# THE ADOPTION OF HIGH EFFICIENCY KILN OF PEOPLE

# IN THE NORTH EASTERN AREA

**PRAWONWAN SAIPAN**

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Prawonwan Saipan
.....
Ms. Prawonwan Saipan
Candidate

Pisit Sukreeyapongse
.....
Assoc. Prof. Pisit Sukreeyapongse,
M.Sc. (Technology of Environmental Management)
Major-Advisor

Prakairat Sukummalachat
.....
Assoc. Prof. Prakairat Sukummalachat,
M.S. (Community Development)
Co-Advisor

.....
Mr.Chanchai Limpiyakorn
M.Eng.(Mechanical Engineering)
Co-Advisor

B. Mahaisavariya
.....
Prof.Banchong Mahaisavariya, M.D.
Dean
Faculty of Graduate Studies

Piyakarn T
.....
Assoc. Prof. Piyakarn Teartisup,
Ph.D. (Foresty)
Chair
Master of Science Programme in Environmental Planning for Community and Rural Development
Faculty of Environment and Resource Studies

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on
May 18, 2007

Prawonwan Saipan
Ms. Prawonwan Saipan
Candidate

A. Hambananda
Dr. Anong Hambananda,
Ph.D. (Bioscience)
Chair

Pisit Sukreeyapongse
Assoc. Prof. Pisit Sukreeyapongse,
M.Sc. (Technology of Environmental
Management)
Member

Prakairat Sukummalachat
Assoc. Prof. Prakairat Sukummalachat,
M.S.(Community Development)
Member

Mr.Chanchai Limpiyakorn
M.Eng.(Mechanical Engineering)
Member

B. Mahaisavariya
Prof.Banchong Mahaisavariya, M.D.
Dean
Faculty of Graduate Studies
Mahidol University

S. Dilokwanich
Assoc. Prof. Sittipong Dilokwanich,
Ph.D. (Human Geography)
Dean
Faculty of Environmental and Resource
Studies
Mahidol University

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Pavornwan Saipan

THE ADOPTION OF HIGH EFFICIENCY KILN OF PEOPLE IN THE NORTH EASTERN AREA

PRAWONWAN SAIPAN 4537249 ENRD/M

M.Sc. (ENVIRONMENTAL PLANNING FOR COMMUNITY AND RURAL DEVELOPMENT)

THESIS ADVISORS : PISIT SUKREEYAPONGSE, M.Sc.,

PRAKAIRAT SUKUMMALACHAT, M.S., CHARNCHAI LIMPIYAKORN, M.Eng.

## ABSTRACT

This research studies the factors influencing the adoption of high efficiency kilns by people in the north eastern region of Thailand and the level of such adoption. Data was collected by questionnaires and interviews with 12 people in Ubonratchathani, 160 in Surin, 100 in Nakornratchasima and 36 in Khonkaen who have, and have not ,used high efficiency kilns, totalling to 308 cases. The data were then processed using SPSS for Windows application software, and summarized in the form of describing the characteristics, quantities, frequencies and data distribution. The statistical values used are percentage, average, arithmetic average and standard deviation. The relationship between 1 independent variable (group measurement level) and other dependant variable (range measurement level) was used analyze the correlation coefficient. The difference between the average values of the two groups of population was analyzed using statistical method for analyzing the difference of two such different groups.

The study indicates that the samples had adoption of high efficiency kilns at low level and at medium level. Most samples had problems and suggestions regarding the adoption of high efficiency kilns Those included : unavailability of personal budget for buying kiln installation equipment, public relation about the benefits in various aspects of the kiln preferred, providing knowledgeable entities to teach them how to use the equipment, as well as training and demonstration, subsidies from governmental entities, making the kiln bigger and public relations through public systems.

The research indicates the occupation, knowledge and attitude toward the use of the kiln were influential in the adoption of high efficiency kilns, whilst such factors as household size, annual net household income, and receipt of energy planning information were found to have nothing to do with the adoption of high efficiency kilns.

This study reflects the need of continual public relation about high efficiency kilns for ongoing adoption and use by in the future.

KEY WORDS : ADOPTION / HIGH EFFICIENCY KILN / NORTH EASTERN

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การยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูงของประชาชนในพื้นที่ภาคตะวันออกเฉียงเหนือ
(THE ADOPTION OF HIGH EFFICIENCY KILN OF PEOPLE IN THE NORTH EASTERN AREA)

ปวรวรรณ สายพันธุ์ 4537249 ENRD/M

วท.ม. (การวางแผนสิ่งแวดล้อมเพื่อพัฒนาชุมชนและชนบท)

คณะกรรมการควบคุมวิทยานิพนธ์ : พิสิฐ ศุกรียพงศ์, M.Sc., ประกายรัตน์ สุขุมาลชาติ, M.S., ชาญชัย ลิมปิยากร, M.Eng.

**บทคัดย่อ**

การยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูงของประชาชนในพื้นที่ภาคตะวันออกเฉียงเหนือ มีวัตถุประสงค์เพื่อศึกษาปัจจัยที่มีผลต่อการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง และระดับการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูงในพื้นที่ภาคตะวันออกเฉียงเหนือ โดยเก็บรวบรวมข้อมูลผ่านแบบสอบถามประกอบการสัมภาษณ์ประชาชนผู้ใช้และไม่ใช้เตาเผาถ่านประสิทธิภาพสูง ในจังหวัดอุบลราชธานี,สุรินทร์,นครราชสีมาและขอนแก่น จำนวน 12,160,100 และ 36 รายตามลำดับ จำนวนรวม 308 ราย จากนั้นผ่านการประมวลผลข้อมูลด้วยโปรแกรมสำเร็จรูป SPSS for Windows โดยข้อมูลลักษณะทั่วไปนำเสนอในรูปแบบของการบรรยายลักษณะ ปริมาณ ความถี่ และการกระจายของข้อมูล สถิติที่ใช้ คือ อัตราส่วนร้อยละ ค่าเฉลี่ย ค่าเฉลี่ยเลขคณิต และส่วนเบี่ยงเบนมาตรฐาน ส่วนความสัมพันธ์ระหว่างตัวแปรอิสระ 1 ตัว(ระดับการวัดเป็นกลุ่ม) กับตัวแปรตาม 1 ตัว(ระดับการวัดเป็นช่วง) ใช้สถิติวิเคราะห์ความแตกต่างของค่าเฉลี่ยของประชากร 2 กลุ่ม

จากการศึกษาพบว่า กลุ่มตัวอย่างมีการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูงในระดับต่ำ(ร้อยละ98.7) และมีการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูงในระดับปานกลาง(ร้อยละ 1.3) โดยกลุ่มตัวอย่างส่วนใหญ่มีปัญหาและข้อเสนอแนะต่อการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ได้แก่ การไม่มีงบประมาณส่วนตัวในการลงทุนซื้ออุปกรณ์ติดตั้งเตาเผาถ่านฯ ควรให้มีการประชาสัมพันธ์ทราบถึงคุณประโยชน์ของเตาเผาถ่านฯด้านต่างๆ มีการให้หน่วยงานที่มีความรู้มาสอนให้เข้าใจในขั้นตอน วิธีการต่างๆ ตลอดจนให้มีการจัดอบรมและสาธิตวิธีทำ การให้ทุนสนับสนุนจากหน่วยงานรัฐ การปรับปรุงเตาให้มีขนาดใหญ่ขึ้น และมีการประชาสัมพันธ์ทางหอกระจายข่าว

สำหรับการทดสอบสมมติฐาน พบว่า อาชีพ ซึ่งเป็นปัจจัยส่วยบุคคล ความรู้เกี่ยวกับเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร และทัศนคติต่อการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ซึ่งเป็นปัจจัยกระตุ้น มีผลต่อการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ส่วนปัจจัยด้านแรงงานในครัวเรือน รายได้สุทธิของครัวเรือนต่อปี และการรับรู้ข่าวสารด้านการวางแผนพลังงาน พบว่า ไม่มีผลทำให้กลุ่มตัวอย่างมีการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง

ผลการศึกษาได้สะท้อนให้ทราบถึง ความจำเป็นในการเผยแพร่ประชาสัมพันธ์อย่างต่อเนื่องในเรื่องเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร เพื่อให้กลุ่มตัวอย่างเกิดการยอมรับและมีการนำไปใช้อย่างต่อเนื่อง

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# CHAPTER 1
# INTRODUCTION

## 1.1 Background and State of Problem

At present, the global energy consumption is extended from natural resources. Since most of them are non-renewable energy, it has forecasting that energy crisis situation would nearly happen. So it is necessary to find the new sources of energy, which called alternative energy. The appropriate energy is ought to be renewable energy and not impact to the environment (clean energy) (Sunthorn Boonyatikan, 2002: 2-4)

According to the energy consumption report of Thailand in 2004, the total energy demanded was 61,080 ktoe (increasing from 2003 as 8.5%), categorized as renewable energy for 17%. The household energy usage was 8,598 ktoe or 14.1% (increasing from 2003 as 4.9%), categorized as renewable energy for 61% (Department of Alternative Energy Development and Efficiency-DEDE, 2004: 16-20). The using of biomass in household (kiln and firewood) is almost energy usage in rural area (5,218 ktoe or 60.7%).

Energy is important for all activities in daily life, especially of energy consumption in rural area which use as cooking and facilities. The major cause of energy waste is energy consumption behavior themselves. Thus, it is need to provide alternative energy or appropriate technology management for rural area before the energy crisis would occur.

One of useful alternative energy is biomass, which suitable for rural sector and usable in some countries such as Denmark (Appropriate Technology Association-ATA, 2002: 107). The biomass is biological energy sources, for instance, wood and agricultural waste. This fuel is burned to produce heat or electricity. The efficiency of

produced energy is depending on kilns type. The digestion block is one type of kilns which common use in rural area. However, it has various types of high efficiency kilns which suitable and high-efficiency than digestion block. The high efficiency kiln is the most useful kilns for support rural sector both characteristic and suitability. Because raw materials and fuel is available, low cost, long life, easy maintenance, and produce high-efficiency kiln (less tar). Besides, it has obtain wood vinegar as by product which useful for livestock. Wood vinegar is fertilizer, pesticide, and growth regulator for root, stem, tube, leaf, and flower in some plant. Wood vinegar can help growth regulation and control plant pathogen which causes from Mermithid nematode and fungi. In addition, wood vinegar is plant hormone and inhibitor when use in different proportion. For livestock, wood vinegar is use as deodorant and insect controller or mixed with animal feed to help assimilation and prevent animal diarrhea. In addition, wood vinegar can sale as product packaging (Appropriate Technology Association-ATA, 2003d: 12-13) The 4 steps of kiln burning procedure are (Appropriate TechnologyAssociation-ATA,2003b:4)

First Phase: While loading fuel, temperature will slightly increase. When the temperature of stack is 55 – 60 $^0$C and burned tank is 150 $^0$C, the smoke is initial smell. When continuous loading fuel until temperature of stack and burned tank are rise to 70 – 75 $^0$C and 200 – 250 $^0$C respectively, the smoke is odor. This phase is called dehydration phase; spend for 2 – 3 hours.

Second Phase: When it is continuous burning, temperature of stack and burned tank are rise to 80 – 85 $^0$C and 300 – 400 $^0$C respectively. The smoke will condense, become white, and stinky. The wood initial become kiln, called exothermic reaction, and the temperature of burned tank is continuous increasing. If use white glazed tile place on the end of stack and found brown clear drop at glazed tile, it can collect wood vinegar immediately. The technique of wood vinegar collecting is use bamboo pipe, length 3 – 5 meter, or acid durable material place on the end of stack to collect the smoke. When the smoke is touching the cool air, it will condense and become drop. Wood vinegar can collect during 4 hours or notice at the color of smoke. If the smoke is become blue, stop to collect.

Third Phase: There is purifying (refinement) by open the front of tank to release the air. This process is making the temperature rising for remove tar from kiln. If tar is not eliminated, produced kiln would have low efficiency. When the tar which remains in kiln is burned at above 425 $^0$C, it will become the chemical compound which is cause of cancer. The temperature in this phase is higher than 150 $^0$C; it should not collect wood vinegar too. Because it has chemical compound which harmful to use for agriculture and livestock. When notice that the color of smoke will change from blue to clear, open the front tank and stack.

Forth Phase: This phase is cool down the kilns (cooling) before get the kiln out. The temperature must cool down at below 50 $^0$C before open the kilns, otherwise kiln would burn again. It can test by touch at the stack, while the smoke cool down it can open the kilns.

The wood vinegar is cannot use immediately, because the whole burning process is not simultaneously occur. So, the smoke is mixed by smoke from low and high temperature. It is contaminated by tar and volatile matter. After collect wood vinegar, it should holdup to purify before use at least 3 months. Keep it in cool and shady place or opaque container.

For energy planning in rural area, the Appropriate Technology Association (ATA) and Ubon Ratchathani Science Centre for Education (USE) are accomplished the project of local energy planning. The study area is located in north-eastern area for promote, planning, and performing conscientiously. The proceeding is formed of local planning in Tambon U-lok, Amphoe Lamduan, Surin Province, Tambon Sa Jorrakhae, Amphoe Dan Khun Tod, Nakhornratchasrima Province, Tambon Nong Sao Lao, Amphoe Chum Phae, Khon Kaen Province, and Tambon Khu Mueang, Amphoe Warin Chamrap, Ubon Ratchathani Province as pilot project. This project is performing for one year during June 2002 – May 2003. The project is aim to develop capability of Tambon Organization Association and community for local energy planning and initial leading the energy conservation activities and renewable energy usage. Based on the information of ATA (Appropriate Technology Association-ATA,

2003a: 1), it can forecast that this pilot area would have average energy consumption about 16 – 22 million baht in 2007. It can separated to electricity 2 – 3 million baht, oil 10 – 16 million baht, natural gas 6 hundred thousand – 1 million baht, and wood 8 hundred thousand – 4 million baht. The value of average energy consumption is expense of community for buying energy about 13 – 19 million baht. One part of them is spending for buying energy or lack of sale available energy in community such as wood. Additionally, this community is release Carbon Dioxide gas about 383 – 496 kilogram per capita per year. If they are not improving the energy consumption behavior, the energy consumption rate would be continuous increase. Therefore, this community is waste their usable energy in local area.

The energy planning in 4 areas is performing by collect the information of energy consumption, data analysis for solving energy problem, and planning of energy usage in 2002 – 2003. After that, the promotion activities according to the plan were carried out. There were including training course, study activities, high-efficiency stove and kilns production promotion such as Iwate kilns and high efficiency kiln, and plant. This campaign is achieved for energy problem solving by establish public consciousness on energy conservation. The energy planning in 2003 – 2004 was determined to decrease electricity consumption about 8 – 10% by change the energy consumption behavior, and decrease firewood consumption about 7 – 20% by promote the high-efficiency stove, economic kilns, and high efficiency kiln usage with high-efficiency kiln. If the proceeding is according to the plan, the public consciousness on energy conservation would occur. Besides, the local network of energy management and local energy development are improved in order to support the economy of community. By the way, the models of saving energy household in 4 areas are about 285 places. There are example of energy saving and conservation by change the energy consumption behavior. The high-efficiency stove and high efficiency kiln were installed about 400 kilns of each type and plant at least 400 trees. (Appropriate Technology Association, 2003a:1)

From the review of literature, it was found that the changing of energy consumption behavior of people in rural area was depending on many different

factors. The study of adoption of high efficiency kilns is use various factors which effect to acceptation of people. Likewise, it was found that the adoption of high efficiency kiln is depend on many factors such as occupation, household income per year, and household labor. The occupation is conduct to work and payment. It is result to different of lifestyle and attitude of people, so it is affect to different acceptation of innovation (Sukhothai Thammathirat Open University-STOU, 1987: 173). The payment factor is also affect, because it is demonstrate the statement of economy and society. People who have a good living are accept to a new innovation easy than the lower. (Refer to Anucha Sakulrat, 2001; 25)

Household labor is the one of factor which affects to the adoption of high efficiency kiln usage. Although, the burning will use workforce not much, workforce is needed when the kiln install. If any household has burning everyday, workforce is important to them.

