคธุรกิจและภาคครัวเรือน

3) ส่งเสริมพลังงานหมุนเวียนทุกรูปแบบ ทั้งลม แสงอาทิตย์ พลังน้ำ ชีวมวล ก๊าซชีวภาพ พลังงานจากขยะ

4) วิจัยและพัฒนาพลังงานทางเลือกพลังงานทดแทนและพลังงานในรูปแบบใหม่

5) ผลักดันให้พลังงานทดแทนเป็นวาระแห่งชาติ พร้อมกำหนดมาตรการจูงใจ

6) สร้างเครือข่ายพลังงานหมุนเวียนให้มีความเข้มแข็งโดยสร้างกระบวนการมีส่วนร่วมในชุมชน อำเภอและจังหวัด เพื่อสร้างความมั่นคงด้านพลังงานในระดับฐานราก

<u>นโยบายที่ 3 : กำกับดูแลราคา ความปลอดภัย</u> : กำกับดูแลราคาพลังงานให้อยู่ในระดับที่เหมาะสม มีเสถียรภาพ และเป็นธรรมต่อประชาชน โดยกำหนดโครงสร้างราคาเชื้อเพลิงที่เหมาะสมและเอื้อต่อการพัฒนาพืชพลังงาน รวมทั้งสะท้อนต้นทุนที่แท้จริงมากที่สุด และบริหารจัดการผ่านกลไกตลาดและกองทุนน้ำมัน เพื่อให้มีการใช้พลังงานอย่างประหยัด และส่งเสริมการแข่งขันและการลงทุนในธุรกิจพลังงาน รวมทั้งพัฒนาคุณภาพการให้บริการและความปลอดภัย โดย

1) กำกับดูแลราคาพลังงานให้มีเสถียรภาพและเป็นธรรม สะท้อนต้นทุนที่แท้จริงตามกลไกตลาด

2) ส่งเสริมการพัฒนาคุณภาพการให้บริการและความปลอดภัยของกิจการ สถานประกอบการ สถานีบริการและอุปกรณ์ด้านพลังงาน

3) ส่งเสริมการแข่งขันและการลงทุนในธุรกิจพลังงาน

<u>นโยบายที่ 4 : การอนุรักษ์พลังงานและประสิทธิภาพ</u> : ส่งเสริมการอนุรักษ์และประหยัดพลังงาน ทั้งในภาคครัวเรือน อุตสาหกรรม บริการ และขนส่ง โดยรณรงค์ให้เกิดวินัยและสร้างจิตสำนึกในการประหยัดพลังงาน และสนับสนุนการใช้พลังงานอย่างมีประสิทธิภาพ มีมาตรการจูงใจให้มีการลงทุนจากภาคเอกชนในการปรับเปลี่ยนอุปกรณ์ประหยัดและมาตรการสนับสนุนให้ครัวเรือนลดการใช้

ไฟฟ้าในช่วงการใช้ไฟฟ้าสูงสุด รวมทั้งการวิจัยพัฒนาและกำหนดมาตรฐานอุปกรณ์ไฟฟ้าและมาตรฐานอาคารประหยัดพลังงาน ตลอดจนสนับสนุนการพัฒนาระบบขนส่งมวลชน และการขนส่งระบบราง เพื่อให้มีการใช้พลังงานอย่างมีประสิทธิภาพและสามารถชะลอการลงทุนด้านการจัดหาพลังงานของประเทศ โดย

1) การพัฒนาและการอนุรักษ์พลังงานของประเทศ

2) รณรงค์ สร้างจิตสำนึกในการประหยัดพลังงานและการให้ความรู้ด้านการอนุรักษ์พลังงาน

3) สร้างแรงจูงใจและสิทธิประโยชน์ในการลงทุนเพื่อประหยัดพลังงาน

4) วิจัยและพัฒนาระบบและเทคโนโลยีที่ทำให้การประหยัด

5) กำหนดมาตรฐาน กฎ ระเบียบ สำหรับอุปกรณ์ วัสดุและวิธีการบริหารจัดการในการประหยัดพลังงาน

6) ส่งเสริมการสร้างเครือข่ายต้นแบบ เช่น ประกอบการ SME ที่มีความโดดเด่น สนใจในการประหยัดพลังงาน

<u>นโยบายที่ 5 : การดูแลสิ่งแวดล้อม</u> : ส่งเสริมการจัดหาและการใช้พลังงานที่ให้ความสำคัญต่อสิ่งแวดล้อมภายใต้กระบวนการมีส่วนร่วมของประชาชน โดยกำหนดมาตรฐานด้านต่างๆ รวมทั้งส่งเสริมให้เกิดโครงการกลไกการพัฒนาพลังงานที่สะอาด เพื่อลดผลกระทบต่อสิ่งแวดล้อมและชุมชน และลดปริมาณก๊าซเรือนกระจก โดย

1) การดูแลผลกระทบต่อสิ่งแวดล้อมที่มาจากการผลิต การแปรรูปและการใช้พลังงาน

2) ส่งเสริมกลไกการพัฒนาที่สะอาด (CDM) สาขาพลังงาน เพื่อลดปริมาณการปล่อยก๊าซเรือนกระจก

3) ควบคุม ดูแลมาตรฐานการปลดปล่อยสาร VOC จากอุตสาหกรรมปิโตรเคมีและการกลั่นไม่ให้เกิดปัญหากับสิ่งแวดล้อม

APPENDIX F

แบบสำรวจรายจ่ายด้านพลังงานในครัวเรือน

รูปแบบการพึ่งตนเองด้านพลังงานในชุมชน

คณะสิ่งแวดล้อมและทรัพยากรศาสตร์ มหาวิทยาลัยมหิดล

1. ข้อมูลพื้นฐาน

ชื่อหัวหน้าครัวเรือน.....บ้านเลขที่.....

ชื่อตัวแทนหัวหน้าครัวเรือน..... ☐ ชาย ☐ หญิง

1.1 อาชีพของครัวเรือน

อาชีพที่ให้รายได้หลัก	รายได้เฉลี่ยต่อเดือน
☐ 1. เกษตรกรรม ระบุ(เช่น ทำนา ,ทำไร่,ปลูกผัก,สวนผลไม้, เลี้ยงสัตว์)	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป
☐ 2. อุตสาหกรรมและหัตถกรรมในครัวเรือน	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป
☐ 3. รับจ้างการเกษตร	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป
☐ 4. รับจ้างทั่วไป	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป
☐ 5. รับราชการ (รวมลูกจ้างรัฐ)	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป

☐ 6. อื่นๆ ระบุ.....	☐ น้อยกว่า ☐ 5,001-10,000 ☐ 10,001-15,000 ☐ 15001-20,000 ☐ 20,001-25,000 ☐ 25,001-30,000 ☐ มากกว่า 30,001 ขึ้นไป

1.2 โครงสร้างของครัวเรือน

ช่วงอายุ	เพศ		จำนวน (คน)		ระดับการศึกษา (ดูรหัส)
	ชาย	หญิง	ชาย	หญิง	
เด็กทารก-6 ปี					
เด็ก 7- 12 ปี					
วัยรุ่น13-17 ปี					
วัยรุ่น18-24 ปี					
ผู้ใหญ่ 25-35ปี					
ผู้ใหญ่ 36-41ปี					
ผู้ใหญ่ 42-50ปี					
ผู้สูงอายุ 60 ปี ขึ้นไป					

รหัสระดับการศึกษา : 1. ปริญญาตรี/และสูงกว่า 2. อนุปริญญา/ปวส. 3. มัธยมศึกษา/ปวช. 4. ประถมศึกษา/อนุบาล

1.3 การถือครองและการใช้ประโยชน์ที่ดิน

1.3.1 การถือครองที่ดิน (ที่อยู่อาศัย)

1. บริเวณที่อยู่อาศัยมีพื้นที่.....ไร่.....ตารางวา

2. ที่อยู่อาศัยของท่านเป็นของ

☐ 1.ตนเอง ☐ 4.ญาติพี่น้อง

☐ 2.เช่าคนอื่น ☐ 5.บุกเบิก

☐ 3.พ่อแม่ ☐ 6.อื่นๆ ระบุ

3. การใช้ประโยชน์ที่ดิน (บริเวณที่อยู่อาศัย)

3.1 ผักสวนครัว

☐กระเพา ☐พริก ☐ผักชี

☐ตำลึง ☐ชะคม ☐ต้นหอม

☐ตะไคร้ ☐ฝักทอง ☐มะกรูด

☐ข่า ☐มะเขือต่างๆ ☐มะนาว

☐ สะเดา ☐สระแน่ ☐ ถั่วต่างๆ

☐อื่นๆระบุ.....

3.2 ไม้ผล

☐ มะม่วง ☐ละมุด

☐มะขาม ☐ลำไย

☐ กล้วย ☐มะปราง

☐น้อยหน่า ☐ฝรั่ง

☐มังคุด ☐อื่นๆระบุ.....

3.3 ไม้ดอกไม้ประดับ

☐กุหลาบ ☐ ดอกรัก ☐ ตีนเป็ด ☐ จำปา

☐ชวนชม ☐ดอกกระเจียว ☐ดาวเรือง ☐ลั่นทม

☐กล้วยไม้ ☐สุพรรณิกา ☐มะลิ

☐พุทธรักษา ☐ จำปี ☐อื่นๆระบุ.....

1.3.2 การใช้ประโยชน์ที่ดิน (ไม่รวมที่อยู่อาศัย)

การถือครองที่ดิน	พื้นที่ (ไร่)						
	ทำนา	ทำไร่	ทำสวนผัก	สวนผลไม้	ทิ้งไว้ให้ว่างเปล่า	ให้เช่า	อื่นๆ เช่นทุ่งหญ้าเลี้ยงสัตว์
1. ที่ดินของตนเอง							
2. เช่าคนอื่น							
3. ได้ทำฟรี							
4. บุกเบิก(บุกรุก)							
5. อื่นๆระบุ							

2. ข้อมูลรายจ่ายภายในครัวเรือน

รายจ่ายภายในครัวเรือนนั้นนอกจากจะมีค่าใช้จ่ายด้านการดำรงชีวิตประจำวันภายในครัวเรือนแล้ว ยังมีค่าใช้จ่ายด้านพลังงาน ดังนี้

2.1 ค่าใช้จ่ายด้านพลังงานไฟฟ้า

เดือนที่แล้วจ่ายค่าไฟฟ้า.....บาท (เดือน.....) หน่วย..... ขนาดมิเตอร์.....AM

กรุณาระบุอุปกรณ์เครื่องใช้ไฟฟ้าที่มีอยู่ในครัวเรือน โดยทำเครื่องหมายถูกที่ช่องว่าง

1. หมวดแสงสว่าง

☐ หลอดนีออนแบบเดิม ได้แก่ หลอดนีออนแบบอ้วน จำนวน.....หลอด อื่นๆระบุ..... จำนวน.....หลอด

☐ หลอดนีออนแบบใหม่ ได้แก่

☐ หลอดนีออน (สั้น อ้วน) จำนวน.....หลอด

☐ หลอดนีออน (สั้น ผอม) จำนวน.....หลอด

☐ หลอดนีออน (ยาว อ้วน) จำนวน.....หลอด

☐ หลอดนีออน (ยาว ผอม) จำนวน.....หลอด

☐ หลอดตะเกียบ จำนวน.....หลอด

☐ หลอดนีออนแบบเดิม ได้แก่ หลอดไส้ธรรมดารูปชมพู่ จำนวน.....หลอด

☐ อื่นๆ ระบุ..... จำนวน.....หลอด

2. หมวดเครื่องใช้ไฟฟ้าภายในครัว

☐ ตู้เย็น.....คิว จำนวน .....เครื่อง ☐ เตาอบขนม จำนวน.....เครื่อง

☐ ไมโครเวฟ จำนวน.....เครื่อง ☐ เครื่องปั่นน้ำผลไม้ จำนวน.....เครื่อง

☐ กระทะไฟฟ้า จำนวน.....เครื่อง ☐ เครื่องปิ้งขนมปัง จำนวน.....เครื่อง

☐ หม้อหุงข้าว.....ลิตร จำนวน.....เครื่อง ☐ กระติกน้ำร้อน จำวนวน.....เครื่อง

☐ หม้อไฟฟ้า จำนวน.....เครื่อง ☐ อื่นๆ ระบุ.....จำนวน.....เครื่อง

☐ ชุดหม้อกระทะไฟฟ้า จำนวน.....เครื่อง

3. หมวดเครื่องใช้ไฟฟ้าที่อำนวยความสะดวกอื่นๆ

☐ เครื่องซักผ้า.....กก. จำนวน.....เครื่อง ☐ โทรทัศน์.....นิ้ว จำนวน.....เครื่อง

☐ เตารีด จำนวน..... เครื่อง ☐ เครื่องเล่นวีดีโอ/ซีดี จำนวน.....เครื่อง

☐ เครื่องปรับอากาศ จำนวน.....เครื่อง ☐ ชุดเครื่องขยายเสียง จำนวน.....เครื่อง

☐ พัดลมเพดาน จำนวน.....เครื่อง ☐ วิทยุ จำนวน.....เครื่อง

☐ พัดลมตั้งโต๊ะ จำนวน.....เครื่อง ☐ โทรศัพท์บ้าน จำนวน.....เครื่อง

☐ อื่นๆ ระบุ.....จำนวน.....เครื่อง

4. หมวดเครื่องใช้ไฟฟ้าที่ใช้ในการศึกษาและการธุรกิจ (ถ้ามี)

☐ คอมพิวเตอร์ตั้งโต๊ะ (PC) จำนวน.....เครื่อง ☐ เครื่องพิมพ์เอกสารจำนวน.....เครื่อง

☐ คอมพิวเตอร์โน้ตบุ๊ค จำนวน.....เครื่อง ☐ กบไฟฟ้า จำนวน.....

☐ สว่านไฟฟ้า จำนวน..... เครื่อง ☐ จักรเย็บผ้าไฟฟ้า จำนวน.....เครื่อง

☐ เลื่อนไฟฟ้า จำนวน.....เครื่อง ☐ อื่นๆระบุ..... จำนวน.....เครื่อง

5. หมวดอุปกรณ์เครื่องใช้ที่ใช้ถ่านและแบตเตอรี่ (ถ้ามี)

☐ โทรศัพท์มือถือ จำนวน.....เครื่อง ☐ วิทยุแบบใส่ถ่าน จำนวน.....เครื่อง

☐ ไฟฉาย จำนวน.....เครื่อง ☐ เครื่องสำรองไฟฟ้าฉุกเฉิน จำนวน.....เครื่อง

☐ อื่นๆระบุ.....จำนวน.....เครื่อง

2.2 ค่าใช้จ่ายด้านน้ำมันเชื้อเพลิง

จ่ายค่าน้ำมันเดือนละ.....บาท (เดือน.....)

กรุณาระบุอุปกรณ์ที่ใช้น้ำมันเชื้อเพลิง โดยทำเครื่องหมายถูกในช่องว่าง

1. หมวดยวนยานพาหนะ

☐ รถยนต์ที่นั่งส่วนบุคคล ได้แก่ ☐ รถเก๋ง จำนวน..... คัน ยี่ห้อ.....ขนาด.....ซีซี
น้ำมันเชื้อเพลิง.....