Additionally, other factors which related to the adoption process are lifetime of high efficiency kiln and information reception. Because there are concern to the decision making process. The knowledge and attitude factor are also concerned. Attitude is gathering personality originated from readiness or inclination of mind. This is expressed to an incentive such as an objects, things, and situations in society. (Boontam Kijpreedaboerisut, 1997: 239)

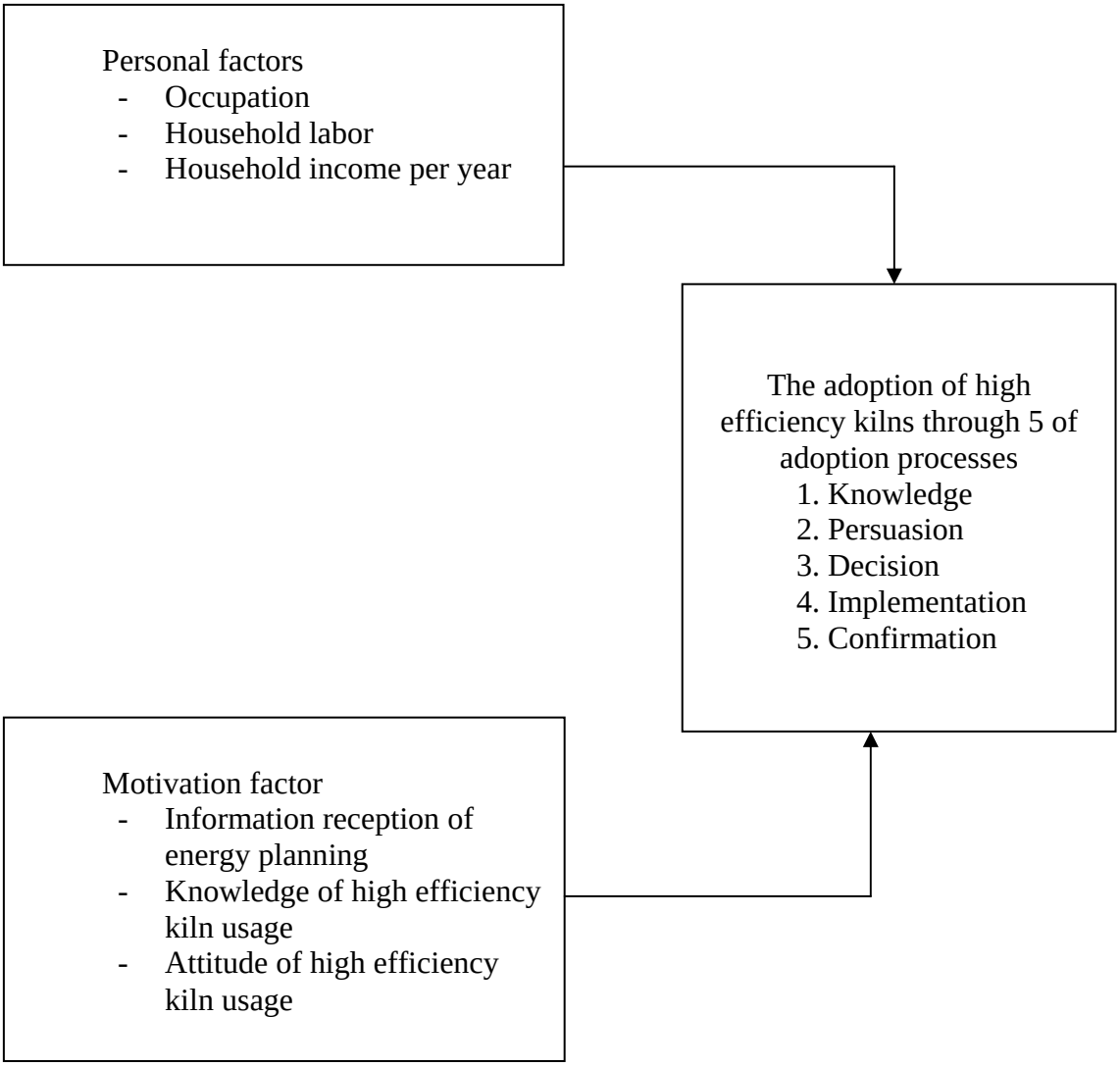
The support of investment cost from government is the one important factor, because the investment cost is indicate the product demanding. If people are obtained the supporting budget, it would encourage them to accept new technology. And the by product factor, wood vinegar is useful by product of high efficiency kiln. It is also affect to adoption of people.

However, this study was not including personal factors in term of gender, age, and education, because these factors are not affecting to adoption. Although the family leader (most of them are male) is the person who decide to use the kilns, the kilns is

the household property. Besides, the educational levels of people in study area are same (not over junior high school). It was not significant to the adoption.

Therefore, the improvement of energy consumption behavior of people in north-eastern area is based on household energy use. Using of high efficiency kiln is the one of process which useful for local energy planning. This process is allows the community people to find out the alternative energy and effective for energy usage. Thus, the adoption of people to the high efficiency kiln was considered in this study. The selected study area is located in north-eastern because it is the same area of pilot project for local energy planning. This is the initial of local energy planning process which useful and advantage for community. Moreover, it can be an example for neighbor community for develops their own energy planning.

## 1.2 Framework of Research




## 1.3 Research of Objectives

1. To study the adoption factors of people of high efficiency kiln usage.
2. To study the adoption levels of people of high efficiency kiln usage.

## 1.4 Scope of Research

This study was considered to people who live in pilot project area which include;

- Tambon Nong Sao Lao, Amphoe Chum Phae, Khon Kaen Province for 9 villages
- Tambon U-lok, Amphoe Lamduan, Surin Province for 11 villages
- Tambon Khu Mueang, Amphoe Warin Chamrap, Ubon Ratchathani Province for 12 villages
- Tambon Sa Jorrakhae, Amphoe Dan Khun Tod, Nakhornratchasima Province for 13 villages

## 1.5 Variables used in this Research

**Independent Variables:**

1. Personal factors: occupation, household labor and household income per year
2. Motivation factors: information reception of energy planning, knowledge of high efficiency kiln usage, and attitude of high efficiency kiln usage.

**Dependent Variables:** the adoption of people of high efficiency kiln usage in north-eastern area.

## 1.6 Variables and Measurement Level

The scale of variable test are showed in Table 1.1

**Table 1.1** The scale of variable

| Factor | Variable | Scale |
|---|---|---|
| Personal factor | 1. Occupation | Nominal Scale |
| | 2. Household labor | Ratio Scale |
| | 3. Household income per year | Ratio Scale |
| Motivation factor | 4. Information reception of energy planning | Nominal Scale |
| | 5. Knowledge of high efficiency kiln usage | Interval Scale |
| | 6. Attitude of high efficiency kiln usage | Interval Scale |
| Dependent variable | 7. The Adoption of high efficiency kiln of people | Interval Scale |

## 1.7 Assumption

The assumptions of this study are;

**Personal factor :** results to the adoption of people to high efficiency kiln usage in term of

1. People who work in agricultural sector would have the adoption of high efficiency kiln usage more than people who not work in agricultural sector.
2. People who have a lot of household labors would have the adoption of high efficiency kiln usage more than people who have a few household labors.
3. People who have a few household incomes per year would have the adoption of high efficiency kiln usage more than people who have a lot of household incomes per year.

**Motivation factor :** results to the adoption of people to high efficiency kiln usage in term of

4. The information reception of energy planning is positive related to the adoption of people to high efficiency kilns usage.
5. The knowledge of high efficiency kilns usage is positive related to the adoption of people to high efficiency kilns usage.

6. The attitude of high efficiency kilns usage is positive related to the adoption of people to high efficiency kilns usage.

## 1.8 Expected Outcome

1. Understand the level of the adoption of people to high efficiency kilns usage in north-eastern area.
2. Understand the factors which affect to the adoption of people to high efficiency kilns usage in north-eastern area.

## 1.9 Definition used

**Adoption** is the process in mind of personal to acknowledge new thing. Start from hearing, adoption new thing to practice in finally. Its characteristic seems like learning and decision.

**The high efficiency kiln** is a high efficiency kilns which used 200 liter capacity as a burning tank. It uses heat to evaporate moisture in wood to become a kiln. This process called “Carbonization”. The tightly seal tank can control excess air and has not be in flame. So, the burned product is good qualification and low ash and obtains the “Wood Vinegar” as by product for agricultural utilization.

**The lifetime of high efficiency kiln** is a number of years which count from the beginning to the end of usage.

**The adoption of high efficiency kiln usage** is the positive attitude to use the high efficiency kiln according to 5 processes as knowledge, persuasion, decision, implementation, and confirmation.

**Household income per year** is the net income of all family members per year.

**Household labor** is family members who are 15 – 65 years old and working.

**Information reception** is the understanding of knowledge and benefit of high efficiency kiln through focus group, training, and workshop from the concerned institutes.

**Knowledge** is the part of fact, content, criteria and even if, other received information which not only concerning to person or thing but also place. Knowledge can be acknowledge by observation, experience and research then go through retention and recall memory to appeared, observable and measurable.

**Attitude** is the feeling and though of individual to stimulus in social. Which has a different response of feeling and though to incentive both positive and negative. When aware with likely things, response would be positive on the other hand response would be negative.

# CHAPTER 2
# LITERATURE REVIEW

The related documents such as conceptual frameworks, acceptation theories, and high efficiency kilns information of the study for public acceptance on high efficiency kilns in northeastern area was described in term of;

2.1 Thought of energy planning
2.2 Thought of high efficiency kiln
2.3 Thought of knowledge
2.4 Thought of attitude
2.5 Thought of adoption
2.6 Literature review on adoption and variables

## 2.1 Thought of Energy Planning

### 2.1.1 Energy Situation in Thailand

According to the “Thailand Energy Situation report” in 2004, the total energy demand of Thailand was separated to domestic production and energy imports for 49,470 and 55,606 ktoe respectively. The energy imports of Thailand can be categorized to various supplies as shown in table 2.1.

**Table 2.1 Thailand energy imports in 2004**

| Type of Energy Imports | Unit (ktoe) | % |
|---|---|---|
| Coal | 4,714 | 8.5 |
| Crude oil | 41,345 | 74.4 |
| Natural gas | 7,607 | 13.7 |
| Petroleum products | 1,640 | 2.9 |
| Electricity | 283 | 0.5 |
| Renewable energy | 17 | 0 |
| **Total** | **55,606** | **100.0** |

Source: Department of Alternative Energy Development and Efficiency (DEDE), 2004: 6

Total 73% of energy imports, especially crude oil and petroleum products, are most supplied to transportation, residential, and manufacturing sectors. The energy consumption by economic sector of Thailand 2004 can be concluded in table 2.2.

**Table 2.2 Energy consumption by economic sector in 2004**

| **Energy consumption** (by economic sector) | **Demanding (%)** |
|---|---|
| Agriculture | 5.6 |
| Manufacturing, Mining, and Construction | 36.7 |
| Residential | 14.1 |
| Commercial | 6.5 |
| Transportation | 37.1 |
| **Total** | **100.0** |

Source: Department of Alternative Energy Development and Efficiency (DEDE), 2004: 18

The relationship of energy provided and energy consumption in 2004 was showed that most of them are used for manufacturing, transportation, and residential which are directly concerned to daily life of public. Besides, the energy consumption for transportation and residential are totally 51.2% of country's demanding. This is greatly cost of energy production. Therefore, it has to decrease the energy use by public awareness and changing of energy consumption activities. It can help to reduce the investment of energy sector provided in Thailand. In addition, it has advantage for environmental conservation and energy saving for our future.

### 2.1.2 Energy Sources

The earth has received enormously energy from the sun. In each day, this energy can change into much usable energy for human life. The classification of energy is divided from many criteria such as type, level of technology usage, international commerce characterization. For this report, it was mention on energy sources for 2 types as summarized below. (Sunthorn Boonyatikarn et al, 2002; 33)

**1. Non – renewable Energy**

Most of non-renewable energy is fossil fuel which originates from the ground as liquids, gases, and solid. They formed from the buried remains of plants and animals that live millions of year ago. Natural gas is normally gases, and coal is a solid. Coal, petroleum, and natural gas are all considered fossil fuels. These energy sources are considered nonrenewable because they cannot be replenished in a short period of time. Thus, they are ought to reserved as future energy than pressing use as present.

(1) Coal

Coal is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geologic time. Coal is classified into four main types (lignite, sub-bituminous, bituminous, anthracite),

depending on the amounts and types of carbon it contains and on the amount of heat energy it can produce.

| | | |
|---|---|---|
| A. Lignite | Energy Capacity | = 17,000 KJ/Kg |
| B. Sub-bituminous | Energy Capacity | = 24,900 KJ/Kg |
| C. Bituminous | Energy Capacity | = 30,450 KJ/Kg |
| D. Anthracite | Energy Capacity | = 32,870 KJ/Kg |

(2) Oil and Natural Gas

Oil and natural gas are the product of compression and heating of ancient organic materials over geological time. The resulting high levels of heat and pressure cause of remains to sensitive combustion matter which has high energy capacity and heat transfer.

(3) Nuclear

Nuclear energy is applied from Uranium, a radioactive element, for electricity production. It is considered as non-renewable energy which high risk of radioactive contamination to environment. The radioactive waste, plutonium, is under gradable waste and toxic to environment.

Although it has high investment of nuclear power plant, it used in various countries such as United States, France, Germany, Japan, and South Korea.

**2. Renewable energy**

Renewable energy sources can be replenished in a short period of time. The renewable sources used most often include charcoal, solar, wind, hydropower (water), biomass, alcohol, biodiesel, and geothermal.

(1) Charcoal

Charcoal is usually low efficiency fuel; nonetheless, production of wood charcoal is leads to forest abandonment and increase greenhouse gas in the

atmosphere. After deforest, it should compensate on growth for environmental conservation.

(2) Solar

Solar energy reaches the Earth's upper atmosphere at a rate of 5.75 x $10^{20}$ Kcal (more than total fuel used about 20,000 times). Solar energy can be converted directly or indirectly into other forms of energy, such as heat and electricity. The major drawbacks of solar energy are: (1) the intermittent and variable manner in which it arrives at the earth's surface and, (2) the large area required collecting it at a useful rate. So far, solar cell installation in Thailand has remains high cost and only 20% of efficiency use. There are 2 processes of solar energy development.

A. Photothermal Process: This conversion of sunlight into thermal energy through thermal storage (or solar collector) which contains of fluid (gas or liquid).

B. Photovoltaic Process: The conversion of sunlight into electricity through a photovoltaic (PVs) cell, commonly called a solar cell. A photovoltaic cell is a no mechanical device usually made from silicon alloys.

(3) Wind Energy

Wind power is the conversion of wind energy into more useful forms, usually electricity using wind turbines. The power in the wind can be extracted by allowing it to blow past moving wings that exert torque on a rotor (2 – 3 pieces). The amount of power transferred is directly proportional to the density of the air, the area swept out by the rotor, and the cube of the wind speed.

(4) Hydropower (Water)

Hydropower is the capture of the energy of moving water for some useful purpose. Prior to the widespread availability of commercial electric power, hydropower was used for irrigation, milling of grain, textile manufacture, and the operation of sawmills. Some people regard hydropower as the ideal fuel for electricity generation because, unlike the nonrenewable fuels used to generate electricity, it is

almost free, there are no waste products, and hydropower does not pollute the water or the air. However, it is criticized because it does change the environment by affecting natural habitats.

(5) Biomass

Biomass, in the energy production industry refers to living and recently living biological material which can be used as fuel or for industrial production. Some examples of biomass fuels are wood, crops, manure, and some garbage. The production process is low cost when compare to others such as oil and natural gas. The disadvantage of biomass is required a lot of raw material, but produces a few of energy.

(6) Alcohol

Currently, alcohol has been used as an automotive fuel and its have become the dominant energy resource for the modern world. Alcohol produced by fermenting agricultural crops such as sugar cane and cassava. There are 2 types of alcohol fuel use.

A. Gasohol: A fuel consisting of a blend of ethyl alcohol and unleaded gasoline, especially a blend of 10 – 15 % ethanol and 90 % gasoline. It is not requires engine modification.

B. Ethanol: The 99.6% ethanol is directly use as a motor fuel and fuel additive. However, it has require engine modification in term of oil and air mixing, explosion, and pressure ratio.

(7) Biodiesel

Biodiesel (or Diester) is a fuel made from natural, renewable sources, such as new and used vegetable oils and animal fats, for use in a diesel engine. It produces by conversion of Trigleceride into Monoalcohol Fatty Acid Ester and Methylester in chemical process. This fuel can reduce environmental pollution, petroleum imports, and excess agricultural crops problem.

(8) Geothermal

Geothermal refers to heat sources within the planet. Temperature within the Earth increases with increasing depth. At the depth of 25 – 30 km. the average temperature is about 550 – 1,000 $^0$C. The temperature at the Earth's center is estimated to be 3,500 – 4,000 $^0$C. In some area, heat source which close to Earth's surface is cause of hot spring. Thailand has use geothermal to produce electricity, for instance, Thermal Power Plant in Amphoe Mae Moh, Chiangmai Province and Krabi Province.

The mentioned above can summarized that most of energy consumption sector in Thailand is a resident. Finding the approach of effective energy use or changing energy consumption behavior is an important of fuel conservation for the future. Therefore, the approach of energy planning is ought to use appropriate technology or alternative energy which suitable to local community both urban and rural area.

### 2.1.3 Local Energy Planning

The local energy planning is a public involvement process in order to effective manages energy, environment, and budget within local community. It had arranged through energy understanding, alternative energy study, local data collecting and analyzing. All data would integrated and forecast the impact of energy system in further. Then, it has to planning energy and environmental management by local people. The good characteristics of local energy planning are; (Appropriate Technology Association – ATA, 2003e: 23 – 26)

1. Support quality of life of local people by provides suitable needs energy and price.

2. Establish local labor and rural development. The employment may come from energy saving equipment production, energy transfer technology, energy production equipment, renewable energy technology, and local fuel usage. This is proposing to circulate energy production investment within community.

3. Reduce energy imports and other energy services. Then, it can reduce indebtedness and increase owner decision making within community.

4. Decrease environmental and ecological problem. These also reduce health problem.

5. Promote and develop beneficial technology for community, for example, create local technology or new technology that response to local needs.

### 2.1.4 Local Energy Planning Tool and Machinery

In general, the important of planning process is have a present status understanding, have visualization, and has an alternative approach. Thus, energy planning is requiring many essential tools and machinery such as;

1. Energy Status

The energy status is express as general information, population, resources, energy consumption, and activities. It is an analysis of related documents on efficiency of energy usage within local community. There is consists of;

1.1 Energy consumption in various sectors such as residential, enterprise, and official place.

1.2 Energy price.

1.3 Energy sources within local community and potential of alternative energy.

1.4 General information of local community.

2. Energy Balance

Energy balance is a tool for describe the overall energy consumption within local community. It illustrates the energy types, equipments, and activities include the economic and environmental impact. Then, analyze the alternative approach for sustainable energy based on energy status.

3. Sustainable Energy Technology

Because of the large amount of energy consumption in Thailand, there is ought to develop sustainable energy sources. The sustainable energy is an activity which promotes the renewable energy and energy conservation. It is emphasize to personalize attitude of energy consumption understanding and look for sustainable energy sources. The selected sustainable energy technology should base on the principals as follows.

1. Clean energy, environmental friendly, and no damage the ecological balance
2. Replenish able (renewable fuel usage)
3. Adequate to energy needs, resources potentially, and local self-reliance management based on sufficiency economy approach
4. High efficiency and saving
5. Simple technology (can manage by local community)

The selected technology for energy planning should be an alternative technology for community in order to compensate old technology. At present, the accepted alternative technology of rural and agricultural sector is high efficiency gasifier, high efficiency kiln, biogas digester, and solar water heater.

4. Community

The community is an important composition of local energy planning. They should prompt to brain storm in meeting and carry out the planning. The associate have to consist of community member, leader (both formal and informal), housewife, and enterprise. Tambon Administration Organization, local government officer, and the authority should cooperate in addition.

In summary, one of alternative technology which appropriate to local area in Thailand is high efficiency kiln. The promotion of brick beehive usage in local community is lead to efficiency public involvement on energy planning.

The study of high efficiency kiln project was an investigated by questionnaire concerning to the public information based on energy perception and local energy plans.

## 2.2 Thought of high efficiency kiln

Thailand is a developing country which counts on fuel wood and charcoal as a source of energy, especially in rural sector. The consumption of fuel wood and charcoal in Thailand is 5,990 ktoe in 2004 as presented in Table 2.3

**Table 2.3 Final renewable energy consumption by type in 2004**

| Type of Renewable Energy | Unit (ktoe) |
|---|---|
| Fuel wood | 3,582 |
| Charcoal | 2,408 |
| Paddy husk | 1,037 |
| Bagasse | 3,441 |

Source: Department of Alternative Energy Development and Efficiency (DEDE), 2004: 20

The most of people who use this type of energy is lives in rural area and they have low income. This is the important energy source for their life because low price and replenish able. Charcoal is produced from carbonization of solid fuel such as wood. Nevertheless, deforest is the main problem in Thailand. So, it has to looking for other alternative fuel and change the behavior of energy consumption. (Savitree Chantranurak, 2000: 3)

It has been continuous improvement on kilns in order to control the air while burning. So far, the kilns was developed till it has high efficiency to produce charcoal. However, the major characteristic of kilns is not only high efficiency but also suitable

for usage in rural sector which charcoal was most utilized. The high efficiency kiln is the most suitable and high efficiency than digestion block and dome block. Table 2.4 compares the qualifications of them.

**Table 2.4 The comparison of qualification between general block and high efficiency kiln**

| Item | Digestion Block | Dome Block | 200 Liter Kilns | Unit |
|---|---|---|---|---|
| Material price (estimation) | 50 | 250 | 400 | Baht |
| Labors | 1 | 2 | 1 | capita |
| Stipend | 120 | 240 | 120 | Baht |
| Wood weight (almost dry) | 500 | 500 | 80 | kg |
| Fuel | Paddy husk | 100 | 6 | kg |
| Charcoal | 70 | 90 | 16 | kg |
| Life time | 1 | 1 | 2 – 3 | year |
| Efficiency | 14 | 18 | 20 | % |

Source: Appropriate Technology Association (ATA), 2003e: 99

### 2.2.1 Qualifications of high efficiency kiln

The high efficiency kilns was used 200 liter capacity as a burning tank. It uses heat to evaporate moisture in wood to become a charcoal. This process called “Carbonization”. The tightly seal tank can control excess air and has not be in flame. So, the burned product is good qualification and low ash and obtains the “Wood Vinegar” as by product for agricultural utilization. The major characteristics of high efficiency kiln are summarized as below (Appropriate Technology Association – ATA, 2003b: 5).

1. Raw material and equipment

The fuel wood is most available. It can use small size wood and not require fuel wood too much. Besides, the burned tank is easily maintenance and long life. The composition of equipment is available in general construction equipment shop as shown in Table 2.5.

**Table 2.5 The equipment of high efficiency kiln**

| Item | Size | Material | Amount | Price (Baht) |
|---|---|---|---|---|
| Burned tank | 200 liter | Oil tank 200 liter size | 1 tank | 250 |
| Wall tank | 1.2 x 1.2 $m^2$ | Tile, galvanized iron, wood* | 3 sheet | - |
| Front wall tank | 1.2 x 1.2 $m^2$ | Tile, galvanized iron, wood* | 1 sheet | - |
| Post | Diameter 3 inch, Length 1.2 m. | Wood* | 8 piece | - |
| Insulator | 0.7 $m^3$ | Soil or sand* | 0.7 $m^3$ | - |
| Stack | Diameter 4 inch, Length 1 m. | Rock wool pipe | 1 piece | 60 |
| Stack bend | $90^o$ Bend, Diameter 4 inch | Rock wool pipe | 1 piece | 25 |
| Brick | 40 cm. x 19 cm. x 7 cm. | Stone flake mixed with concrete | 5 piece | 25 |
| Wood vinegar collected pipe | Diameter 4 inch, Length 5 m. | Bamboo* | 1 piece | - |

Remark: * = materials which available in local area (have no price)

Source: Survey from construction equipment shops in local area: 2005

2. Production process

The burning process of high efficiency kiln is spends time for 1 day. It can control level of air and produce low ash. The processing is consists of composition and installation, wood loading, front kilns composition, and burning charcoal. All processes are using only one labor. The burning process is compose of 4 phase as described below.

First Phase: Dehydration

- Initial set on fire in front of burned tank
- Load fuel carefully. Heat will disperse in burned tank to drive cool air and dehydrate. The temperature of stack and burned tank are 55 – 60 $^0$C and 150 $^0$C respectively. The smoke is white and smells of Methanol acid in wood.
- Continuous load fuel carefully. The temperature of stack and burned tank are 70 – 75 $^0$C and 200 – 250 $^0$C respectively. The white smoke will increase and odor (spend 2 – 3 hours).

Second Phase: Exothermic Reaction

- When continuous burning for a while, the white smoke will become gray. The temperature of stack and burned tank are 80 – 85 $^0$C and 300 – 400 $^0$C respectively. Wood will have an exothermal reaction and temperature in burned tank will increase. In this phase, reduce fuel loading.
- After stop fuel loading, it has to control the air by reduce front tank area to 20 – 30 m$^2$ for temperature level keeping and extend time to collect wood vinegar. The most suitable time for wood vinegar collecting, stack temperature is 82 – 120 $^0$C. After that, the gray smoke will become dark blue. The temperature of stack and burned tank are 400 – 450 $^0$C respectively.

The suitable time for wood vinegar collecting can test by use white glazed tile place near the stack ending. If it has brown clear drop at glazed tile, this can collect wood vinegar immediately and continuous collecting for 4 hours.

Third Phase: Refinement

- This phase needs exclusive careful because it is concern to amount of ash. Wood will become completely charcoal. It needs to increase temperature rapidly by open one-third of front area for 30 minutes.
- Observe the end of stack. If dark blue smoke became light blue, it means wood has become completely charcoal. The light blue smoke will fade away and adhering rubber inner stack will dry. Temperature is about 500 $^0$C. Finally, the light blue smoke will become clear.

- When the smoke is clear, close the front area by use clay filling the hole. Then, close the stack and do not let the air leak into kilns.

Forth Phase: Cooling

- Spread out the soil on kilns for release the heat. Live it for 1 night or 8 hours at least for completely burning. Then, open the kilns and pick up the charcoal, dry in the sun for 1 hour, and packing.

All processes can be summarized as diagram of relationship between temperature and burning time of high efficiency kiln as follows.

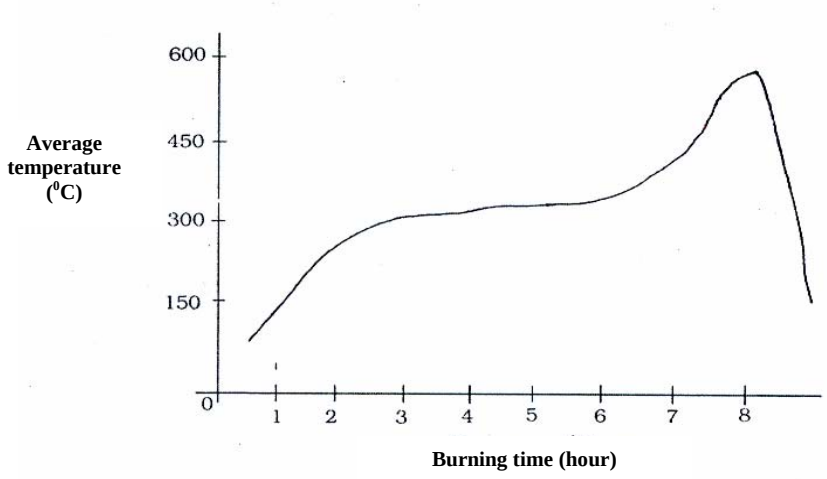



**Figure 2.1 Diagram of relationship between temperature and burning time of high efficiency kiln**

Source: Appropriate Technology Association (ATA), 2003b: 14

From the above diagram of relationship between temperature and burning time, it can be expressed as;

The initial 1–2 hours period: It was increased slightly in dehydration phase.

The next 2–3 hours period: The exothermic reaction phase, stop fuel loading.

The 3–4 hours period: The refinement phase, collect the wood vinegar spend time for 4–6 hours.

The 7–8 hours period: The charcoal purification phase.

The last 8–9 hours period: Close up the kilns.

3. Product

The product from high efficiency kiln is high quality charcoal. It is not harm to human health because it has less tar but good qualification (20 – 22% by almost dry weight). That is means 100 kilograms of fuel wood would become 20 – 22 kilograms of charcoal and a few ash for 0.12% by almost dry weight. Additionally, it is obtains wood vinegar as by product for 5 – 8% by almost dry weight.

Wood vinegar is a brown clear liquid and smoke smell. It is obtains from condensation of smoke which occur from charcoal production in refinement phase. In the period of 300 – 400 $^{0}$C, chemical compounds in fuel wood will break up and form to new compounds. However, if collect the smoke in over 425 $^{0}$C period, tar will decompose as carcinogen. It can remove by refinement again at 60 – 70 $^{0}$C.

The wood vinegar is cannot use immediately, because the whole burning process is not simultaneously occur. So, the smoke is mixed by smoke from low and high temperature. It is contaminated by tar and volatile matter. Tar is not solute in water and trap the stomata and adhere the root, so it cannot use in agriculture. The purification process of wood vinegar is precipitation, percolation, and refining. It has different color of purified wood vinegar as shown in figure 2.1. The utilization of wood vinegar is; (Appropriate Technology Association – ATA, 2003d: 12 – 15)

- Agriculture: Use as fertilizer, pesticide, growth regulator for root, stem, tube, leaf, flower, and fruit in some plant. Wood vinegar can help growth regulation and control plant pathogen which causes from Mermithid nematode and

fungi. In addition, wood vinegar is plant hormone and inhibitor when use in different proportion.

- Livestock: Use as deodorant and insect controller. Wood vinegar mixed with animal feed can prevent animal diarrhea because it help enrich animal feed in term of test, color, and smell. It can help to increase vitamins and milk, also reduce cholesterol and Ammonium and Sulfur Dioxide gas (deodorant). Besides, it can inhibit hatching of insect in manure, especially for fly. However, it should mix with carbon powder before use because it would odor when directly mixed with water.

- Industry: Manufacture of deodorant, skin softener, derma skin care, and smoked food industry.

- Others benefit: Wound healing, disturbed animal extermination such as termite, ant, centipede flag, scorpion, and millipede. In some case, wood vinegar can sale as product packaging.

Nevertheless, the utilization of wood vinegar should carefully use for

- Leave it to precipitate at least for 3 months before use.

- It has high acidity, use it carefully. Do not let to the eyes.

- Wood vinegar is not fertilizer, but it is catalyst. So it cannot use take place as fertilizer.

- Using wood vinegar for eliminate micro organism and bug should do before crop for 10 days.

- Using wood vinegar for crop should dilute appropriately for each plant.

- Using wood vinegar for flower and fruit should spray before blooming.

4. Investment, break even, and return period

It has low cost and short return period as showed in Table 2.6 and 2.7. So, it is suitable for household investment in rural sector.

**Table 2.6 Construction cost of high efficiency kiln**

| Item | Price (Baht) |
|---|---|
| 1. Oil tank 200 liter size | 250 |
| 2. Rock wool pipe, diameter 4 inch, length 1 m. | 60 |
| 3. $90^0$Bend, diameter 4 inch | 25 |
| 4. 5 Brick | 25 |
| 5. Wage for tank drilling | 20 |
| **Total** | **380** |

Source: Pricing survey from construction equipment shop in local area: 2548

**Table 2.7 Break even and return period of using high efficiency kilns**

| Burning Time | Income | Expense | Cash Flow | Total Cash |
|---|---|---|---|---|
| - | - | 380* | -380 | -380 |
| 1 | 75** | 24.5*** | 50.5 | -329.5 |
| 2 | 75 | 24.5 | 50.5 | -279 |
| 3 | 75 | 24.5 | 50.5 | -228.5 |
| 4 | 75 | 24.5 | 50.5 | -178 |
| 5 | 75 | 24.5 | 50.5 | -127.5 |
| 6 | 75 | 24.5 | 50.5 | -77 |
| 7 | 75 | 24.5 | 50.5 | -26.5 |
| 8 | 75 | 24.5 | 50.5 | **24 (break event point)** |
| 9 | 75 | 24.5 | 50.5 | 74.5 |
| 10 | 75 | 24.5 | 50.5 | 125 |
| **Total** | **750** | **630** | **120** | |

Source: Calculated: 2005

Remarks: * = Construction cost of high efficiency kiln

** = Charcoal product 15 kg. (5 Baht/kg.)

*** = Wood price when burned 1 time

- Volume of wood for burning 1 time 65 kg.
- Fuel kiln 5 kg. ( 350 Baht/ton )

The high efficiency kiln can produce charcoal for 150 times per 1 kiln or it has life time for 2-3 years depend on frequency of use.

The thought study of 200 liter brick beehives kilns was found that its qualifications, both efficiency and characteristics, are provide for villager. It is not only providing high efficiency charcoal but also provides wood vinegar as by product. In addition, it helps to reduce the deforest problem, smoking, labor, investment, and burning time.

Hence, the author was studied information of high efficiency kiln for use as knowledge base for understanding test, attitude test, and acceptance test of people in this study.

## 2.3 Thought of Knowledge

### 2.3.1 Knowledge

There have been many academicians refer to the definition of ‘Knowledge’, example are following:

Webster’ Dictionary (1994: 748) proposes that knowledge is truth, criterion and structure which originated by study and research. Otherwise knowledge is concern with place, thing or person gained from observation, experiment or reception report. All truth must be crystal clear and need time spent.

Yothin Boonsin (1996: 27) proposes that knowledge is truth, criteria, incident and others specification which has been obtained through research, learn or observe. Then gathering memory from easy to complex and express it in term of recall

behaviour to recall memorable to appear, observe and measure. In addition, all facts acknowledgement is need time.

Dictionary of the royal institute (2003: 232) proposes that knowledge is gathering from learn, research, experience, practice ability and skill, understanding or information gained by experience, hearing, listening and thinking or practice.

As all meaning mentioned above, it can be concluded that “knowledge” is part of fact, content, criteria and even if, other received information which not only concerning to person or thing but also place. Knowledge can be acknowledge by observation, experience and research then go through retention and recall memory to appeared, observable and measurable.

### 2.3.2 Knowledge Categorization

Bloom et al. were categorized knowledge as following (refer in Mayuree Patarachaiyakoupt, 1999: 37-39)

Knowledge of Specifics is reminiscence to separated matter, stress on abstract sign. This subject is level at the lowest abstract which may be though that is a complexity and abstract of knowledge i.e.