☐ รถจักรยานยนต์ จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี
น้ำมันเชื้อเพลิง..... น้ำมันหล่อลื่น.....

☐ รถใช้งาน ได้แก่ ☐ รถปิกอัพ จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถบรรทุก ☐ 6 ล้อ ☐ 10 ล้อ จำนวน.....คัน ยี่ห้อ..... ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถสามล้อเครื่อง จำนวน.....คัน ยี่ห้อ..... ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ อื่นๆระบุ.....จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถใช้ในการเกษตร ได้แก่ ☐ รถไถเดินตาม จำนวน.....คัน ยี่ห้อ..... .ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถอีแต๋น จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถแทรกเตอร์ จำนวน.....คัน ยี่ห้อ..... ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถอีแต่ก จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ รถเกี่ยวข้าว จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

☐ อื่นๆระบุ.....จำนวน.....คัน ยี่ห้อ.....ขนาด.....ซีซี น้ำมันเชื้อเพลิง.....

2. เครื่องยนต์ที่ใช้น้ำมันเชื้อเพลิงอื่นๆ ได้แก่

☐ เครื่องสูบน้ำ จำนวน.....เครื่อง ยี่ห้อ.....ขนาดแรงม้า..... น้ำมันเชื้อเพลิง.....

☐ เครื่องพ่นยา จำนวน.....เครื่อง ยี่ห้อ..... ขนาดแรงม้า..... น้ำมันเชื้อเพลิง.....

☐ เครื่องสีข้าว จำนวน….....เครื่อง ยี่ห้อ.....ขนาดแรงม้า.....

น้ำมันเชื้อเพลิง.....

☐ เครื่องตัดหญ้า จำนวน.....เครื่อง ยี่ห้อ.....ขนาดแรงม้า.....

น้ำมันเชื้อเพลิง.....

☐ อื่นๆ ระบุ.....จำนวน.....เครื่อง ยี่ห้อ.....ขนาดแรงม้า.....

น้ำมันเชื้อเพลิง.....

3. หมวดแสงสว่างที่ต้องใช้น้ำมัน

☐ ตะเกียงกระป๋อง จำนวน.....อัน ☐ ตะเกียงเจ้าพายุ จำนวน.....อัน

☐ ตะเกียงรั้ว จำนวน.....อัน ☐ ตะเกียงโป๊ะ จำนวน.....อัน

☐ อื่นๆ ระบุ.....จำนวน.....อัน

2.3 ค่าก๊าซหุงต้ม

ค่าใช้จ่ายก๊าซหุงต้มต่อเดือน.....บาท จำนวนถังที่ใช้.....ถัง ขนาดถัง.....(กก.)

ราคาถังละ.....บาท

ถังหนึ่งใช้ได้..... เดือน เตาแก๊สสำรองใช้เมื่อแก๊สหมด (ถ้ามี) ขนาดถัง.....(กก.)

ราคาถังละ.....บาท

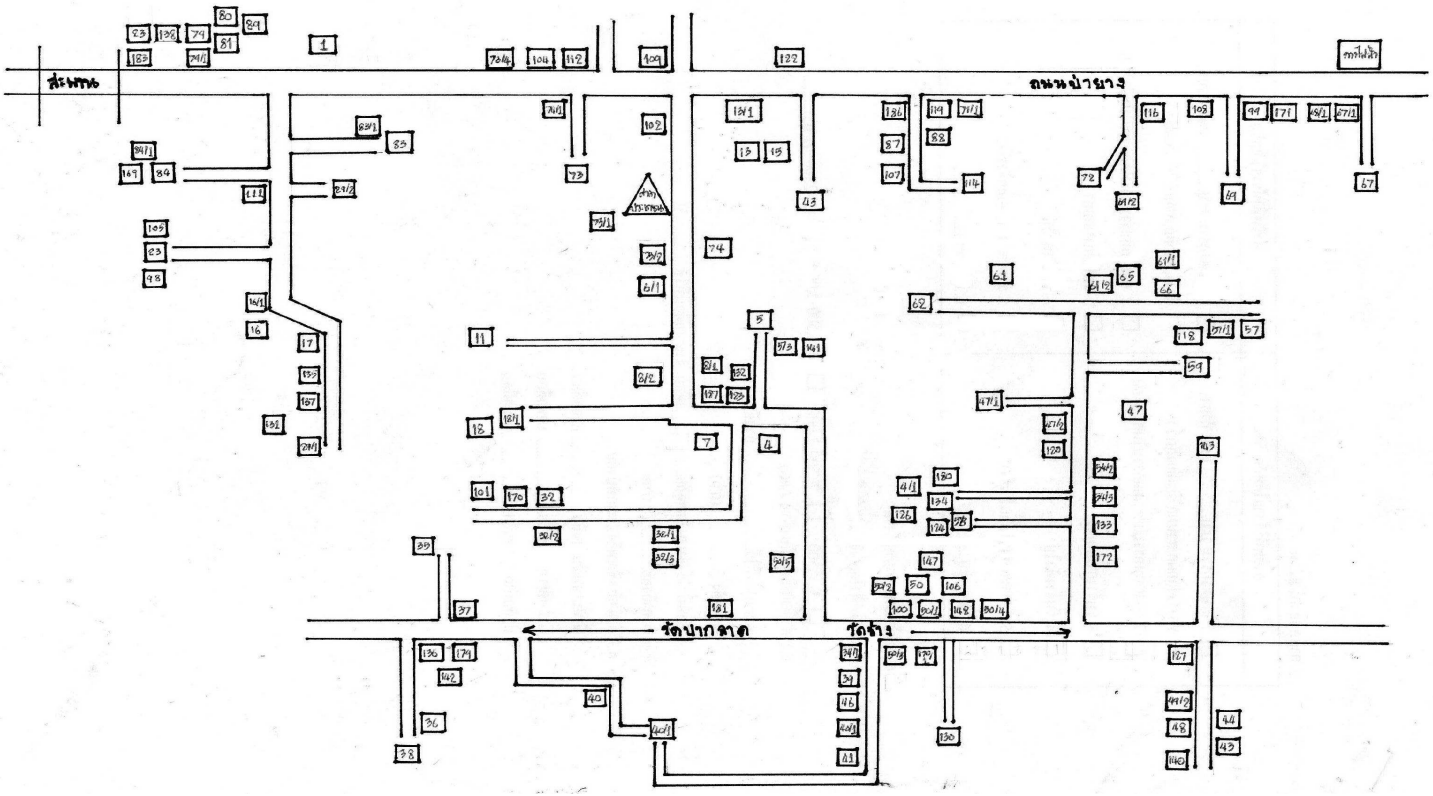
2.4 ค่าเชื้อเพลิงประเภทฟืน (ถ้ามี)

มีรายจ่ายค่าฟืนต่อเดือน.....บาท

2.5 ค่าเชื้อเพลิงประเภทถ่าน (ถ้ามี)