1. Knowledge of terminology is knowledge of specific sign both of language and non language. Together with accepted sign. Knowledge on any kinds of symbol which may have used only one or knowledge in the appropriate to those signs usage.

2. Knowledge of specific fact is knowledge of date, situation, person and place etc. Probably, conclude accurate and specific substance, for example, exactly period or general amount order of phenomenon.

**Knowledge of ways and means of dealing with specifics** is knowledge in methodology to deal consideration study system and criticize though or occurrence that can be separated in to minor group as following

1. Knowledge of conventions is knowledge in characteristic of the methodology to make and raised an idea or phenomenon. Must be observed that, even the format and cultural is assumption, not intend originate or base on all kind of

power, format and custom are still going on. Because it is a result from major group agreement or each person are associated with phenomenon or problem.

2. Knowledge of trends and sequence is knowledge of sequence and alignment which is the basic of specified purpose of argument subject or problem gave.

3. Knowledge of criteria is knowledge of fact, principal, opinion and practice.

4. Knowledge of methodology is knowledge of investigation, technique and process of some branches. This knowledge use for investigate some problems and phenomenon. It has concentrate in individual knowledge methodology more than ability in methodology used.

**Knowledge of universals and abstractions in field** is knowledge about plan, appearance important format, gathered knowledge, structure, theology and several conclusions. These influencing subject and be able to use for a phenomenon study even a problem solving. This is the highest level of abstracts knowledge and complexity that are separated as following;

1. Knowledge of principle and generalisations is knowledge about part of abstracts that summarized value remarks to explanation, description, prediction, specified the practice at appropriate direction and the most as harmonious as could.

2. Knowledge of theories and structures is knowledge in principle, ordinary conclusion and its relation. Presented clearly seen image of incident, problem or complexity. This knowledge level is use for present a relation and organization by many specific things.

From the principle above shown that knowledge in various things both factual and abstract are presented fact, though, experience, image and other conclusions which value to explanation into the harmony and appropriate direction.

### 2.3.3 Knowledge Measurement

Knowledge Measurement is a measurement on brain efficiency concerning to recalling memory or situations which has experience, been ever known or be done before. The measurement person can set up question tools. The character of questions

will be difference depend on type of knowledge and memory. While there is one joint character, that is, question's type is for remind past situation and experience which previously remind in form of vocabulary, definition, theory, rule, custom and any principle. Chichewa Pearatkul (Refer in Mayuree Patarachaiyakupt, 1999:39) said that;

1. Knowledge measurement about vocabularies and definition are the measurement meaning and characteristic of "word" or "phrase" or meaning of signs, pictures, acronyms, and other signs.

2. Knowledge measurement about rules and truth is measure formula, rule, truth, fact, content, and core of content which proved or accepted.

3. Knowledge measurement about the operation is the measure memory of process and work pattern of any phenomenon about its cause, pattern, and step of process but not focus on practical.

4. Measurement about pattern understands measurement of pattern, form, custom or tradition.

5. Knowledge measurement about sequence and tendency is the knowledge measurement in situations about movement trend direction, time series and occurrence sequence.

6. Knowledge measure about classification is a measurement about classification on things, content and variety of occurrences by its type, kind and sequence.

7. Knowledge measurement about criteria is a measurement memory in variety of rules which used for diagnosis and examine fact; weather or not remember and which rules or principles must be chose.

8. Knowledge measurement about methodology or work process is a measurement technique and practical means to find results. In addition, how to find proceed to use processes and methodology finding truth.

9. Knowledge measurement about sum up in core content is a memory measurement of conclusion or main idea of the content.

10. Knowledge measurement about principle and principle expansion is a measurement that weather or not recognize principles, which are essential in contents.

11. Knowledge measurement about theory and structure is a measurement an ability to recognize and conclude related part from theories and principles into main content or compiled within one content.

From principles above it can be seen that knowledge measurements, in practical, have to set up tools, which cover all ideas, to complete memory knowledge measurement.

### 2.3.4 Knowledge Measurement Tools

There are many kinds of tools for knowledge measurement. Each kind is proper to knowledge measurement by its different properties. In this research will focus on favor tools for knowledge measurement that is 'test'.

**Meaning and Characteristic of the test**

Test meant systematic methodology which used for behavior comparison of 2 persons at same time or one person or many people at different time. Tests have 3 main characteristics that are;

1. Systematic Procedure Test meant test should have certainly criteria about managing structure and scoring.
2. Behaviors Test which will measure only measurable practice. The responses have to answers the questions which aren't the direct measure.
3. Sample of All Possible Items Test Truly, there are no available completely tests which have all required behavior questions. As consequence, there have to assume that questions in a test are the representative of total behavior. In addition, if responders can answer any question right the score should be gave as equal as other questions.

**Test Types**

Tests characteristic are very difference both pattern usage and purpose to set up. Test Types are separated by criteria as following;

1. Separated by psychology; which have 3 types that are;

1.1 Achievement test is a test for measure understanding by cognitive domain from learning. This test type is separated into 2 types that are

- Teacher-Made Test is ordinary sat up. Test will be sat up when need to use once. If want to reuse test again, it should be modified, improved and revised because those tests haven't been analyzed the quality.

- Standardized test is a test which was many times developed through statistical analysis till complete quality. There is not only developed in precise but also accurately, easy-difficult, classification, multiple choices and norm for comparison. As conclusion, it should have standard on test progression and score translation.

1.2 Aptitude Test is a test for measure brain efficiency of human in term of general aptitude and specific aptitude. This test is separated into 2 types that are;

- Scholastic Aptitude test is a test for measure scholastic aptitude. This is presents an ability to further study on that subject and quantity ability to study.

- Specific Aptitude Test is a test for measure specific ability of personal such as musical skill, medical skill and art skill etc. It is used in the way of occupational suggestion.

1.3 Personal-Social Test is a test to measure personality and adapting to social (Boontham Kijpreedaboerisut, 2000: 84-87)

2. Separated by ask and answers forms are 2 types as following;

2.1 Essay Test; This type give specified questions then answerer have to compile the answers by themselves. Outstanding characteristic is at the answerer can freely answers. The answerer has to compile knowledge, understanding and though then write down as their own aptitude. Major of time spent for think and write down the answers, thus this test is not ordinary used. This test will be used for an interview form or only in primary survey.

2.2 Short Answer Test; This test give specified questions and short answers. Answerer has to find out answers by themselves as writing essay. There are 3 types of Short Answer test as following

2.2.1 Completion Item; Asking pattern is done by complete sentences. Answers should be short with one word or phrase.

2.2.2 Incomplete Statement; Asking pattern is done by incomplete sentences and leave spaces for fill the answers to complete the sentences.

2.2.3 Fill in related words; To question by main sentence then followed by words or minor text and space to filled are left. Filled answers should be related to minor word or phrase which specified.

2.3 Multiple Choices Item; this type is specified both question and answers. Answerer should choose answers from the specified answers. Outstanding of Multiple Choices Item is at answerer, which will spend most of time for read and figure out whilst less time for answer. Examine and analyze are easily and smoothly to do, thus this test is ordinary used in collecting data for research (Boontam Kijphreedaboerisut, 1997: 217-218.

Multiple Choices have many types, ordinary seen and always used in research are following;

2.3.1 Two Choices Test; mainly is true-false test. This test use for ask fact and measure knowledge from memory, for example, definition of vocabulary and methodology. Within Two Choices Test the specified answers have to be truly true or false answers with clearly questions and not be negative sentence. Sentences of question should be a short and mono meaning only except for asking reason. This test is normally used for interview or distributes low educated people.

2.3.2 Multiple Choices Test; This test give specified more than 2 choices, which are from 3-5 choices even generally are 4 choices. Answerer has to select one from

specified choices. The answers may be the most one word correct answers or one correct answer or wrong answers. It is generally sent to high educated sample groups. Question must be clear and ask only one main point. Questions are independent each to avoid instruction to each other. Question should be a complete sentence and not be a negative sentence. Answers in the same section should be same item and probability. Difficult or easy and short or long of question sentence should be equal. All answers should be independent from each other. It should not be intersection between rights or wrong answers because it will be affect to answer more complicate.

3. Answer Characteristic; are separated into 3 types as following;

3.1 Performance Test: This test is done by reality practice such as perform a play or doing on craftsman.

3.2 Paper-Pencil Test: This test is ordinary used which uses paper and pencil or pen to answer. All answers should be written down by answerer.

3.3 Oral Test: This test is done by oral answer in addition to write down. It is always conversation between asker an answerer, for example, interview.

4. Separated by Limited Time; There are 2 types as following;

4.1 Speed Test is limited time test, answer must be done within limited time,

always many questions with less time.

4.2 Power Test is unlimited time test; answerer can spend as much as time they want.

5. Separated by Criteria; There are 2 types as follow;

5.1 Criteria-Reference Test is test follow objectives of learning or external criteria which is theme of main subject.

5.2 Norm-Referenced Test is test for comparison results between tester groups.

From reviewed the literature review concerning about knowledge as above, researcher brought to design Knowledge Test about High efficiency kilns and measurement adoption usability High efficiency kilns Test in step of knowledge. The knowledge test of High efficiency kilns sizes 200 liters, researcher selected Achievement Test, with multiple choices (4 choices), for measure knowledge behavior in knowledge of memory, understanding and usability.

## 2.4 Thought of Attitude

### 2.4.1 Definition of Attitude

Carter V. Good (1973: 48-49) gave the definition of attitude as trend and reaction to thing, situation and popularity compile with feeling and mood within that opinion. Attitude can not be observed but can be refer from speech and action behavior.

Dictionary of the Royal Institute in 1999 gave the attitude meaning as is an idea (2003: 521).

Boontam Kijpreedaboerisut (1997: 239) give the definition of attitude as gathering personality originated from readiness or inclination of mind. This is expressed to an incentive such as an objects, things, and situations in society. Presented in the enhancement, agree with that stimulus on the other hand anti, disagree with that stimulus.

Mayuree Patarachaiyakoupt (1999: 44) gives the definition of attitude as belief, though and feeling of personal to environment surrounding in addition minds readiness of personnel responses to stimulus or situation. These things are a result from experience and learning of individual gained and collecting for a long time.

From all meaning above can be concluded that attitude meant feeling and though of individual to stimulus in social. Which has a different response of feeling

and though to incentive both positive and negative. When aware with likely things, response will be positive on the other hand response will be negative.

### 2.4.2 Attitude Component

Psychologist thought have been raised 3 components of attitude as following;

1. Attitude with 3 components as;

1.1 Cognitive Component i.e. knowledge, belief, though and opinion of individual to Attitude Object, for example, attitude to smoking. Before express feeling to smoking, which is like or dislike and agree or disagree, understanding tobacco and its advantage or disadvantage from smoking should be known.

1.2 Affective Component i.e. feeling like, dislike, good reaction or bad reaction to Affective Object. These are state of feeling, respond to stimulus or object in positive or negative. Affective Component is the result continuing from Cognitive Component.

1.3 Behavioral Component i.e. tendency or readiness of individual which will action to Attitude Object. If there are appropriate stimulus or attitude object, action or reaction will be occur.

2. Attitude with 2 components this thought identified that attitude have only 2 components i.e. knowledge components and feeling reaction component.

3. Attitude with 1 component this thought identified that attitude has 1 component that is an attitude in feeling reaction component. This attitude is present or response to Attitude Object by like or dislike and good or bad (Boontam Kijpredabhoerisut,1997:240-241)

From all 3 thoughts above, the thought that attitude has 1 component in feeling reaction component is the most generally used and accepted.

### 2.4.3 Principle Attitude Measurement

Attitude measuring have 3 primary principles to understanding as following;

1. Content; to measure attitude, stimulus is needed to activate in order to present behavior. General stimulus i.e. content which likely to measure, for example, would like to measure an attitude on family life of persona decision. From this case, stimulus content is the decision situation on family life and relationship within family.

2. Direction; Attitude measurement in general assumed that the attitude direction is a continually linearity (left-right or plus-minus). Beginning with strongly agree, less agree, neutral, continually decreased, disagree until strongly disagree. It should be seen that, character of agree-disagree is in same line and continuity.

3. Intensity; reaction or feeling which express to stimulus have different amount. If it has high intensity, in any direction, the feeling or reaction will be more extreme. (Boontam Kijpredabhoerisut, 1997:241)

### 2.4.4 Attitude Measurement

The famous scales for attitude measurement have 4 types as following;

1. Rating Scale; is the easiest methodology to rating personnel scale in one content by rating themselves. Attitude measurement by this method is easy to set up and use the test especially for the responders who capability to respond and dare to extremely show theirs opinion. Otherwise, mode of the answers will be at medium because major people don't like to express in violence.

2. Likert Scale; is the most generally known because it is easy to measure and uncomplicated. This technique begins with collection or arrangement concerning to study attitude contents. Each text have 5 choices as following;

| | | Positive | Negative | |
|---|---|---|---|---|
| Strongly agree | rating | 5 | 1 | points |
| Agree | rating | 4 | 2 | points |
| Undecided | rating | 3 | 3 | points |
| Disagree | rating | 2 | 4 | points |
| Strongly disagree | rating | 1 | 5 | points |

3. Thurstone Scale; this technique is focus on equal or likely to equal intervals problems more than other techniques. In practical meant methodology to weighting or scaling texts each which composed into scale. Each text has same weight within equal interval each. Methodology to measure equal intervals of Thurstone Scale can be done by 4 assumptions as following;

3.1 Individual attitude of content in each is the liking interval which can not be separated.

3.2 The expressed opinion is index of attitude level.

3.3 Individual opinion of content in each identified individual attitude level in the liking intervals. Therefore, this opinion level and liking interval have to be decided.

3.4 Attitude level; in a liking intervals, for example, level in the average criteria of expressed opinion. Opinions from same person should have value in the same liking intervals.

Standard set up of measurement by measure on equal interval of Thurstone methodology have 2 important steps that are, firstly is selecting contents and secondly is specification scale for each contents. Beginning from specified structure, which is content of wanted attitude measure. Contents should be prepared with several of choices and rely on many information sources together with newspaper, journal, magazine and all information sources. In addition personal, moreover, must have both positive and negative content.

4. Guttman Scale; is methodology to estimate series of created attitude measurement content, Guttman called Scalogram Analysis. This technique is trying to find series of attitude measurement content which its characteristic is scalable. That is in the series of attitude measurement content, if the responders agree with the second content they might be agree with the first content and if they agree with the third content the second content might agreed with.

From the literature review about thought of attitude, it can be seen that attitude is the feeling and individual to stimulator in social. Attitude responds to stimulus in

both positive and negative way. There have the principle to measure attitude by attitude scale with different methodology depending on the content structure appropriation. Data which researcher would like to measure should rely from various sources and should have both positive and negative.

In this research, researcher selected Likert Scale to measure attitude in attitude measurement form of High efficiency kilns sizes 200 liters usability. In this form, there are both equal between positive and negative content. Because this method easy to measure and appropriate with time period for doing research.

## 2.5 Thought of Adoption

### 2.5.1 Definition of Innovation

Innovation as in the Royal Institute Sociology Dictionary in 1981 (refer in Methe Rungsaeng, 1997:45) meant new occurred thing, that maybe, though, behavior, new social, new acknowledgement and new model in a cultural. In addition discovering and thinking to invent as well as little change may be the innovation.

Boonkua Khuanhawej, Assistant Professor (1999:12) said that innovation meant bringing new things to change or add in the old style for better efficiency.

Kidanant Malithong, associate professor (2000:255) gives a definition of innovation as; innovation is the thought, practical or recently invention which has never been used. Innovation is the development and modification old things to up-to-date, more efficiency and more effective than ever. In addition, innovation can save time and workforce, too.

NSTDA (1998: preface) “Innovation” is production, learning and new though usage to gain results form benefit in part of economic and social. New ideas are new for division or economic unit which is company, government, industry or country.

As conclusion, innovation is though, action, thing or invention which individual though that it is a new technique or new things. Then import it to improve work to be better or higher efficiency.

### 2.5.2 Definition of Adoption

Many academicians gave the definition of adoption. Major of them focus on acknowledgement, learning and decision to practice. Each definition has difference in detail depending on various opinions.

Rogers (1968 refered in Mayuree Patarachaiyakoupt, 1999:50) gave the meant of adoption procedure that are mental process which each person can feel from first hearing concerning with change to the adoption step and finally used.

Anucha Sakulrach (2001:17) said that adoption meant personnel acknowledge innovation or new things occurrence. Innovation information completely receipt as much as interested in. Then lead to used or practice latter.

Jorge M Foster (Refer in Piyarat Nimsakul: 1996:15) gave definition of adoption new idea or technology as people studying through education. This is able to describe through the learning process. Adoption will be occurred if there have self learning. That learning will be succeeding if person is practice. When person convinced that the invention have certainly advantages, they will dare to investigate to buy that invention.

As the meant of “adoption” above can be conclude that adoption is the process in mind of personal to acknowledge new thing. Start from hearing, adoption new thing to practice in finally. Its characteristic seems like learning and decision.

### 2.5.3 Adoption Process

Rogers (1983 refer in Mayuree Patarachaiyakoupt, 1999:52-54) raised decision process concerning with innovation. By improve from old thought about adoption process which be presented in 1968. He aimed that new thought can clearly explain decision behaviors of personal in accept or not accept innovation than ever. There are 5 decision process related to innovation as following.

1. Knowledge; is the initiation part of process which person acknowledged that there were innovations occurred and more studied in it to find out the

understanding of that innovation. This level of knowledge can be separated into 3 types as following;

1.1 Knowledge that there are occurred innovation and known the duty of that innovation.

1.2 Essential knowledge for innovation correctly used.

1.3 Knowledge about principles and rules of innovation which can assist to access innovation usability.

In this process, there are some people already having innovation knowledge and they are not see any useful or concerning to them. They would hold a though about that innovation at that level and not pass to other level.

2. Persuasion; is the step which related to mood and feeling reaction of personal who agree or disagree, like or dislike and know or do not know the value of innovation. This step personal should estimate characteristic of innovation by interpret from of received information then personal will search data to support their though of innovation. Rogers indicated that interpersonal source especially on local people will be influencing the feeling like or dislike innovation of person.

3. Decision: is the step of personal to decision that accepts or unaccepted innovation. If personal has knowledge about innovation, feel like and see advantages from innovation, personal will decided to accept. Whilst, if they have not enough knowledge about innovation or feel dislike and have not seen value of innovation they will decide unaccepted the innovation. This step is for person to consider alternatives which expected to success their goals. Moreover it is in harmony with their economic status, custom and tradition, too. As consequence this step separate people into 2 groups that are adopt innovation group and not adopt innovation group.

4. Implementation; is bringing the innovation to use in real situation to find out the uncertain answers in innovation and set up permanent confidential accept later.

5. Confirmation; is a step that personal searching information and encourage force to support their decision. If received data support old data, there maybe change in behavior that is, adopt innovation group may turned to not adopt innovation group whereas not adopt innovation group may turned to adopt innovation group.

From this research, researcher selected innovation adoption process of Roger in 1983 to be tools in study adoption High efficiency kilns sizes 200 liters or use high efficiency kilns to use followed process 5 steps that are knowledge, persuasion, decision, implementation and confirmation. By using estimate scale which have 3 ways to answer which is the most generally method and easy to measure.

### 2.5.4 Factors Affected to Adoption

Adoption innovations have many factors. Person will accept innovation fast or slow have 2 issues as

1. Characteristic of Innovation; Innovation can access to social fast or slow depend on characteristic of innovation. There are 5 characteristics of innovation which are important and influence to adoption (refer in Mayuree Patarachaiyakoupt, 1999:55-56) as following;

1.1 Relative Advantage; is innovation bringing to use because there are comparison with intersect useful from many cause such as crisis, change agent and accident.

1.2 Compatibility; is value conservation and passed experience of accept person. This thought can not be mixed with cultural norm of social which will not be accept, for example, exception fee for monk, novice and other religion followers who wrap a piece of cloth around the head etc.

1.3 Complexity; complexity innovation will less accept than less complexity.

1.4 Divisibility; such as can bring to test by using small time to test.

1.5 Communicability; such as after tested that innovation can explain to the others.

2. Characteristic of Population in Social; the different population characteristic, personality and popularity affect to quickly accept innovation in some groups whereas

others have to spend more time to accept. Roger and Shoemaker, 1971:182-185) separated innovation into 5 groups as following;

2.1 Innovators; is the first group that accepts innovation. Outstanding of this group is they please to test new thing, dare, enterprising, wide vision to other place social, ability to understand and bring complexity new knowledge apply to use.

2.2 Early Adopters; is the group who respected from others in the local. Be model person, mild, cautious and success in use innovation. So, major people always ask the recommend and information about innovation from these people before accept new thought.

2.3 Early Majority; this group will accept new idea before normal members of social please to contact with friends but not head of group. Think cautiously and spend time to decide on adoption innovation longer than above 2 groups. And will be adopt innovation after members of group were adopted.

2.4 Late Majority; this group will be accepts innovation after other groups. Adoption innovation of this group is as consequence of economic need and social pressure, especially from friend's pressure. Outstanding of this group is always question and suspicious. They must to wait for until that innovation was accepted to social standard before their acceptation.

2.5 Laggards; this is last group who will accept innovation. There are strongly conservative, hard to change, belief in the old thing or old method. As consequence, when this group accepts innovation, it was already turned to old innovation and new innovation is invented.

From the study of factors which influencing adoption shown that there are many factors related to adoption innovation. Researcher can use as guide for specified variable from the study of adoption on high efficiency kiln as characteristic of innovation, population in social, comparison on advantages, complexity and separable.

## 2.6 Literature Review on Adoption and Variables

### 2.6.1 Literature Review on Adoption

According to the previous researches, it was not found the studied on adoption of High efficiency kilns usage. As consequence, researcher studied related works about adoption to consider path for specified variable into this research. Related works are as following;

Sakda Mayukhachote (1995:71-77) had studied on car color spray personal protective equipment adoption of car mechanic in Bangkok. The result shown that, sample group adopted car color spray personal protective equipment at medium level. And have strongly knowledge in car color spray personal protective equipment at high level. When studied relation between adoption car color spray personal protective equipment and individual variable factor and social-psychology factor the results shown that number of children, salary, information reception, knowledge in this equipment and self health checking are the related factors to adoption car color spray personal protective equipment used of car mechanism in Bangkok in significant at the 0.001 level.

Prinn Seripong (1998:136-138) had studied adoption usage double combustion chamber crematory furnace of abbot in Bangkok. The studied shown that the level of adoption to use double combustion chamber furnace of abbots is at medium level. Influence factors to adoption this kind of furnace are income from cremation yearly, cremation statistics yearly, knowledge about double combustion chamber crematory furnace pollution control, information received about this furnace and acknowledgement on characteristic of double combustion chamber crematory furnace. There is significant at the 0.01 level. Useful life factor of double combustion chamber crematory furnace is an influencing factor on adopt combustion chamber crematory furnace of abbot temple in Bangkok in significant at the 0.05 level.

Mayuree Patarachaiyakoupt (1999: 130-137) Studied bicycle usage adoption in people everyday life case study: Amphoe Muang, Nakhonnayok Province found that major of sample group (more than 90 percent) adopted bicycle usage for every day life in at high level. Individual factors which influencing adoption bicycle usage for every day life are level of education and income. Level of education relate to income in significant at the 0.01 level. Motivated factor, which influencing by information reception, traffic problem knowledge, bicycle usage attitude and government

enhancement (allocate bicycle way), in significant at the 0.01 level. Other factors i.e. sex, age and member's family are not affected to adoption bicycle usage for every day life in significant at 0.05 the level.

Praphunpong Chuahuem (2001: 102-103) Studying farmer adoption to irrigation system by piping for agriculture of land reform area in Sakonnakhon. The studied found that age, level of education, family's income, capital for cultivate irrigation system by piping in significant at the 0.05 level. For variables that are information reception, experience water vegetation, agriculture land availability, trained and ever been member of organization/groups. There are not affected farmer to adopt irrigation system by piping for agriculture in significant at the 0.05 level.

Manorot Sittanon, Police Lieutenant Colonel, (1997: 93-94) Studied wastewater treatment adoption by factory owner: case study in Amphoe Samphran, Nakonpathom Province. The studied found that majority population adopt wastewater treatment in significant at medium level. Factor influencing adoption usage wastewater treatment is individual factor. In addition, found that population with different age, level of education and administration experience are different adoption in significant at the 0.01 level. Factors in term of socio-economic shown that the population with different salary, wastewater treatment expense monthly, wastewater treatment system cost, capital and debt have different adoption wastewater treatment usage in significant at the 0.001 level. And factor in term of socio-psychology found that population who are different modernism and wastewater treatment system information reception are difference in significant at the 0.001 level.

Somphop Artchanasuk (1999, 87-88) Studied adoption people participation to developing government system of officer found that majority committee administration provincial hospital adopt in people participation to develop hospital procedure system. People participation to develop hospital personnel and hospital administration in cover view is in medium level and adoption people participation on expenditure hospital budget at low level. From analysis relation after adjusted dependent variables found that only attitude factor and knowledge on enhance people participation of hospital committee were related to adoption people participation by hospital administration committee. It is concluded that, hospital administration

committee who have good and fair attitude in enhance people participation, and have knowledge in enhance people participation in good level will have more adoption on people participation than other groups. Factors in attitude and knowledge about people participation of hospital administration committee affected to explanation variability of adoption people participation in hospital development at 14.44 percent and 2.56 percent, respectively.

Thipwan Kwansrisut (1997: 152-153) Studied adoption on household energy saving equipment usage of Bangkok population: case study in energy saving equipment in Prachachon Ruam Jai Prayat Faifa project by EGAT found that the variable of occupation, average numbering of energy equipment in household, knowledge about energy saving equipment, knowledge about Prachachon Ruam Jai Prayat Faifa project, information reception on energy saving equipment, characteristic reception of energy saving equipment and different attitude in energy saving. Adoption on household energy saving equipment usage are difference in significant at the 0.001 level. The difference of level of education variable and family's income average variable, are difference in significant at the 0.01 level. The difference of age variable affect adoption on household energy saving equipment usage is significant at the 0.05 level. The difference in others variables which are sex and energy expense monthly are difference with no significant.

From the reviewed of related documents about adoption, researcher has assumed that the factors which affect to adoption High efficiency kilns sizes 200 liters are occupation, household labor, household income per year, life of the kilns, information reception on energy strategy and knowledge about High efficiency kilns sizes 200 liters, attitude to usage High efficiency kilns sizes 200 liters. In addition others relate factors are money support for investment to build the Kilns and wood vinegar as by product.

### 2.6.2 Literature Review on Variables

**Occupation**

Occupation meant types of work which personnel do to bring income which are wage, reward or benefit. Different occupation will affect to different life style and personal aspect (SukhoThai Thammathirat Open University, 1987: 173). These are affecting to different innovation adoption.

As the study by Piyarat Nimsakul (1996,: 118) adoption in consumption uncontaminated vegetable of housewife in Bangkok found that different occupation's housewife have different adoption on consumption uncontaminated vegetable in significant at the 0.05 level. According to result of study by Police Lieutenant Colonel Jitti Rodbangyang (1996: 139) as adoption on solid waste separation by police housewife in Bangkok: A case study police's apartment in middle found that the occupational variable has adoption solid waste separation in significant at the 0.001 level.

The researcher assumed that agriculturist will adopt usage High efficiency kilns sizes 200 liters more than people who work out site the agriculture section. As consequence, researcher is interested in agriculture occupation.

**Household labor**

Household labor is the factor which researcher expected to affect usage High efficiency kilns sizes 200 liters, as a result from the process to set up High efficiency kilns sizes 200 liters. Although the burning will use workforce not much, workforce is needed when the kiln install. If any family burning everyday, workforce is an important factor affect to adoption. As consequence, different household labor will affect to the difference on originate kilns and usage level. From past study found that difference in household labors will have different adoption. From the study of factors relate to adoption organic rice grow up by farmer who is member of increase efficiency farmer project in Surin Province found that relation between farmer household labor and cultivation are related in significant at the 0.01 level. The correlation coefficient for regression analysis is 0.451. These show agriculturists who

have more household labors will have more adoption cultivation for organic rice grows.

For the study for adoption High efficiency kilns usage sizes 200 liters. The researcher assumed that more household labor will have more usage in High efficiency kilns than less household labor. As a result of more household labor have more ability to set up and originate or amount of burning charcoals than less household labor.

Thus, researcher has set hypothesis as population who have more household labors have more tendency to adoption High efficiency kilns usage sizes 200 liters.

**Household income per year**

As the study by Warakon Suktamraksa (1994: 141) of socio-economic factors affected to the Neem extracted adoption to control pest of Ratchaburi agriculturist. The study found that the Neem extracted usage adoption agriculturist have low family net income yearly less than the other groups. Because high family net income yearly has extremely purchasing power to by chemicals, they are disinterested in spent time for the Neem extraction. Contrast, with low family net income yearly that have not enough capitals to buy chemicals, which chose to use the Neem extracts. This method has small expense and can mark down the capital cost.

Thus, researcher set hypothesis as population who have low income will more adopt High efficiency kilns usage sizes 200 liters than high income people. Because people who have low household income per year will regard in family's expense. Any methods which have less expense will be the solution of people to choose.

**Information Reception**

Information reception is an important factor to adoption High efficiency kilns usage sizes 200 liters. Supoj Perdpring (2001: 74) studied in the attitude of people to forestry resources restoration and reservation project case study Pranburi Park, Prachuapkirikhan Province that is people who receive information will have agree attitude to the project in any plans. While the project has unavailable information on attitude, these people do not know the truth of project. And how was the project administration useful to public or community. Thus, they are not daring to decide

agree or disagree. The research of Seksan Chantruangsa (1997: 159) is the adoption of people to community service police unit in Phathumtani Province found that criminal information reception is related to adoption on service community police unit in term of performance, behavior in performing duty and personality. People who received criminal information through word of mouth and newspaper have lower adoption than received from radio and television. As consequence of the information reception through word of mouth and newspaper are not clear and incorrect. Lead to misunderstand or be out of the picture of situation, violence and dangerous from criminal that affected adoption on service community police unit as performance, behavior of performing duty and personality at low level than received information from radio and television.

Thus, researcher set hypothesis as energy planning information reception will be positive related to adoption on high efficiency kilns usage sizes 200 liters of people.

**Knowledge of high efficiency kiln usage**

The stydy by Suranaat Cheanwej (1997:82) studied factors which affected to adoption ahead agreement market system as the urge asparagus production project for exportation by members of asparagus grower group, Nakhonpathom Province found that the difference of knowledge on ahead agreement market system of members of asparagus grower group result in difference in adoption ahead agreement market system in significant at the 0.01 level. Addition the studied by Somphop Artchanasuk (1999: 83-85) as adoption people participation to developing government system of officer case study in northeast provincial hospital found that especially on attitude variable and knowledge in enhance people participation of hospital administrative committee have relation to adoption people participation in develop the hospital. This probably because of enhance on people participation in develop hospital was not seriously did in the past. Thus, majority of committee can not estimate the effect to hospital operation and results of themselves clearly.

Thus, researcher set hypothesis as knowledge in high efficiency kilns usage sizes 200 liters may positive related to adoption high efficiency kilns usage sizes 200 liters of people.

**Attitude of high efficiency kiln Usage**

Factors in attitude or people ideas are related to adoption. The study by Somnuk akkraisi (1998: 148) in factor to swine farm waste treatment technology with biogas adoption found that farmer who have attitude in problems and water pollution from swine farm solution at high level will more adopt swine farm waste treatment technology with biogas than who have medium and low attitude. Tippawan Kwansr (1997:158) has studied in adoption household energy saving equipment of people in Bangkok. Found that population in highly agreement attitude on energy saving are adopt to use household energy saving equipment more than medium and low attitude groups. Result in, the medium and low attitude groups are still not understand characteristics and property of energy saving equipment. And still not understand how the equipment really can save the energy and think that it is expensive. Moreover, they are not receiving truth and clearly information about useful of this instrument, thus, have no activated to adoption.

Hence, the researcher has set the hypothesis that the attitude of people on high efficiency kiln usage would have a positive relationship with the adoption on high efficiency kiln usage.

# CHAPTER 3

# RESEARCH METHODOLOGY

This research, a survey research, was to study the Adoption level of using high efficiency kiln of inhabitants in north eastern region. Questionnaire was used as the instrument for collecting data. The research guidelines were established as follows:

## 3.1 Target Population

The target population in this research were those people using and not yet using high efficiency kiln in 251 households living in the areas of Tambon U-lok, Amphoe Lamduan, Surin Province, Tambon Sa Jorrakhae, Amphoe Dan Khun Tod, Nakhornratchasrima Province, Tambon Nong Sao Lao, Amphoe Chum Phae, Khon Kaen Province, and Tambon Khu Mueang, Amphoe Warin Chamrap, Ubon Ratchathani Province

## 3.2 Sample Size and Sampling

### 3.2.1 Sample Size

In this research, the sample size was determined using the sampling formula of Taro Yamane (referred to in Boontham Kitpreedaborisuth, 2000 : 164) as follows:

$$\text{Formula} \quad n = \frac{N}{1 + N(e)^2}$$

Where N = population size at 280 households

n = sample size

e = tolerance of sample

In this research, the tolerance was set to 0.05

Substitution in Formula

$$n = \frac{251}{1 + 251\,(0.05)^2}$$

$$= 154$$

The above calculation yields 154 households. The sample size was thus set to 154 households for users of high efficiency kiln and more 154 nearby households.

### 3.2.2 Sampling

In this research, sampling was made with inhabitants in the pilot areas in four provinces as previously described. Multi-Stage Sampling was conducted as follows:

**First Stage**

Purposive Sampling was conducted to selectively study those four sub-districts where the use of high efficiency kiln was introduced as follows:

Group 1: Inhabitants in U-lok Sub-district, Lamduan District, Surin Province

Group 2: Inhabitants in Sa Jorrakhae Subdistrict, Dan Khun Tod District, Nakhornratchasrima Province

Group 3: Inhabitants in Nong Sao Lao Sub-district, Chum Phae District, Khon Kaen Province

Group 4: Inhabitants in Khu Mueang Sub-district, Warin Chamrap District, Ubon Ratchathani Province

From the above four provinces, not less than 154 samples would be collected by the proportion of the usage of high efficiency kiln in each area.