มีรายจ่ายค่าถ่านต่อเดือน.....บาท

APPENDIX G



รูปภาพที่ 3 แผนที่แสดงครัวเรือนในหมู่บ้านหนองมะกอก

APPENDIX H

ตารางที่ ภ-7 แสดงค่าใช้จ่ายพลังงานของแต่ละครัวเรือนในแต่ละรูปแบบการพึ่งพลังงาน

ลำดับ	ตำบลและหมู่บ้านในการวิจัย		ชื่อ-สกุล	รายได้	ค่าใช้จ่าย	ค่าใช้จ่ายพลังงานแต่ละชนิด				ค่าใช้จ่ายด้านพลังงาน	สัดส่วนค่าใช้จ่ายพลังงานแต่ละชนิดต่อครัวเรือน					สัดส่วนค่าใช้จ่ายพลังงานแต่ละชนิดต่อครัวเรือน				
1. รูปแบบการพึ่งพาพลังงาน 4 ชนิด 1.1 รูปแบบการใช้พึ่งพาพลังงานไฟฟ้า น้ำมันเชื้อเพลิง แก๊สหุงต้ม ถ่าน ฟืน(หาของ) จำนวน 63 ครัวเรือน	1-4	5-6		ในครัวเรือน (บาท/เดือน)	ในครัวเรือน (บาท/เดือน)	ค่าไฟฟ้า (บาท/เดือน)	ค่าน้ำมันเชื้อเพลิง (บาท/เดือน)	ค่าแก๊สหุงต้ม (บาท/เดือน)	ค่าถ่าน (บาท/เดือน)		ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	รวม	ไฟฟ้า	น้ำมันเชื้อเพลิง	แก๊สหุงต้ม	ถ่าน	รวม
1		3	นายประยูร สุขสุด	6,667	2,750	0	100	59	-	159.00	-	1.50	0.88	-	2.38	0.00	3.64	2.15	-	5.78
2		1	นางสอ้อน วิชาญ	2,083	1,000	0	100	24.58	-	124.58	-	4.80	1.18	-	5.98	0.00	10.00	2.46	-	12.46
3		3	นายนิยม กงศิลป์	16,833	8,433.33	0	100	103.33	-	203.33	-	0.59	0.61	-	1.21	0.00	1.19	1.23	-	2.41
4		2	นายสนัน รูปถม	6,875	2,316.67	0	200	100	-	300.00	-	2.91	1.45	-	4.36	0.00	8.63	4.32	-	12.95
5		4	นางสาวบุญมาก เปลื้องศรี	8,333	4,750	0	200	100	-	300.00	-	2.40	1.20	-	3.60	0.00	4.21	2.11	-	6.32
6		2	นางสาวิเชียร ธนูศร	4,167	1,875	0	160	100	-	260.00	-	3.84	2.40	-	6.24	0.00	8.53	5.33	-	13.87
7		4	พ่อยวง แป้นงาม	8,000	3,750	630	1,800	98.33	-	2,528.33	7.88	22.50	1.23	-	23.73	16.80	48.00	2.62	-	67.42
8		3	นายบุญช่วย ธนูศร	4,167	1,750	170	200	98.33	-	468.33	4.08	4.80	2.36	-	7.16	9.71	11.43	5.62	-	26.76
9		1	พ่อน่วม ช่างแก้ว	3,000	1,833.33	0	400	98.33	-	498.33	-	13.33	3.28	-	16.61	0.00	21.82	5.36	-	27.18
10		2	นายณรงค์ ย่ำอินทร์	7,917	4,458.33	0	400	100	-	500.00	-	5.05	1.26	-	6.32	0.00	8.97	2.24	-	11.21
11		2	นางสาวแสงอ่อน ใจบุญ	11,750	6,250	0	400	100	-	500.00	-	3.40	0.85	-	4.26	0.00	6.40	1.60	-	8.00
12		2	นางกรองพิมพ์ ทองอินทร์	5,834	2,917	300	200	73.75	-	573.75	5.14	3.43	1.26	-	4.69	10.28	6.86	2.53	-	19.67
13		3	นายสมโภช โกมลดี	6,500	4,975	0	500	98.33	-	598.33	-	7.69	1.51	-	9.21	0.00	10.05	1.98	-	12.03
14		3	นายอาจ เพียรผดุง	16,667	8,583.33	297	400	50	-	747.00	1.78	2.40	0.30	-	2.70	3.46	4.66	0.58	-	8.70
15		2	นางสำเนียง กุกถด้า	4,167	3,000	0	600	73.75	-	673.75	-	14.40	1.77	-	16.17	0.00	20.00	2.46	-	22.46
16		4	นายบุญธรรม ปะทิพย์	13,167	8,441.67	200	400	100	-	700.00	1.52	3.04	0.76	-	3.80	2.37	4.74	1.18	-	8.29
17			5 นายประจวบ เปรมปรี	12,500	5,125	460	200	147.5	-	807.50	3.68	1.60	1.18	-	2.78	8.98	3.90	2.88	-	15.76
18		3	นายวิชัย ปั้นทอง	8,333	5,750	300	400	173.33	-	873.33	3.60	4.80	2.08	-	6.88	5.22	6.96	3.01	-	15.19
19			5 นางสาวเพียร รักษาก้อย	8,333	7,333.33	373	300	147.5	-	920.50	4.48	3.60	1.77	-	5.37	5.09	4.09	2.01	-	11.19
20		4	นายวิเชียร แป้นงาม	10,000	4166.67	0	700	100	-	800.00	-	7.00	1.00	-	8.00	0.00	16.80	2.40	-	19.20
21		3	นางพิมพ์ นาคสิมพันธ์	4,000	1,166.67	300	400	150	-	850.00	7.50	10.00	3.75	-	13.75	25.71	34.29	12.86	-	72.86
22			6 นางสิ้นชื่น เปรมปรี	17,000	13,333	300	500	100	-	900.00	1.76	2.94	0.59	-	3.53	2.25	3.75	0.75	-	6.75
23		4	นายฉลิมพล ผักรวกขมขาด	5,958	3,750	320	500	100	-	920.00	5.37	8.39	1.68	-	10.07	8.53	13.33	2.67	-	24.53
24		4	นายศรัทธ์ เคนอ่วาม	7,916	4416.67	500	400	295	-	1,195.00	6.32	5.05	3.73	-	8.78	11.32	9.06	6.68	-	27.06
25		4	นายสมนึก พรมเงิน	10,000	5625	500	400	310	-	1,210.00	5.00	4.00	3.10	-	7.10	8.89	7.11	5.51	-	21.51
26			5 นายสมหมาย ศิริทอง	10,000	2593.33	600	400	49.17	-	1,049.17	6.00	4.00	0.49	-	4.49	23.14	15.42	1.90	-	40.46
27		3	นายบุญส่ง กงศิลป์	6,000	3000	505	500	73.75	-	1,078.75	8.42	8.33	1.23	-	9.56	16.83	16.67	2.46	-	35.96
28		4	นายพร ศุขประสงค์	8,083	6696.67	460	800	100	-	1,360.00	5.69	9.90	1.24	-	11.13	6.87	11.95	1.49	-	20.31
29		3	นางประภา รักษาก้อย	15,833	10,666.67	500	1,000	100	-	1,600.00	3.16	6.32	0.63	-	6.95	4.69	9.37	0.94	-	15.00