**Second Stage:** Calculate the ratio of population from the four groups by comparing with the proportion of usage of high efficiency kiln in all areas.

**Third Stage:** Upon receipt of the required samples, Random Sampling would be conducted for population from the four groups with the usage of high efficiency kiln.

**Fourth Stage:** Collect samples from nearby households without the use of high efficiency kiln by using Purposive Sampling as shown in Table 3.1

**Table 3.1 Districts and Households Randomly Sampled Using Several Methods in Each Studied Area**

| Sub-district | Number of High Efficiency kiln | Ratio of Randomized Households in Each Sub-district | |
|---|---|---|---|
| | | Use | Non Use |
| U-Lok | 130 | 80 | 80 |
| Sa Jorrakhae | 82 | 50 | 50 |
| Nhong Sao Lao | 30 | 18 | 18 |
| Koo Muang | 9 | 6 | 6 |
| **Total** | **251** | **154** | **154** |
| | | **308** | |

Source : Calculation

### 3.3 Research Instrument

On collecting data, the instruments used in this research were questionnaire and knowledge, attitude and Adoption tests. The questionnaire was devised to include 6 parts as follows:

**Part 1**: Personal profiles such as occupation, number of useful labors in household and income per family per year. The questions were both closed- and open-ended.

**Part 2**: The samples would be asked about their receipt of information update regarding local energy planning and high efficiency kiln project through several media. They would also be asked to specify the frequency of receiving information update monthly.

**Part 3**: Multiple-choice knowledge test about high efficiency kiln. Each question had 4 choices and would ask about:

1. Characteristics of high efficiency kiln
    - Prominent characteristics high efficiency kiln
    - Installation procedures of high efficiency kiln
    - Productivity from using high efficiency kiln
    - By-products derived from using high efficiency kiln
    - Raw materials used in charcoal burning
    - Efficiency of high efficiency kiln
2. Maintenance and Cautions
    - Maintenance of stove body
    - Operating caution
3. Impact from Burning Charcoal
    - Environmental Impact
    - Community Impact

4. Corrective Guidelines for Charcoal-Burning Impact

**Part 4**: Attitude test using Rating Scale of Likurt with 5 choices. There were 2 types of scoring - both positive and negative statements in equal number as follows:

| | Score Level | |
|---|---|---|
| | Positive Statement | Negative Statement |
| Most Agree | 5 | 1 |
| Strongly Agree | 4 | 2 |
| Moderately Agree | 3 | 3 |
| Less Agree | 2 | 4 |
| Least Agree | 1 | 5 |

It also included attitude test for people toward the use of high efficiency kiln as follows:

1. Attitude toward Convenience
    - Fewer labors.
    - Reduced waste time in burning charcoal.
    - Swiftness of installation procedures
    - Installation area problem solving
2. Attitude toward Economy
    - Price of the materials used to build high efficiency kiln
    - Break-even point of using high efficiency kiln
3. Attitude toward Health
4. Attitude toward Productivity

5. Attitude toward Safety
    - Accidents caused by the installation
    - Materials and equipment required for the installation
6. Attitude toward Environment
    - Smoke produced from burning charcoal
    - Forest resource conservation
7. Attitude toward Value
    - Participation in conserving forest resources
    - Leadership or being good people conserving their own communities
    - Nurturing thrifty habit

**Part 5**: Adoption test with 5 stages - knowledge, inducement, decision, adoption and confirmation using Rating Scale with 3 choices and scoring criteria as follows:

| | |
|---|---|
| Yes, Agree, or Recommend | 2 Points |
| Unsure | 1 Point |
| No, Disagree, or Not Recommend | 0 Point |

The details of the Adoption test in each stage are as follows:

1. Knowledge
    - Proper installation procedures
    - Benefits gained
2. Inducement
    - Production costs and break-even point
    - Forest resource reduction
    - Operating Life
    - Installation Area
    - By-product from burning charcoal
    - Operational safety
3. Decision

- Purchase of equipment required for the installation
- Using high efficiency kiln in households
- Making decision to deploy high efficiency kiln perpetually in communities

4. Adoption
   - Results of using high efficiency kiln
     * Installation convenience
     * Swiftness of charcoal burning process
     * By-products from burning charcoal
   - Obstructions in adopting high efficiency kiln
   - Accidents caused by the installation and during operation
   - Impact to the amount of forest resources in communities
5. Confirmation
   - Awareness to the benefits of high efficiency kiln
   - Recommend or persuade others to use such high efficiency charcoal-burning stove

The Adoption test was used in 2 different ways:

1. All of the 5 stages of Adoption test would be used with those groups using the high efficiency charcoal-burning stove as they had direct experience and were well aware of information and facts about the stove.

2. Only the first and second stages of Adoption test would be applied for those groups not using the high efficiency charcoal-burning stove as they had no direct experience or had not tried the stove.

**Part 6**: Obstacles to people's Adoption of 200-litr high efficiency charcoal-burning stove, including suggestions.

### 3.4 Instruments Development Procedures

The instruments were created and developed on the following procedures:

3.4.1 Study problem conditions and inclination to perform research, including seeking consultation from related persons and determining the scope of research.

3.4.2 Review research literatures, study subject matters, theories, elements, knowledge measurement criteria, attitude and Adoption, including related research works, in order to create and develop the questionnaire.

3.4.3 Determine scope and content of the questionnaire by:

1. Studying the nature of the areas under study regarding existing basic data, including all basic factors related to the studied areas.

2. Studying consumption data of each type of energy of inhabitants, local energy planning, objective plans from sub-district-level energy planning of the four areas, books and related research works, including asking individuals related plan implemented in the areas.

3. Creating a questionnaire comprising 6 parts with elements in each part as described above.

## 3.5 Instrument Efficiency Determination

The research was implemented by the researchers in 3 steps as follows:

1. Had content validity checked by Thesis Control Committee equipped with experiences and skills in academic content and in creating instruments in order to check validity, clarity and coverage as to how thoroughly the issues concerned are measured for further improvement.

2. Conducted a pre-test of the questionnaire with people nearby to the studied areas for 30 samples.

3. Used the responded questionnaire to determine the efficiency of the instruments.

### 3.5.1. Knowledge Test Efficiency Determination

1. Difficulty Level and Discrimination Power; starting by check the scores in the knowledge test:

| | | |
|---|---|---|
| Right Answer | 1 | point |
| Wrong or Unsure Answer | 0 | point |

The scores of each of the samples would be totaled and sorted in descending order. Then the samples would be divided into high-score and low-core groups by counting from the highest scores 27 percent down and from the lowest scores 27 percent up. Finally, the difficulty level and discrimination power would be determined using the following formulas:

$$\text{Difficulty Level } (P) = \frac{P_H + P_L}{2n}$$

$$\text{Discrimination Power } (r) = \frac{P_H - P_L}{n}$$

Where $P_H$ = number of respondents with right answers in the 27-percent high-score group

$P_L$ = number of respondents with right answers in the 27-percent low-score group

$n$ = number of all respondents either high- or low-score group

In consideration of the questions, the difficulty level should range between 0.2 - 0.8 (the test was too difficult if below 0.2 and too easy if above 0.8). Discrimination power only above 0.2 would be used (the higher it was the better).

2. Reliability; Reliability of the knowledge test was measured using Kuder-Richardson's twentieth formula (Boontham Kitpredaborisuth, 1997 : 211) as follows:

$$\text{Reliability } (r_{tt}) = \frac{k}{k-1}\left[1 - \Sigma S_i^2 / S_x^2\right]$$

Where $k$ = number of total questions

$\Sigma S_i^2$ = variance of the scores of each question

$S_x^2$ = variance of the total scores

If $r_{tt}$ is equal to 0.80 or higher, it means that such test has satisfactory reliability.

### 3.5.2 Attitude Test Efficiency Determination

1. Power of Discrimination could be determined using the attitude test with 5 levels of evaluation as follows:

| | Scores Level | |
|---|---|---|
| | Positive Statement | Negative Statement |
| Most Agree | 5 | 1 |
| Strongly Agree | 4 | 2 |
| Moderately Agree | 3 | 3 |
| Less Agree | 2 | 4 |
| Least Agree | 1 | 5 |

The scores of each of the samples would be totaled and sorted in descending order. Then the samples would be divided into high-score and low-core groups by counting from the highest scores 27 percent down and from the lowest scores 27 percent up. Finally, item analysis would be applied to determine discrimination power by testing the difference of average scores between high- and low-score groups using t-test ( Boontham Kitpredaborisuth, 2000 : 198 )

$$t = \frac{X_H - X_L}{\sqrt{\frac{S_H^2 + S_L^2}{n}}}$$

Where n = number of persons in high- and low-score groups

$X_H$ = average scores of high-score group

$X_L$ = average scores of low-score group

$S_H^2$ = standard deviation of high-score group

$S_L^2$ = standard deviation of low-score group

Only the discrimination power of the items with t above 1.75 was considered applicable.

2. Reliability; the items of attitude test with discrimination power from 1.75 upward would be used to determine the reliability using Coefficient Alpha formula of Kuder-Richardson as follows: (Boontham Kitpredaborisuth, 2000 : 182) as follows:

$$\text{Reliability}\ (r_{tt}) = \frac{k}{k-1}\left[1 - \Sigma S_i^2 / S_x^2\right]$$

Where $k$ = number of total questions

$\Sigma S_i^2$ = variance of the scores of each question

$S_x^2$ = variance of the total scores

### 3.5.3 Adoption Test Efficiency Determination

The efficiency of Adoption test was determined from the reliability calculated using Coefficient Alpha formula of Kuder-Richardson which was the same as that did with the determination of reliability of the attitude test. The calculation should meet the criteria of usability.

## 3.6 Data Collection

Data collection would be performed in the 308 randomly sampled households in north eastern region, with the aid of the Dean of Faculty of Environment and Resource Studies, Mahidol University, in issuing a letter of permission request to the studied areas for cooperation in data collection.

## 3.7 Data Processing Procedures

The data collected would be organized and assigned codes for processing by the software package of social science researches, SPSS for Windows. The scoring criteria are as follows:

### 3.7.1 Knowledge Test

Right answer had 1 point while wrong answer had no point. The total scores of 308 samples were classified into 3 groups based on the following grouping criteria:

| | | |
|---|---|---|
| Little-Knowledge Group | = | scores less than 50% of total |
| Moderate-Knowledge Group | = | scores between 50-75% of total |
| Much-Knowledge Group | = | scores higher than 75% of total |

### 3.7.2 Attitude Test

The Attitude Test used Rating Scale of Likurt with 5 choices and 2 different scoring methods as follows:

| | Positive Statement | Negative Statement |
|---|---|---|
| Most Agree | 5 | 1 |
| Strongly Agree | 4 | 2 |
| Moderately Agree | 3 | 3 |
| Less Agree | 2 | 4 |
| Least Agree | 1 | 5 |

The scores of 308 samples would be totaled and classified into 3 group based on the following grouping criteria:

Attitude toward using high efficiency kiln = knowledge scores less than 50% of total kiln at low level

Attitude toward using high efficiency kiln = knowledge scores between 50-75% of total kiln at medium level

Attitude toward using high efficiency kiln = knowledge scores higher than 75% of total kiln at high level

### 3.7.3 Adoption Test

The Adoption Test used Rating Scale with 3 choices and scoring method as follows:

| | |
|---|---|
| Yes, Agree, or Recommend | 2 Points |
| Unsure | 1 Point |
| No, Disagree, or Not Recommend | 0 Point |

The scores of 308 samples would be totaled and classified into 3 group based on the following grouping criteria:

| | | |
|---|---|---|
| Low-Adoption-Level Group | = | scores less than 50% of total |
| Moderate-Adoption-Level Group | = | scores less than 50-75% of total |
| High-Adoption-Level Group | = | scores higher than 75% of total |

## 3.8 Data Analysis

1. The general analysis of individual factors was based on such descriptive statistics as frequency distribution using percentage, mean, arithmetic mean and standard deviation.
2. The analysis of correlation between one independent variable based on Nominal Scale and one dependent variable based on Interval Scale used Correlation statistical analysis method.
3. The analysis of difference among the average of 2 population groups used t-test.

# CHAPTER 4

# DATA ANALYSIS RESULTS

In the study of adoption of high efficiency kiln Burning of inhabitants in northeast region, the researcher has conducted the study with 308 samples using questionnaires which include such items as individual factors, knowledge about high efficiency kiln Burning, attitudes toward the use of high efficiency kiln Burning, and adoption of using high efficiency kiln Burning. This study was analyzed using SPSS for Windows software and its data analysis results are presented in 8 categories as follows:

1. Individual factors such as gender, age, occupation, number of household labours, and annual net household income

2. Receipt of information update regarding local energy planning and high efficiency kiln Burning project

3. Knowledge about high efficiency kiln Burning

4. Attitudes toward the use of high efficiency kiln Burning

5. Adoption by inhabitants of using high efficiency kiln Burning

6. Problems, obstacles and recommendations with respect to adoption of using high efficiency kiln Burning

7. Comparison of individual factors of and receipt of information update about energy planning and high efficiency kiln Burning by those who use and do not use high efficiency kiln Burning

8. Analysis of factors influential to the adoption of using high efficiency kiln Burning of inhabitants in northeast region

## 4.1 Individual Factors

The studying results of individual factors of 308 samples are as follows: (Table 4.1)

**1. Gender**

The results indicate that 58.4 percent - most part of the samples, are male, and 41.6 percent are female.

**2. Age**

The results indicate that the majority of the samples have age range of 41-50 years at 35.7 percent, followed by 31-40 years and 50-59 years at 22.4 percent, 60-70 years at 9.7 percent, 21-30 years at 6.8 percent, 71 years up at 1.6 percent, and 15-20 years at 1.3 percent.

**3. Occupation**

The results indicate that the majority of the samples have agricultural occupation at 76.0 percent, followed by general engagement at 14.0 percent, bureaucratic occupation 5.2 percent, other occupations at 2.6 percent, merchandising and own businesses 1.9 percent, and housewife/househusband at only 0.3 percent.

**4. Number of Household Labours**

The results indicate that the majority of the samples have working-age members at 4-6 persons, accounting to 57.8 percent, followed by 1-3 persons at 40.6 percent, and 7 persons up only at 1.6 percent.

**5. Annual Net Household Income**

The results indicate that the majority of the samples have annual net household income of 50,000 Baht or less at 40.3 percent, followed by 50,0001-100,000 Baht at 31.5 percent, 100,001-150,000 baht at 19.8 percent, 150,001-200,000 Baht at 5.2 percent, 200,001-250,000 Baht at 2.6 percent, and 300,001 Baht or more at 0.6 percent. The average annual income of the samples is 76,483 Baht, minimum annual net household income is 5,580 Baht, and maximum annual net household income is 331,200 Baht.

**Table 4.1 Quantity and Percentage of Individual Factors**

| Individual Factor | Person(s) | Percentage |
|---|---|---|
| **Total Persons** | **308** | **100.0** |
| **Gender** | | |
| Male | 180 | 58.4 |
| Female | 128 | 41.6 |
| **Age** | | |
| 15-20 Years | 4 | 1.3 |
| 21-30 Years | 21 | 6.8 |
| 31-40 Years | 69 | 22.4 |
| 41-50 Years | 110 | 35.7 |
| 50-59 Years | 69 | 22.4 |
| 60-70 Years | 30 | 9.7 |
| 71 Years up | 5 | 1.6 |
| (Mean = 46.2,S.D. = 11.42, Min. = 15, Max. = 75) | | |
| **Occupation** | | |
| Agriculture | 234 | 76.0 |
| General Engagement | 43 | 14.0 |
| Bureaucracy | 16 | 5.2 |
| Others | 8 | 2.6 |
| Merchandising/Own Businesses | 6 | 1.9 |
| Housewife/Househusband | 1 | 0.3 |
| **Number of Household Labours** | | |
| 1-3 persons | 125 | 40.6 |
| 4-6 persons | 178 | 57.8 |
| 7 persons up | 5 | 1.6 |
| (Mean = 3.76,S.D. = 1.25 , Min. = 1, Max. = 8) | | |
| **Total Persons** | **308** | **100.0** |

**Table 4.1 Quantity and Percentage of Individual Factors (cont.)**

| Individual Factor | Person(s) | Percentage |
|---|---|---|
| **Annual Net Household Income** | | |
| 50,000 Baht or less | 124 | 40.3 |
| 50,001-100,000 Baht | 97 | 31.5 |
| 100,001-150,000 Baht | 61 | 19.8 |
| 150,001-200,000 Baht | 16 | 5.2 |
| 200,001-250,000 Baht | 8 | 2.6 |
| 300,001 Baht up | 2 | 0.6 |
| (Mean = 76,483,S.D. =52,575, Min. = 5,580, Max. = 331,200) | | |

## 4.2 Receipt of Local Energy Planning and high efficiency kiln Burning Project Information Update

### 4.2.1 Receipt of Local Energy Planning Information Update

With respect of receipt of information update about local energy planning, most of the samples in northeast region have received information update about local energy planning at 91.6 percent. Only few of them have not received information update about energy planning at 8.4 percent. With respect of frequency of such receipt of information update about local planning, the majority of the samples have received information update about local energy planning at an average frequency of 1-3 times per week at 91.8 percent, followed by more than 6 times per week at 3.5 percent, less than once per week at 2.5 percent, and 4-6 times per week at 2.1 percent. In addition, the study reveals that the majority of the samples have received information update about local energy planning through government officials at 21.9 percent, followed by television at 16.7 percent, radio at 13.7 percent, friend/neighbour at 12.9 percent, and information leaflet at 10.0 percent. With respect of the needs of receipt of information update about local energy planning, the majority of the samples need information update about local energy planning at almost 96.8 percent, whilst only few samples do not need such information at 3.2 percent.