30		4	นายพิชญุตม์ เปรมปรี	7,917	4750	0	1,000	100	-	1,100.00	-	12.63	1.26	-	13.89	0.00	21.05	2.11	-	23.16
31		1	นายคปลงศักดิ์ ประดับบุบ	7,548	1589.75	0	1,000	44.29	-	1,044.29	-	13.25	0.59	-	13.84	0.00	62.90	2.79	-	65.69
32		3	นายบุญชู ทองอินทร์	10,833	2416.67	450	600	98.33	-	1,148.33	4.15	5.54	0.91	-	6.45	18.62	24.83	4.07	-	47.52
33		4	นางสงอง ขอนคต	10,000	3375	320	800	147.5	-	1,267.50	3.20	8.00	1.48	-	9.48	9.48	23.70	4.37	-	37.56
34			7 นายบุญเรือน โลกนิมิตร	7,500	3130	0	1,200	103.33	-	1,303.33	-	16.00	1.38	-	17.38	0.00	38.34	3.30	-	41.64
35		4	นายทรี บุญมา	6,250	3375	440	800	98.33	-	1,338.33	7.04	12.80	1.57	-	14.37	13.04	23.70	2.91	-	39.65
36		4	นายบุญมี มณีทอง	8,750	5258	1,050	1,000	100	-	2,150.00	12.00	11.43	1.14		12.57	19.97	19.02	1.90		40.89
37		2	นางวิรัยา ธนูศร	5,833	3000	0	1,700	147.5	-	1,847.50	-	29.14	2.53	-	31.67	0.00	56.67	4.92	-	61.58
38		3	นางบุตม กุกถด้า	10,000	9750	289	1,500	100	-	1,889.00	2.89	15.00	1.00	-	16.00	2.96	15.38	1.03	-	19.37
39			6 นายหยัด ทรายแก้ว	11,666	5333.33	800	1,000	98.33	-	1,898.33	6.86	8.57	0.84	-	9.41	15.00	18.75	1.84	-	35.59
40			7 นายสำเภา สินชู	5,750	3208.33	800	1,000	98.33	-	1,898.33	13.91	17.39	1.71	-	19.10	24.94	31.17	3.06	-	59.17
41		4	นายอาโน่ กาต้น	8,000	5750	1,300	800	98.33	-	2,198.33	16.25	10.00	1.23	-	11.23	22.61	13.91	1.71		38.23
42		4	นางสุรีย์ พรมอินทร์	10,000	8333.33	90	1,500	885	-	2,475.00	0.90	15.00	8.85	-	23.85	1.08	18.00	10.62	-	29.70
43			7 นายศักดา ทองอินทร์	10,000	7500	700	1,500	98.33	-	2,298.33	7.00	15.00	0.98	-	15.98	9.33	20.00	1.31	-	30.64
44		2	นายสมหวัง สอดรัก	10,000	3750	340	2,000	98.33	-	2,438.33	3.40	20.00	0.98	-	20.98	9.07	53.33	2.62	-	65.02
45			6 นายยงยศ ศุขอิน	13,750	6500	700	1,600	150	-	2,450.00	5.09	11.64	1.09	-	12.73	10.77	24.62	2.31	-	37.69
46		5	นางเพ็ญนภา กงศิลป์	15,000	13204.17	900	1,500	150	-	2,550.00	6.00	10.00	1.00	-	11.00	6.82	11.36	1.14	-	19.31
47		3	นายประจวบ วิเลค	14,000	10929.17	250	2,200	150	-	2,900.00	1.79	17.86	1.07	-	18.93	2.29	22.87	1.37	-	26.53
48			6 นายทรงศักดิ์ วิเลค	7,917	4958.33	600	2,200	100	-	2,900.00	7.58	27.79	1.26	-	29.05	12.10	44.37	2.02	-	58.49
49		4	นายบุญแต้ศ รวมทศล	16,250	10777.5	412	2,500	155	-	3,067.00	2.54	15.38	0.95	-	16.34	3.82	23.30	1.44	-	28.46
50			7 นางสมจิตร ธูปทรัพย์	15,000	7500	941	2,500	100	-	3,541.00	6.27	16.67	0.67	-	17.33	12.55	33.33	1.33	-	47.21
51		4	นายทักเรียน ธูปอุด	12,500	4083.33	450	3,000	100	-	3,550.00	3.60	24.00	0.80	-	24.80	11.02	73.47	2.45	-	86.94
52		4	นางสังวาล ชำวิจิตร	20,000	5000	500	3,000	98.33	-	3,598.33	2.50	15.00	0.49	-	15.49	10.00	60.00	1.97	-	91.97
53		4	นายบุญนาค ทูกอินทร์	12,500	5875	380	3,500	103.33	-	3,983.33	3.04	28.00	0.83	-	28.83	6.47	39.57	1.76	-	67.80
54		3	นางสาย อินทรประเทริฐ	22,333	11024.17	1,500	2,400	147.5	-	4,047.50	6.72	10.75	0.66	-	11.41	13.61	21.77	1.34	-	36.71
55		2	จ.ส.ส ประสิทธิ์ รอดประเสริฐ	17,000	5860	490	3,500	98.33	-	4,088.33	2.88	20.59	0.58	-	21.17	8.36	59.73	1.68	-	69.77
56			5 นายสมปอ โกโสถา	20,000	7916.67	1,000	3,000	98.33	-	4,098.33	5.00	15.00	0.49	-	15.49	12.63	37.89	1.24	-	51.77
57		4	นายศันสิ กงศิลป์	40,000	11830	544	4,400	77.5	-	5,021.50	1.36	11.00	0.19	-	11.19	4.60	37.19	0.66	-	42.45
58			6 นายสุวรรณ บุษชมพู	20,000	7193.67	310	4,700	300	-	5,310.00	1.55	23.50	1.50	-	25.00	4.31	65.34	4.17	-	73.81
59			5 นายบุญชู วงศ์ทวน	17,000	10,000	700	6,000	300	-	7,000.00	4.12	35.29	1.76	-	37.06	7.00	60.00	3.00	-	70.00
60		4	นายบัวย ไข่แก้ว	16,667	8730	400	6,500	150	-	7,050.00	2.40	39.00	0.90	-	39.90	4.58	74.46	1.72	-	80.76
61			6 นายบุญเรือง แก่นบำรุง	20,000	14658	990	12,000	155	-	13,145.00	4.95	60.00	0.78	-	60.78	6.75	81.87	1.06	-	89.68
62		4	นายชรินทร์ แสวงโมกธรรม	80,000	63304.17	357	61,000	98.33	-	61,455.33	0.45	76.25	0.12	-	76.37	0.56	96.36	0.16	-	97.08
63		4	นายสำราญ จันทรชา	8,000	1500	388	600	36.88	-	1,024.88	4.85	7.50	0.46	-	7.96	25.87	40.00	2.46	-	68.33
	รวม			768,047	349,861.60	25,106.00	156,460	8,108.44		189,674.44										