With respect to types of information update about local energy planning needed by these samples, benefits obtained from local energy planning is at 28.6 percent, local energy planning procedure at 25.9 percent, pros and cons resulted from local energy planning at 22.2 percent, authority from which local energy planning information can be sought at 22.2 percent, others such as at preference to receive information through village public address system, and budgets allocated by responsible authority or organisation for supporting meetings and field trips with ongoing evaluations, at 1.1 percent.(Table 4.2)

**Table 4.2 Quantity and Percentage of Receipt of Information Update about Local Energy Planning**

| Receipt of Local Energy Planning Information Update | Person(s) | Percentage |
|---|---|---|
| **Openness to Receipt of Local Energy Planning Information Update** | | |
| Ever | 282 | 91.6 |
| Never | 26 | 8.4 |
| **Total** | **308** | **100.0** |
| **Frequency of Receipt of Local Energy Planning Information Update (Per Week)** | | |
| Less than once/week | 7 | 2.5 |
| 1-3 times/week | 259 | 91.8 |
| 4-6 times/week | 6 | 2.1 |
| From 7 times/week up | 10 | 3.5 |
| **Total** | **282*** | **100.0** |
| **Through Media (Multiple answers allowed)** | | |
| Government Official | 926 | 21.9 |
| Television | 708 | 16.7 |
| Radio | 578 | 13.7 |
| Friend | 546 | 12.9 |
| Information Leaflet | 422 | 10.0 |

**Table 4.2 Quantity and Percentage of Receipt of Local Energy Planning Information (cont.)**

| Receipt of Local Energy Planning Information Update | Person(s) | Percentage |
|---|---|---|
| Others | 319 | 7.5 |
| Sibling/Son | 285 | 6.7 |
| Newspaper | 221 | 5.2 |
| Magazine | 210 | 5.0 |
| Billboard | 15 | 0.4 |
| **Total** | **4230**** | **100.0** |
| **Need of Receiving Local Energy Planning Information** | | |
| Yes | 298 | 96.8 |
| No | 10 | 3.2 |
| **Total** | **308** | **100.0** |
| **Type of Preferred Local Energy Planning Information (Multiple answers allowed)** | | |
| Benefits Obtained from Local Energy Planning | 200 | 28.6 |
| Local Energy Planning Procedure | 181 | 25.9 |
| Pros and Cons Resulted from Local Energy Planning | 155 | 22.2 |
| Authority from whom Local Energy Planning Information can be Sought | 155 | 22.2 |
| Others | 8 | 1.1 |
| **Total** | **699**** | **100.0** |

* For those who have received local energy planning information only

** Multiple answers allowed

### 4.2.2 Receipt of Information about high efficiency kiln Burning

With respect of receipt of information update about high efficiency kiln Burning, most of the samples in northeast region have received information update about high efficiency kiln Burning at 91.2 percent. Only few of them have not received information update about high efficiency kiln Burning at 8.8 percent. With respect of frequency of such receipt of information update about high efficiency kiln Burning, the majority of the samples have received information update about high efficiency kiln Burning at an average frequency of 1-3 times per week at 92.5 percent, followed by 4-6 times per week at 4.6 percent, 7 times up per week at 2.1 percent, and less than once per week at 0.7 percent. In addition, the study reveals that the majority of the samples have received information update about high efficiency kiln Burning through information leaflet at 26.0 percent, followed by sibling at 18.9 percent, radio at 17.1 percent, government official at 10.0 percent, and friend/neighbour at 9.6 percent. With respect of the needs of receipt of information update about high efficiency kiln Burning, the majority of the samples need information update about high efficiency kiln Burning at almost 95.5 percent, whilst only few samples do not need such information at 4.5 percent.

With respect of types of information update about local energy planning preferred, , benefits obtained from high efficiency kiln Burning project at 30.4 percent, acquisition of a high efficiency kiln Burning at 25.3 percent, authority from which information about the high efficiency kiln Burning can be sought at 24.9 percent. pros and cons resulted from the high efficiency kiln Burning at 18.6 percent, other information such as proper use of the high efficiency kiln Burning, amount of kilns obtained from using the high efficiency kiln Burning, and proper method of keeping wood vinegar to maximize the volume of wood vinegar, at 0.9 percent (Table 4.3)

**Table 4.3 Quantity and Percentage of Receipt of Information About high efficiency kiln Burning**

| Receipt of Information About high efficiency kiln Burning | Person(s) | Percentage |
|---|---|---|
| **Openness to Receiving Information About high efficiency kiln Burning** | | |
| Ever | 281 | 91.2 |
| Never | 27 | 8.8 |
| **Total** | **308** | **100.0** |
| **Frequency of Information Receipt (Per Week)** | | |
| Less than once/week | 2 | 0.7 |
| 1-3 times/week | 260 | 92.5 |
| 4-6 times/week | 13 | 4.6 |
| More than 6 times/week | 6 | 2.1 |
| **Total** | **281*** | **100.0** |
| **Through Media (Multiple answers allowed)** | | |
| Information Leaflet | 968 | 26.0 |
| Relatives & Siblings | 702 | 18.9 |
| Radio | 634 | 17.1 |
| Government Official | 371 | 10.0 |
| Friend | 357 | 9.6 |
| Newspaper | 307 | 8.2 |
| Magazine | 298 | 8.0 |
| Energy Project Official | 82 | 2.2 |
| **Total** | **3719**** | **100.0** |
| **Need of Receiving Information About Kiln Burning Project** | | |
| Yes | 294 | 95.5 |
| No | 14 | 4.5 |
| **Total** | **308** | **100.0** |

**Table 4.3 Quantity and Percentage of Receipt of Information About high efficiency kiln Burning (cont.)**

| Receipt of Information About high efficiency kiln Burning | Person(s) | Percentage |
|---|---|---|
| **Type of Preferred Information About Kiln Burning Project (Multiple answers allowed)** | | |
| Benefits Obtained from High efficiency kiln Burning Project | 204 | 30.4 |
| Method of Acquisition of High efficiency kiln Burning | 170 | 25.3 |
| Authority from which Information about Kiln Burning Project can be Sought | 167 | 24.9 |
| Pros and Cons Resulted from High efficiency kiln Burning Project | 125 | 18.6 |
| Others | 6 | 0.9 |
| **Total** | **672**** | **100.0** |

* For those who have received information about high efficiency kiln Burning project only

** Multiple answers allowed

### 4.3 Knowledge About High efficiency kiln Burning

With respect of knowledge about high efficiency kiln Burning, the researcher has produced questionnaires with 4-choice 23 questions which were aimed to assess the knowledge about kiln Burning characteristics, maintenance and cautions, consequent impact from using it, and remedial guidelines for such impact. The study reveals that the samples who are knowledgeable about high efficiency kiln Burning have average scores at 16.47, whilst lowest scores at 6 and highest scores at 22. The score classification criteria used are as follows:

Few Knowledge Level: scores less than 50 percent of total scores (0-11 scores)

Intermediate Knowledge Level: scores at 50-75 percent of total scores (12-17 scores)

Much Knowledge Level: scores higher than 75 percent of total scores (18-23 scores)

According the above criteria, the majority of the samples have much and intermediate knowledge about high efficiency kiln Burning at near proportions of 43.5 percent and 40.3 percent respectively, whilst only 16.2 percent have few knowledge. (Table 4.4)

**Table 4.4 Percentage of Knowledge Level about high efficiency kiln Burning**

| Knowledge About high efficiency kiln Burning | Knowledge Level | | | Total |
|---|---|---|---|---|
| | Few | Intermediate | Much | |
| High efficiency kiln Burning in overall picture (23 scores) (Mean = 16.47, S.D. = 4.37 ,Min. = 6, Max = 22) | 16.2 | 40.3 | <u>43.5</u> | 100.0 |
| *Characteristics of Kiln Burning (16 scores (Mean = 10.98, S.D. = 3.17, Min.= 3, Max =15) | 18.8 | <u>43.5</u> | 37.7 | 100.0 |
| *Maintenance and Cautions (2 scores) (Mean = 1.60, S.D. = 0.64 ,Min.= 0, Max = 2) | 31.8 | 0.0 | <u>68.2</u> | 100.0 |
| *Consequent Impact from Kiln Burning (2 scores) (Mean = 1.69, S.D. = 0.57, Min. = 0, Max = 2) | 25.3 | 0.0 | <u>74.7</u> | 100.0 |
| *Remedial Guidelines for Impact from Kiln Burning (3 scores) (Mean = 2.20 ,S.D. = 0.89, Min. = 0, Max = 3) | 20.1 | 33.8 | <u>46.1</u> | 100.0 |

Remark: Maximum percentages are underlined

* For those who use high efficiency kiln Burning only

### 4.3.1 Knowledge About Characteristics of high efficiency kiln Burning

The assessment of knowledge about the characteristics of high efficiency kiln Burning covers such prominent aspects of the kiln Burning as production process, characteristics of the productivity, including by-products, derived from Burnings by using the high efficiency kiln Burning for various applications, and characteristics of the raw materials used for kiln burning, of 16 questions in total (16 scores).

The assessment indicates that the samples who are knowledgeable about high efficiency kiln Burning have average scores at 10.98, whilst lowest scores at 3 and highest scores at 15. The score classification criteria used are as follows:

Few Knowledge Level: scores less than 50 percent of total scores (0-7 scores)
Intermediate Knowledge Level: scores at 50-75 percent of total scores (8-12 scores)
Much Knowledge Level: scores higher than 75 percent of total scores (13-16 scores)

The majority of the samples have intermediate knowledge about high efficiency kiln Burning at 43.5 percent, followed by much level at 37.7 percent, and low level at 18.8 percent (Table 4.4).

Consideration of the percentage of the respondents who chose the correct answer of each question in the Kiln Burning Characteristic Questionnaires can be classified as follows (Table 4.5):

**Characteristics of Kiln Burning**

Most of the samples have proper knowledge and understanding in the prominent aspects of the kiln Burning at 83.1 percent, whilst the number of those who have knowledge about prominent aspects of the production process is lower at 74.0 percent.

**Kiln Burning Steps Using Kiln Burning**

Most of the samples are aware of kiln burning steps using high efficiency kiln Burning at 87.0 percent, whilst the awareness of the particular steps requiring attention and expertise is so very low at 47.4 percent.

**Productivity Derived from Kiln Burning Using Kiln Burning**

Most of the samples have knowledge about the characteristics of the productivity derived from kiln burning using high efficiency kiln Burning at 76.6 percent.

**By-Products Derived from Kiln Burning Using Kiln Burning**

The number of samples who have knowledge about products derived from kiln burning using 200-litre high-efficiency and are able to utilize them is highest at 98.1 percent, followed by those who have knowledge about how to purify wood vinegar at 90.9 percent, and those who have knowledge about how to utilize wood vinegar in other areas at 64.3 percent. Those who have knowledge about utilizing wood vinegar in agriculture are least in number at 43.5 percent.

**Raw Materials for Kiln Burning**

The most samples who have knowledge about selecting kiln-ignition fuel are at 99.4 percent, followed by those who have knowledge about characteristics of firewood used as raw materials for Burning at 66.2 percent, and those who have least knowledge about characteristics of wood used for kiln burning at 62.3 percent.

**Efficiency of Kiln Burning**

The most samples who have knowledge about carcinogen contaminating in kilns at 78.6 percent, followed by knowledge about characteristics of kilns derived from kiln burning using high efficiency kiln Burning for grilling purpose safe for consumption at 61.0 percent, knowledge about the average operating life of high efficiency kiln Burning at 53.9 percent, and least knowledge about factors determining the operating life of high efficiency kiln Burning at 11.7 percent.

### 4.3.2 Knowledge about Maintenance and Cautions

The assessment of knowledge about maintenance and cautions covers 2 questions (2 scores) of maintenance of high efficiency kiln Burning and operating cautions. The assessment indicates that the samples have average scores at 1.60, lowest scores at 0 and highest scores at 2. The score classification criteria used are as follows:

Few Knowledge Level: scores less than 50 percent of total scores (0 score)
Intermediate Knowledge Level: scores at 50-75 percent of total scores (1 score)
Much Knowledge Level: scores higher than 75 percent of total scores (2 scores)

According the above criteria, the majority of the samples having much knowledge about maintenance and cautions are at 68.2 percent, followed by few knowledge scores at 31.8 percent, and zero knowledge score at 0.0 percent.

Consideration of the percentage of the respondents who chose the correct answer of each question in the Maintenance and Caution Questionnaires (Table 4.5) can be classified as follows:

**Kiln Kiln Maintenance**

The study reveals that 87.0 percent of the samples have knowledge about individuals who maintain the kiln properly.

**Operating Cautions**

The study reveals that 72.7 percent of the samples have knowledge about proper operating cautions.

### 4.3.3 Knowledge about Impact Against Kiln Burning

The assessment of knowledge about impact against kiln burning covers 2 questions (2 scores) of environmental and community impact. The assessment indicates that the samples have average scores at 1.69, lowest scores at 0 and high scores at 2. The score classification criteria used are as follows:

Few Knowledge Level: scores less than 50 percent of total scores (0 score)
Intermediate Knowledge Level: scores at 50-75 percent of total scores (1 score)
Much Knowledge Level: scores higher than 75 percent of total scores (2 scores)

According the above criteria, the majority of the samples having much knowledge about kiln burning impact are at 74.7 percent, followed by few knowledge scores at 25.3 percent, and zero knowledge score at 0.0 percent.

Consideration of the percentage of the respondents who chose the correct answer of each question in the Kiln Burning Impact Questionnaires (Table 4.5) can be classified as follows:

**Environmental Impact**

The samples were found to have knowledge about environmental and community impact at as high as 93.5 percent.

**Community Impact**

The study reveals that 75.3 percent of the samples have knowledge about the distance from the installation of kiln Burning to the community or neighbouring households.

### 4.3.4 Knowledge about Remedial Guidelines for Impact Resulted from Kiln Burning

The assessment of knowledge about remedial guidelines resulted from kiln burning covers 3 questions (3 scores) of selection of kiln burning time, remedial actions if the kilns flame upon collection, and best precaution keeping the produced smokes from burning clothes and body. The assessment indicates that the samples have average scores at 2.20, lowest scores at 0 and high scores at 3. The score classification criteria used are as follows:

Few Knowledge Level: scores less than 50 percent of total scores (0-1 score)
Intermediate Knowledge Level: scores at 50-75 percent of total scores (2 scores)
Much Knowledge Level: scores higher than 75 percent of total scores (3 scores)

According the above criteria, the majority of the samples having much knowledge about kiln burning impact are at 46.1 percent, followed by intermediate knowledge scores at 33.8 percent, and few knowledge score at 20.1 percent.

Consideration of the percentage of the respondents who chose the correct answer of each question in the Kiln Burning Impact Questionnaires (Table 4.5) can be classified as follows:

The samples having knowledge about best precaution keeping produced smokes from burning physical body and clothes are highest at 80.5 percent, followed by those having knowledge about the reason of choosing to burn kilns on midday at 76.0 percent, and those having knowledge about appropriate corrective actions upon flaming of kilns at 63.6 percent.