ตารางที่ ภ-7 แสดงค่าใช้จ่ายพลังงานของแต่ละครัวเรือนในแต่ละรูปแบบการพึ่งพลังงาน(ต่อ)

Model	จำนวนแบบจำลองในครัวเรือน		อาชีพ	รายได้ (บาท/เดือน)	ค่าใช้จ่ายในครัวเรือน (บาท/เดือน)	ค่าใช้จ่ายพลังงานแต่ละชนิด				ค่าใช้จ่าย ด้านพลังงาน (บาท/เดือน)	อัตราส่วนค่าใช้จ่ายพลังงานต่อรายได้ของครัวเรือน					อัตราส่วนค่าใช้จ่ายพลังงานต่อค่าใช้จ่ายของครัวเรือน				
	1-4	5-6				ค่าใช้ไฟฟ้า (บาท/เดือน)	ค่าน้ำมันเชื้อเพลิง (บาท/เดือน)	ค่าเสื่อมทุนสิ่งก่อสร้าง (บาท/เดือน)	ค่าอาหาร (บาท/เดือน)		ไฟฟ้า	น้ำมันเชื้อเพลิง	เสื่อมทุนสิ่งก่อสร้าง	อาหาร	รวม	ไฟฟ้า	น้ำมันเชื้อเพลิง	เสื่อมทุนสิ่งก่อสร้าง	อาหาร	รวม
1.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า-น้ำมันเชื้อเพลิง-แก๊สหุงต้ม-ถ่าน (ซื้อ)หรือ พึ่งพิง(หาย)จำนวน 25 ครัวเรือน																				
1 นางสุมล ศิริณมติยาไพ	2		ข้าราชการบำนาญ	15,000	4500	0	200	147.5	20	367.50	0.00	1.33	0.98	0.13	2.45	0.00	4.44	3.28	0.44	8.17
2 นางสาวบุษกร บำบัดภัย	2		พนักงานบริษัท	20,000	7500	0	200	98.33	50	348.33	0.00	1.00	0.49	0.25	1.74	0.00	2.67	1.31	0.67	4.64
3 นางสาว บุญทำ	4		พนักงานโรงงาน	5,000	2500	0	600	300	50	950.00	0.00	12.00	6.00	1.00	19.00	0.00	24.00	12.00	2.00	38.00
4 นายสหร ปฏิบัติ	1		ลูกสังเสียเลี้ยงดู	3,000	1250	360	320	98.33	30	908.33	12.00	10.67	3.28	1.00	26.94	28.80	25.60	7.87	2.40	64.67
5 นางพยงศ์ ศรีมงกล	3		พนักงานโรงงาน	6,000	4041.67	300	400	100	20	820.00	5.00	6.67	1.67	0.33	13.67	7.42	9.90	2.47	0.49	20.29
6 นายธรัก ศิณชู	4		พนักงานโรงงาน	8,333	5500	400	500	98.33	33.33	1,031.66	4.80	6.00	1.18	0.40	12.38	7.27	9.09	1.79	0.61	18.76
7 นางจิน เธรัญนา	3		รับจ้างอาชีพ	7,917	1666.67	200	600	77.5	50	927.50	2.53	7.58	0.98	0.63	11.72	12.00	36.00	4.65	3.00	55.65
8 นางสาวมานิต ชูชุช	3		พนักงานบริษัท	17,000	14166.67	360	800	98.33	20	1,278.33	2.12	4.71	0.58	0.12	7.52	2.54	5.65	0.69	0.14	9.02
9 นายสมปอง ศุดไท		5	รับจ้างก่อสร้าง	8,333	4625	500	600	100	20	1,220.00	6.00	7.20	1.20	0.24	14.64	10.81	12.97	2.16	0.43	26.38
10 นายประวิทย์ ชุชอาชีพ		5	พนักงานโรงงาน	7,917	5000	300	1,100	300	25	1,725.00	3.79	13.80	3.79	0.92	21.79	6.00	23.00	6.00	1.50	34.50
11 นายสุรินทร์ ปรุงกิจ	3		พนักงานโรงงาน	8,000	3333.33	200	1,100	98.33	125	1,523.33	2.50	13.75	1.23	1.56	19.04	6.00	33.00	2.95	3.75	45.70
12 นายสาธิต อุปชา		5	พนักงานโรงงาน	13,750	6000	500	1,200	50	20	1,770.00	3.64	8.73	0.36	0.15	12.87	8.33	20.00	0.83	0.33	29.50
13 นายถิรเกริม ชัยเจริญ	4		ข้าราชการ	15,000	12083.33	692	1,200	147.5	15	2,054.50	4.61	8.00	0.98	0.10	13.70	5.73	9.93	1.22	0.12	17.00
14 นายเกริก ทรัพสมบัติ	4		รับจ้างก่อสร้าง	9,833	5987.5	340	1,500	150	30	2,020.00	3.46	15.25	1.53	0.31	20.54	5.68	25.05	2.51	0.50	33.74
15 นายไบ พาบเมิน	4		พนักงานโรงงาน	12,500	4833.33	500	1,400	150	30	2,080.00	4.00	11.20	1.20	0.24	16.64	10.34	28.97	3.10	0.62	43.03
16 นายเอกลิศร เศร่าแจ้ง	3		ข้าราชการ	15,000	4500	480	1,500	100	20	2,100.00	3.20	10.00	0.67	0.13	14.00	10.67	33.33	2.22	0.44	46.67
17 นายสมชาย จุลดี		6	พนักงานโรงงาน	10,100	4208.33	557	1,500	100	20	2,177.00	5.51	14.85	0.99	0.20	21.55	13.34	35.64	2.38	0.48	51.73
18 นายบุญชาย บุญลือ	4		ทำนา ทำสวน	8,000	4791.67	501.78	2,200	98.33	20	2,820.11	6.27	27.50	1.23	0.25	35.25	10.47	45.91	2.05	0.42	58.85
19 นายถนาม ปืนแก้ว	4		ทำขายใบย่าง	15,000	8800	1,500	1,200	295	50	3,045.00	10.00	8.00	1.97	0.33	20.30	17.05	13.64	3.35	0.57	34.60
20 นายบุญชาย พูลสวัสดิ์	4		ข้าราชการ	25,000	4250	385	2,500	98.33	33.33	3,016.66	1.54	10.00	0.39	0.13	12.07	9.06	58.82	2.31	0.78	70.98
21 นางบัญญดี ศรีจันทร์	4		ข้าราชการ	20,000	7000	1,300	3,000	147.5	33.33	4,480.83	6.50	15.00	0.74	0.17	22.40	18.57	42.86	2.11	0.48	64.01
22 นายบัว วิมก		8	พนักงานโรงงาน	15,000	6100.83	1,100	4,500	100	48	5,748.00	7.33	30.00	0.67	0.32	38.32	18.03	73.76	1.64	0.79	94.22
23 นางแสงทอง กงรักดี		7	ทำนา พนักงานโรงงาน	10,833	8333	580	5,500	98.33	33.33	6,211.66	5.35	50.77	0.91	0.31	57.34	6.96	66.00	1.18	0.40	74.54
24 นายพิชิต มณี		5	ปลูกผักขาย	30,000	20833.33	600	15,000	98.33	50	15,748.33	2.00	50.00	0.33	0.17	52.49	2.88	72.00	0.47	0.24	75.59
25 นายประกอง รพพันธ์	3		ธุรกิจส่วนตัว	50,000	20000	3,000	15,000	200	20	18,220.00	6.00	30.00	0.40	0.04	36.44	15.00	75.00	1.00	0.10	91.10
รวม				356,516	171,804.66	14,653.78	63,620.00	3,349.97	866.32	82,492.07										

ตารางที่ ภ-7 แสดงค่าใช้จ่ายพลังงานของแต่ละครัวเรือนในแต่ละรูปแบบการพึ่งพลังงาน(ต่อ)

Model	จำนวนสมาชิกในครัวเรือน		อาชีพ	รายได้ (บาท/เดือน)	ค่าใช้จ่ายทั้งในครัวเรือน (บาท/เดือน)	ค่าใช้จ่ายแต่ละชนิด				ค่าใช้จ่ายด้านพลังงาน (บาท/เดือน)	อัตราส่วนค่าใช้จ่ายพลังงานต่อรายได้ของครัวเรือน					อัตราส่วนค่าใช้จ่ายพลังงานต่อค่าใช้จ่ายของครัวเรือน				
	1-4	5-6				ค่าไฟฟ้า (บาท/เดือน)	ค่าน้ำมันเชื้อเพลิง (บาท/เดือน)	ค่าเชื้อเพลิงอื่นๆ (บาท/เดือน)	ค่าท่าน (บาท/เดือน)		ไฟฟ้า	น้ำมันเชื้อเพลิง	เชื้อเพลิงอื่นๆ	ท่าน	รวม	ไฟฟ้า	น้ำมันเชื้อเพลิง	เชื้อเพลิงอื่นๆ	ท่าน	รวม
2. รูปแบบการพึ่งพาพลังงาน 3 ชนิด 2.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง - แก๊สหุงต้ม จำนวน 19 ครัวเรือน																				
1 นายเข็ม สุขสิน			ลูกส่งเสีย	5,000.00	1,250.00	0	50	100	-	150.00	0.00	1.00	2.00	-	3.00	0.00	4.00	8.00	-	12.00
2 นายชวน เอกพัศ			ปลูกผัก	6,000.00	1,666.67	0	400	150	-	550.00	0.00	6.67	2.50	-	9.17	0.00	24.00	9.00	-	33.00
3 นายไสกณ ธนูศร			ทำนา รับจ้างรายวัน	4,167.00	2,958.33	230	200	98.33	-	528.33	5.52	4.80	2.36	-	12.68	7.77	6.76	3.32	-	17.86
4 นางอัญชลี ห่อแก้ว			พนักงานโรงงานบริษัท	22,000.00	13,750.00	300	200	98.33	-	598.33	1.36	0.91	0.45	-	2.72	2.18	1.45	0.72	-	4.35
5 นายอุชาติ ลูกอินทร์			รับซื้อของเก่า	5,000.00	1,250.00	0	500	25	-	525.00	0.00	10.00	0.50	-	10.50	0.00	40.00	2.00	-	42.00
6 นายยงยศ ปราบพาล		7	พนักงานโรงงานบริษัท	25,000.00	2,716.67	600	400	75	-	1,075.00	2.40	1.60	0.30	-	4.30	22.09	14.72	2.76	-	39.57
7 นายมาโนช ธูปหูด			ทำนา พนักงานโรงงาน	24,833.00	12,215.00	560	500	77.5	-	1,137.50	2.26	2.01	0.31	-	4.58	4.58	4.09	0.63	-	9.31
8 นางบรรเจิด คงสิ้น			ทำนา ทำขาย	14,033.00	10,818.00	450	1,000	98.33	-	1,548.33	3.20	7.12	0.70	-	11.02	4.16	9.24	0.91	-	14.31
9 นายบุญเรือง นัดอวัสสน		7	พนักงานโรงงาน	6,667.00	3,125.00	787	800	147.5	-	1,734.50	11.80	12.00	2.21	-	26.02	25.18	25.60	4.72	-	55.50
10 นายทินพงษ์ ปทุมวุฒ			ลูกจ้างรัฐ	6,500.00	2,916.67	368	1,500	100	-	1,968.00	5.66	23.08	1.54	-	30.28	12.62	51.43	3.43	-	67.47
11 นายมานะ ไฟแก้ว			ทำนา ข้าราชการ	11,250.00	6,500.00	400	2,000	300	-	2,700.00	3.56	17.78	2.67	-	24.00	6.15	30.77	4.62	-	41.54
12 นายอนุเทพ วิมลนิทพงษ์			ข้าราชการ	30,000.00	4,083.33	780	2,000	25	-	2,805.00	2.60	6.67	0.08	-	9.35	19.10	48.98	0.61	-	68.69
13 นางบญเพรง รุ่งเรือง			พนักงานโรงงาน/บริษัท	10,000.00	6,673.33	388	400	150	-	938.00	3.88	4.00	1.50	-	9.38	5.81	5.99	2.25	-	14.06
14 นายอาวุ ธูปหูด			ข้าราชการ	16,667.00	7,416.67	400	2,500	150	-	3,050.00	2.40	15.00	0.90	-	18.30	5.39	33.71	2.02	-	41.12
15 นายพงษ์ ฤทธิ์เพชรกล้า			ข้าราชการบำนาญ	10,000.00	5,833.33	900	3,600	100	-	4,600.00	9.00	36.00	1.00	-	46.00	15.43	61.71	1.71	-	78.86
16 นายชั้น ธนูศร		5	ค้าขายขนมเบี้ย	40,000.00	12,521.00	1,200	3,000	3540	-	7,740.00	3.00	7.50	8.85	-	19.35	9.58	23.96	28.27	-	61.82
17 นายประดิษฐ์ หนูเจิน		7	ข้าราชการ	35,000.00	12,500.00	5,800	3,000	59	-	8,859.00	16.57	8.57	0.17	-	25.31	46.40	24.00	0.47	-	70.87
18 นายนิรชิต หนิกัย	4		ข้าราชการ	30,000.00	16,666.67	1,187.36	5,000	98.33	-	6,285.69	3.96	16.67	0.33	-	20.95	7.12	30.00	0.59	-	37.71
19 นายคำรง ศรีจุมพอน	4		รับซื้องรายวัน ขับรถส่งของ	15,000.00	11,250.00	680	10,000	100	-	10,780.00	4.53	66.67	0.67	-	71.87	6.04	88.89	0.89	-	95.82
รวม				317,137.00	136,110.67	15,030.36	37,050.00	5,492.32		57,572.68										
2.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง -ถ่านและฟืน (หาบ60) จำนวน 10 ครัวเรือน																				
1 นางเยื่อน นิพาศักษณ์	3		ทำนา รับซื้องรายวัน	3,500	1000	0	100	-	-	100	0.00	2.86	-	-	2.86	0.00	10.00	-	-	10.00
2 นายแบน นิพาศักษณ์	3		รับจ้างก่อสร้าง	5,833	2666.67	0	300	-	-	300	0.00	5.14	-	-	5.14	0.00	11.25	-	-	11.25
3 นางฉวีจำไพ แป้นงาม	2		พนักงานโรงงาน	8,000	2833.33	0	400	-	-	400	0.00	5.00	-	-	5.00	0.00	14.12	-	-	14.12
4 นางรัชนี ไกลสวน	4		พนักงานโรงงาน	8,333	4750	250	200	-	-	450	3.00	2.40	-	-	5.40	5.26	4.21	-	-	9.47
5 นายประชวบ รับความสุข	3		ทำนา รับซื้องชั่วคราว	5,750	3333.33	0	500	-	-	500	0.00	8.70	-	-	8.70	0.00	15.00	-	-	15.00
6 นางสมควร แสงจันท	2		ทอหรหมเรือนทำ	3,500	2033.33	303	320	-	-	623	8.66	9.14	-	-	17.80	14.90	15.74	-	-	30.64
7 นายชำนาญ เปลื้องศรี	4		ทำนา เลี้ยงสัตว์	6,000	3833.33	296	600	-	-	896	4.93	10.00	-	-	14.93	7.72	15.65	-	-	23.37
8 นายบุญมา ปานศิ	3		พนักงานโรงงาน	10,833	4833.33	700	200	-	-	900	6.46	1.85	-	-	8.31	14.48	4.14	-	-	18.62
9 นายพาน เปลื้องศรี	4		พนักงานโรงงาน	9,167	5750	0	1,000	-	-	1000	0.00	10.91	-	-	10.91	0.00	17.39	-	-	17.39
10 นายชำนงค์ ลูกอินทร์	4		ทำนา ทำไร่	7,917	2583.33	430	1,000	-	-	1430	5.43	12.65	-	-	18.06	16.65	38.71	-	-	55.35
รวม				68,833.00	33,616.65	1,979.00	4,620.00	-	-	6,599.00										
2.3 รูปแบบการพึ่งพาพลังงานไฟฟ้า - แก๊สหุงต้ม - ถ่านและฟืน (หาบ60) จำนวน 3 ครัวเรือน																				
1 นายอินทร์ จุดดี	1		ลูกส่งเสีย	2,083	1541.67	0	-	49.17	-	49.17	0.00	-	2.36	-	2.36	0.00	-	3.19	-	3.19
2 นางคมคาย สายทน		5	รับจ้างรายวัน	4,500	1000	0	-	100	-	100	0.00	-	2.22	-	2.22	0.00	-	10.00	-	10.00
3 นายเฉลิม สว่างแจ้ง	3		รับจ้างรายวัน	5,000	1083	361.5		150	-	511.5	7.23	-	3.00	-	10.23	33.38	-	13.85	-	47.23
รวม				11,583	3,624.67	361.5		299.17		660.67										
2.4 รูปแบบการพึ่งพาพลังงานไฟฟ้า - แก๊สหุงต้ม - ถ่าน (ซื้อ) และฟืน จำนวน 2 ครัวเรือน																				
1 นางจิ๋น ลินรพ	1		ไม่มีอาชีพแน่นอน	2,500	1,000.00	0	-	24.58	50	74.58	0.00	-	0.98	2.00	2.98	0.00	-	2.46	5.00	7.46
2 นางสมจิตร ปทุมจิต	1		ลูกส่งเสีย	3,000	1,000.00	0	-	75	50	125	0.00	-	2.50	1.67	4.17	0.00	-	7.50	5.00	12.50
รวม				5,500.00	2,000.00	0		99.58	100	199.58										
2.5 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง (น้ำมัน - ถ่านและฟืน (หาบ60) จำนวน 1 ครัวเรือน																				
1 นายอุบัน วงษ์ทวน	1		ลูกส่งเสีย ขายถ่าน	2,500	1,108.33	0	1.67	-	-	1.67	0.00	0.07	-	-	0.07	0.00	0.15	-	-	0.15
รวม				2,500.00	1,108.33	0	1.67			1.67										

ตารางที่ ภ-7 แสดงค่าใช้จ่ายพลังงานของแต่ละครัวเรือนในแต่ละรูปแบบการพึ่งพลังงาน(ต่อ)

Model	จำนวนสมาชิกในครัวเรือน		อาชีพ	รายได้	ค่าใช้จ่าย	ค่าใช้จ่ายพลังงานแต่ละชนิด				ค่าใช้จ่าย	มีการช่วยเหลือใช้จ่ายพลังงานก่อนรายได้หลังครัวเรือน					มีการช่วยเหลือใช้จ่ายพลังงานก่อนค่าใช้จ่ายหลังครัวเรือน				
				(บาทเดือน)	รายในครัวเรือน	ค่าไฟฟ้า	ค่าน้ำมัน	ค่าเศษทุจริต	ค่าถ่าน	ด้านพลังงาน	ไฟฟ้า	น้ำมัน	เศษทุจริต	ถ่าน	รวม	ไฟฟ้า	น้ำมัน	เศษทุจริต	ถ่าน	รวม
					(บาทเดือน)	(บาทเดือน)	เชื้อเพลิง	(บาทเดือน)	(บาทเดือน)	(บาทเดือน)		เชื้อเพลิง					เชื้อเพลิง			
3. รูปแบบการพึ่งพาพลังงาน 2 ชนิด	1-4	5-6					(บาทเดือน)													
3.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง																				
จำนวน 3 ครัวเรือน																				
1 นายศิริศักษณ์ นาคอินทร์	2		ทนักงานโรงงาน	5,833	3,500.00	300	400	-	-	700	5.14	6.86	-	-	12.00	8.57	11.43	-	-	20.00
2 พ.ต.ท.สมใจ ทรัพย์ทิน	6		ข้าราชการ	65,000	25,000.00	1,593.81	9,100	-	-	10693.81	2.45	14.00	-	-	16.45	6.38	36.40	-	-	42.78
3 นายเดชลิทธิ์ บำบัดโรค	4		ข้าราชการ	70,000	22,333.33	949.58	18,000	-	-	18949.58	1.36	25.71	-	-	27.07	4.25	80.60	-	-	84.85
รวม				140,833.00	50,833.33	2,843.39	27,500.00			30,343.39										
3.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า - แก๊สหุงต้ม																				
จำนวน 1 ครัวเรือน																				
1 นายไมล์ ลูพลวัลล์	2		ลูกค้าเลี้ย	2,000	1,583.33	150	-	150	-	300	7.50	-	7.50	-	15.00	9.47	-	9.47	-	18.95
รวม				2,000	1,583.33	150		150		300										
3.3 รูปแบบการพึ่งพาพลังงานน้ำมันเชื้อเพลิง -อ่าน หิน(ทาเลย)																				
จำนวน 3 ครัวเรือน																				
1 นายบุญส่ง เปรมมิรี	3		รับจ้างประจำ (รปภ)	8,000	4,666.67	0	2,000	-	-	2,000.00	0.00	25.00	-	-	25.00	0	42.86	-	-	42.86
2 นายสวัสดิ์ บุญค้ำ	3		รับจ้างเกษตร ก่อสร้าง	5,000	1,250.00	0	200	-	-	200	0.00	4.00	-	-	4.00	0	16.00	-	-	16.00
3 นายนคร เปลื้องดี	2		ทำนา รับจ้างก่อสร้าง	5,000	1,200.00	0	200	-	-	200	0.00	4.00	-	-	4.00	0	16.67	-	-	16.67
รวม				18,000	7,116.67	0	2,400			2,400.00										
3.4 รูปแบบการพึ่งพาพลังงานไฟฟ้า - อ่านและหิน (ทาเลย)																				
จำนวน 2 ครัวเรือน																				
1 นายสุกัญญา ชำนาญการณิชย์	2		ขายขนม	3,500	1500	300	-	-	-	300	8.57	-	-	-	8.57	20.00	-	-	-	20.00
2 นายบุญมี แป้นงาม	1		รับจ้างรายวัน	2,200	1000	0	-	-	-	0	0.00	-	-	-	0.00	0.00	-	-	-	0.00
รวม				5,700.00	2,500.00	300.00				300.00										

ตารางที่ ภ-7 แสดงค่าใช้จ่ายพลังงานของแต่ละครัวเรือนในแต่ละรูปแบบการพึ่งพลังงาน(ต่อ)

Model	จำนวนสมาชิกในครัวเรือน		อาชีพ	รายได้	ค่าใช้จ่าย	ค่าใช้จ่ายพลังงานแต่ละชนิด				ค่าใช้จ่าย	มีการช่วยเหลือใช้จ่ายพลังงานก่อนรายได้หลังครัวเรือน					มีการช่วยเหลือใช้จ่ายพลังงานก่อนค่าใช้จ่ายหลังครัวเรือน				
				(บาทเดือน)	รายในครัวเรือน	ค่าไฟฟ้า	ค่าน้ำมัน	ค่าเศษ	ค่าถ่าน	ด้านพลังงาน	ไฟฟ้า	น้ำมัน	เศษทุจริต	ถ่าน	รวม	ไฟฟ้า	น้ำมัน	เศษทุจริต	ถ่าน	รวม
					(บาทเดือน)	(บาทเดือน)	เชื้อเพลิง	ทุจริต	(บาทเดือน)	(บาทเดือน)		เชื้อเพลิง					เชื้อเพลิง			
4. รูปแบบการพึ่งพาพลังงาน 4 ชนิด และมีการใช้พลังงานทดแทนนอกจากถ่านและหิ	1-4	5-6					(บาทเดือน)	(บาทเดือน)												
4.1 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง																				
แก๊สชีวภาพ - ถ่านและหิน(ทาเลย) จำนวน 1 ครัวเรือน																				
1 นายธงชน เอกนัคร	4		ทำนา ค้าขาย รับจ้างทั่วไป	12,500	5,500.00	500	3,000.00	-	-	3,500.00	4.00	24.00	-	-	28.00	9.09	54.55	-	-	63.64
รวม				12,500	5,500.00	500	3,000.00			3,500.00										
4.2 รูปแบบการพึ่งพาพลังงานไฟฟ้า - น้ำมันเชื้อเพลิง - แก๊สหุงต้ม - พลังงานแสงอาทิ																				
1 นายสุชาติ ใหม่ทอง		6	ธุรกิจส่วนตัว	35,000.00	25,000.00	1,600	10,000	150	-	11,750.00	4.57	28.57	0.43	-	33.57	6.4	40	0.6	-	47
รวม				35,000.00	25,000.00	1,600	10,000	150		11,750.00										

BIOGRAPHY

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