**Table 4.5 Quantity and Percentage of Samples Choosing Right Answers Regarding Knowledge about Characteristics of Kiln Burning**

| Item | Topic | Person(s) | Percentage |
|---|---|---|---|
| | **1. Knowledge about Characteristics of Kiln Burning** | | |
| | Prominent Aspects of Kiln Burning | | |
| 1 | Aspects that are prominent of the kiln of Burning | 128 | 83.1 |
| 2 | Prominent Production Process | 114 | 74.9 |
| | Kiln Burning Steps Using Kiln Burning | | |
| 3 | Kiln Burning Steps Using Kiln Burning | 134 | 87.0 |
| 4 | Particular Burning Steps Requiring Attention and Expertise | 73 | 47.4 |
| | Productivity Derived from Kiln Burning Using Kiln Burning | | |
| 5 | Characteristics of Productivity Derived from Kiln Burning Using Kiln Burning | 118 | 76.6 |
| | By-Products Derived from Kiln Burning Using Kiln Burning | | |
| 6 | By-products derived from Kiln Burning Utilizable | 151 | 98.1 |
| 7 | wood vinegar Purifying Method | 140 | 90.9 |
| 8 | wood vinegar Purifying Method for Agriculture | 67 | 43.5 |
| 9 | Utilizing wood vinegar in Other Areas | 99 | 64.3 |
| | Raw Materials for Kiln Burning | | |
| 10 | Type of Firewood used as Raw Materials for Burning | 102 | 66.2 |
| 11 | Type of wood used for kiln burning | 96 | 62.3 |
| 12 | Type of kiln-ignition fuel | 153 | 99.4 |
| | Efficiency of Kiln Burning | | |
| 13 | Average Operating Life | 83 | 53.9 |
| 14 | Operating Life Factor | 18 | 11.7 |
| 15 | Characteristics of Kilns Obtained from Kiln Burning for grilling safe to Consumers | 94 | 61.0 |
| 16 | carcinogen Contaminated in Kilns Obtained from Traditional Kiln | 121 | 78.6 |

**Table 4.5 Quantity and Percentage of Samples Choosing Right Answers Regarding Knowledge about Characteristics of Kiln Burning (cont.)**

| Item | Topic | Person(s) | Percentage |
|---|---|---|---|
| | **2. Knowledge about Maintenance and Precautions** | | |
| | Kiln Maintenance | | |
| 17 | Individuals Maintaining Kiln Properly | 134 | 87.0 |
| | Operating Precautions | | |
| 18 | Procedures Properly Taken during Burnings | 112 | 72.7 |
| | **3. Knowledge about Consequential Impacts** | | |
| | Environmental Impacts | | |
| 19 | Environmental Impact Occurring in Community | 144 | 93.5 |
| | Community Impact | | |
| 20 | Interval between Kiln Installation in Community or Neighbourhood | 116 | 75.3 |
| | **4. Knowledge About Corrective Guidelines for Impacts** | | |
| 21 | Reasons of Choosing Midday for Kiln Burning | 117 | 76.0 |
| 22 | Appropriated Corrective Action when Kilns Blaze | 98 | 63.6 |
| 23 | Best Precaution for Keeping Smokes from burning Body and Clothes | 124 | 80.5 |

## 4.4 Attitudes Towards the Use of high efficiency kiln Burning

### 4.4.1 Overview of Attitude Towards Using Kiln Burning

The attitude check towards high efficiency kiln Burning of 24 questions (120 scores) includes attitudes to convenience, economy, health, productivity, safety, environment and value. It indicates that the samples have overall scores of the attitude towards high efficiency kiln Burning averaged at 84.03, with highest scores at 109, lowest scores at 47. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-60 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (61-90 scores)
Attitude at High Level: scores higher than 75 percent of total scores (91-120 scores)

According to the above criteria, most samples at 70.8 percent have attitude towards using kiln Burning at intermediate level, 25.3 percent at high level and 3.9 at low level. (Table 4.6)

**Table 4.6 Percentage of Samples Classified by Attitude Towards Using High efficiency kiln Burning**

| Attitude Check | Attitude Level | | | Total |
|---|---|---|---|---|
| | Low | Intermediate | High | |
| Overall Attitude (120 scores) | 6 | 109 | 39 | 154 |
| Mean = 84.03,S.D.= 9.77,Min.= 47, Max = 109 | (3.9) | (70.8) | (25.3) | (100.0) |
| * Attitude to Convenience (20 scores) | 5 | 97 | 52 | 154 |
| Mean = 14.68,S.D.= 2.05,Min. = 7,Max = 20 | (3.2) | (63.0) | (33.8) | (100.0) |
| Attitude to Economy (20 scores) | 22 | 118 | 14 | 154 |
| Mean = 12.74,S.D. = 3.13,Min. = 0,Max = 19 | (14.3) | (76.6) | (9.1) | (100.0) |
| * Attitude to Health (5 scores) | 7 | 28 | 119 | 154 |
| Mean = 3.99, S.D. = 0.98, Min. = 0, Max = 5 | (4.5) | (18.2) | (77.3) | (100.0) |
| * Attitude to Productivity (20 scores) | 1 | 97 | 56 | 154 |
| Mean = 14.73,S.D. = 2.08,Min.= 8,Max = 20 | (0.6) | (63.0) | (36.4) | (100.0) |
| * Attitude to Safety (10 scores) | 154 | 0 | 0 | 154 |
| Mean = 7.28,S.D. = 1.65,Min.= 2, Max = 10 | (100.0) | (0.0) | (0.0) | (100.0) |
| * Attitude to Environment (15 scores) | 16 | 86 | 52 | 154 |
| Mean = 14.62,S.D.= 1.65,Min.= 8,Max = 20 | (10.4) | (55.8) | (33.8) | (100.0) |
| * Attitude to Value (25 scores) | 10 | 119 | 25 | 154 |
| Mean = 16.00,S.D.= 2.90,Min. = 3,Max = 22 | (6.5) | (77.3) | (16.2) | (100.0) |

Remark: Underscored values are of highest percentage

### 4.4.2 Attitude to Convenience

The check of attitude to convenience covers consumption of less labours, reduction of \wasted kiln burning time, speediness of kiln installation procedures and solving of problems with respect to place of installation of 4 questions (20 scores). The study indicates that the samples have scores of the attitudes to convenience averaged at 14.68, with highest scores at 20, lowest scores at 7. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-10 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (11-15 scores)
Attitude at High Level: scores higher than 75 percent of total scores (16-20 scores)

According to the above criteria, most samples at 63.0 percent have attitude to convenience at intermediate level, followed by highest level at 33.8 percent, and lowest level at 3.2 percent (Table 4.6). When considering the percentage of the respondents of questionnaires about convenience, most samples have attitudes to all of the four topics at the level of “much-agree”.(Table 4.7)

### 4.4.3 Attitude to Economy of Using high efficiency kiln Burning

The check of attitude to economy includes attitudes to kiln assembly materials and break-even point of using the kiln of 4 questions (20 scores). The study indicates that the samples have scores of the attitudes to economy averaged at 12.74, with highest scores at 19, lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-10 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (11-15 scores)
Attitude at High Level: scores higher than 75 percent of total scores (16-20 scores)

According to the above criteria, most samples have good attitudes to using kiln Burning at intermediate level of 76.6 percent, good attitude to economy of using kiln Burning at low level of 14.3 percent, high level at 9.1 percent respectively (Table 4.6).

When considering the percentage of the respondents of questionnaires about attitudes, most samples mostly agree to the worthiness of using kiln Burning, whilst the break-even point and reduction of difficulty in buying kiln assembly materials are much agreed, and the costs of kiln assembly are intermediately agreed. (Table 4.7)

### 4.4.4 Attitude to Health

The check of attitude towards high efficiency kiln Burning regarding health contains 1 question (5 scores) about kilns obtained from using the kiln. The study reveals that the samples have scores of the attitudes to health at 3.99, with highest scores at 5, lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-2 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (3 scores)
Attitude at High Level: scores higher than 75 percent of total scores (4-5 scores)

According to the above criteria, most samples have good attitudes to health at high level of 77.3 percent, followed by intermediate and low level at 18.2 and 4.5 percent respectively (Table 4.6). When considering the percentage of the respondents of questionnaires about health, the samples mostly agree to the quality of kiln productivity obtained from using the high efficiency kiln Burning. (Table 4.7)

### 4.4.5 Attitude to Productivity

The researcher has checked the attitudes towards the use of high efficiency kiln Burning regarding productivity in respect of kiln volume obtained, and the utilization of wood vinegar in agricultural works and others, income generation from selling and storing wood vinegar during the course of Burnings, of 4 questions (20 scores). The study reveals that the samples have scores of the attitudes to productivity averaged at 14.73, with highest scores at 20, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-9 scores)

Attitude at Intermediate Level: scores at 50-75 percent of total scores (10-14 scores)
Attitude at High Level: scores higher than 75 percent of total scores (15-20 scores)

According to the above criteria, most samples have good attitudes to productivity at intermediate level of 36.4 percent, high level at 36.4 percent and low level at 0.6 percent (Table 4.6). When considering the percentage of the respondents of questionnaires about the 4 topics, most samples agree that the kiln productivity obtained is better than that obtained from using other kinds of kiln Burnings, including the utilization of wood vinegar for agricultural works and others, and income additionally generated from selling wood vinegar at the level of "much-agree". However, at the level of "intermediately agree", their attitudes to the storing of wood vinegar is that it increases their workload. (Table 4.7)

**4.4.7 Attitude to Safety**

As for check of attitudes towards the use of high efficiency kiln Burning regarding safety, the researcher has checked the attitudes of the samples regarding accidents from kiln installation, and materials and equipment used for assembling the kiln, of 2 questions (10 scores). The study reveals that the samples have scores of the attitudes to safety averaged at 7.28, with highest scores at 10, and lowest scores at 2. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-5 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (6-7 scores)
Attitude at High Level: scores higher than 75 percent of total scores (8-10 scores)

According to the above criteria, 100% of the samples have good attitudes to safety at low level and no sample have good attitudes to safety at intermediate and high level (Table 4.6). When considering the percentage of the respondents of questionnaires about attitude, most samples have attitudes to the use of kiln Burning regarding safety of the materials and equipment used for assembling the kiln at the level of "much agree", whilst their attitudes to the safety from using the kiln regarding accidents from kiln installation are at the level of "least agree". (Table 4.7)

### 4.4.7 Attitude to Environment

The researcher has focused on studying such 3 aspects of attitudes to environment as smokes produced from using the kiln Burning, choosing from appropriate burning time and installation place to avoid smokes, forest resource preservation and illegal wood cutting, of 4 questions (20 scores). The study reveals that the samples have scores of the attitudes to environment averaged at 14.62, with highest scores at 20, and lowest scores at 8. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-9 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (10-15 scores)
Attitude at High Level: scores higher than 75 percent of total scores (16-20 scores)

According to the above criteria, the samples have good attitudes to the resulting environment at intermediate level of 55.8 percent, followed by high and low level at 33.8 percent and 10.4 percent respectively (Table 4.6). When considering the percentage of the respondents of questionnaires about attitude, the researcher found that most samples have attitudes to the smokes produced from Burnings at the level of “intermediately agree”, while having attitudes to the choosing of appropriate burning time and installation place to avoid smokes, forest resource preservation and reduction of illegal wood cutting at the level of “much agree”. (Table 4.7)

### 4.4.8 Attitude to Value

The measurement of attitudes towards high efficiency kiln Burning regarding value covers such topics as participation in forest resource preservation, thriftiness promotion, leadership or being good people in conserving one’s own community, unpopularity of 200-litre kiln Burning and non-adoption of using 200-litre kiln Burning, of 5 questions (25 scores). The study reveals that the samples have scores of the attitudes to value averaged at 16.0, with highest scores at 22, and lowest scores at 3. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-12 scores)

Attitude at Intermediate Level: scores at 50-75 percent of total scores (13-18 scores)

Attitude at High Level: scores higher than 75 percent of total scores (19-25 scores)

According to the above criteria, most samples have good attitudes to the resulting value at intermediate level of 76.6 percent, followed by high and low level at 16.2 percent and 6.5 percent respectively (Table 4.6). When considering the percentage of the respondents of questionnaires about attitude, the researcher found that most samples have attitudes to such topics as participation in forest resource preservation, thrifty habit, leadership or being good people in conserving one's own community at the level of "much agree", whilst the attitudes to the unpopularity of 200-litre kiln Burning are at the level of "intermediately agree", and the attitudes to non-adoption of using 200-litre kiln Burning are at low level. (Table 4.7)

**Table 4.7 Percentage of Samples Classified by Attitude Towards Using high efficiency kiln Burning**

| Item | Attitude Towards Using Kiln | Score Level | | | | | | $\bar{X}$ | S.D. |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Attitude Towards Convenience | | | | | | | | |
| 1 | Less Labour Consumption | 0.0 | 1.3 | 0.6 | 13.6 | 48.1 | 36.4 | 4.16 | 0.86 |
| 2 | Kiln Burning Time Reduction | 0.6 | 0.0 | 1.3 | 18.8 | 55.8 | 23.4 | 3.99 | 0.76 |
| 3 | Speediness of Kiln Installation | 5.2 | 8.4 | 16.2 | 26.0 | 35.1 | 9.1 | 2.64 | 1.25 |
| 4 | Solving of Installation Place Issue | 1.3 | 0.6 | 6.5 | 16.9 | 49.4 | 25.3 | 3.88 | 0.97 |
| | Attitude Towards Economy | | | | | | | | |
| 5 | Costs of Kiln Assembly Equipment | 4.5 | 1.9 | 11.7 | 31.2 | 28.6 | 22.1 | 2.29 | 1.13 |
| 6 | Reduction of Difficulty in Buying Kiln Assembly Equipment | 4.5 | 3.2 | 11.7 | 30.5 | 31.2 | 18.8 | 3.37 | 1.26 |
| 7 | Break-even Point | 6.5 | 1.3 | 2.6 | 26.6 | 43.5 | 19.5 | 3.58 | 1.24 |
| 8 | Worthiness of Kiln's Operating Life | 5.8 | 5.2 | 7.5 | 22.1 | 32.5 | 26.6 | 3.5 | 1.40 |

**Table 4.7 Percentage of Samples Classified by Attitude Towards Using high efficiency kiln Burning (cont.)**

| Item | Attitude Towards Using Kiln | Score Level | | | | | | $\bar{X}$ | S.D. |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Attitude Towards Health | | | | | | | | |
| 9 | Kiln Productivity of better quality and good for health because of less tars contained | 0.6 | 3.9 | 0.0 | 18.2 | 45.5 | 31.8 | 3.99 | 0.98 |
| | Attitude Towards Productivity | | | | | | | | |
| 10 | Volume of Better Productivity Than those obtained from other kilns | 0.0 | 0.0 | 1.9 | 17.5 | 52.6 | 27.9 | 4.06 | 0.72 |
| 11 | Usefulness of wood vinegar for agricultural works and others | 0.0 | 0.0 | 0.0 | 15.6 | 46.1 | 38.3 | 4.23 | 0.70 |
| 12 | Additional income generated from selling wood vinegar | 3.2 | 4.5 | 5.8 | 34.4 | 37.0 | 14.9 | 3.42 | 1.15 |
| 13 | Storing wood vinegar resulting in more workloads | 3.2 | 11.7 | 21.4 | 37.0 | 19.5 | 7.1 | 3.01 | 1.21 |
| | Attitude Towards Safety | | | | | | | | |
| 14 | Installation Accidents | 3.9 | 35.7 | 22.1 | 18.2 | 14.3 | 5.8 | 3.56 | 1.44 |
| 15 | Materials and Equipment for assembling Kiln | 0.6 | 0.6 | 6.5 | 31.8 | 39.0 | 21.4 | 3.72 | 0.93 |
| | Attitude Towards Resulting Environment | | | | | | | | |
| 16 | Smokes Produced by Kiln Burning | 1.9 | 23.4 | 9.7 | 33.8 | 22.1 | 9.1 | 3.10 | 1.33 |
| 17 | Choosing of Appropriate Time and Installation Place to Avoid Smokes | 4.5 | 2.6 | 9.1 | 22.1 | 36.4 | 25.3 | 3.59 | 1.28 |
| 18 | Forest Resource Preservation | 1.9 | 1.9 | 3.9 | 11.7 | 40.9 | 39.6 | 4.06 | 1.07 |
| 19 | Reduction of Illegal Wood Cutting | 0.0 | 6.5 | 2.6 | 18.2 | 44.2 | 28.6 | 3.86 | 1.06 |
| | Attitude Towards Value | | | | | | | | |
| 20 | Participation in Forest Resource Preservation | 0.6 | 0.6 | 0.6 | 17.5 | 46.8 | 33.8 | 4.10 | 0.83 |
| 21 | Thriftiness Promotion | 0.6 | 0.0 | 5.2 | 21.4 | 47.4 | 25.3 | 3.91 | 0.88 |

**Table 4.7 Percentage of Samples Classified by Attitude Towards Using high efficiency kiln Burning (cont.)**

| Item | Attitude Towards Using Kiln | Score Level | | | | | | $\bar{X}$ | S.D. |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | | |
| | Attitude Towards Resulting Environment | | | | | | | | |
| 22 | Leadership or being Good People in conserving one's own community | 11.0 | 0.6 | 11.0 | 22.1 | 35.1 | 20.1 | 2.04 | 1.17 |
| 23 | Unpopularity of 200-Litre Kiln Burning | 9.7 | 14.3 | 35.1 | 23.4 | 14.3 | 3.2 | 2.72 | 1.25 |
| 24 | Non-adoption of using 200-Litre Kiln Burning | 1.3 | 22.7 | 16.9 | 30.5 | 21.4 | 7.1 | 3.23 | 1.28 |

## 4.5 Adoption by inhabitants of Using high efficiency kiln Burning

### 4.5.1 Overall Adoption by Inhabitants of Using high efficiency kiln Burning

The measurement of people's adoption of using high efficiency kiln Burning of 32 questions (64 scores) containing questionnaires about adoption at knowledge level of 6 questions (12 scores), persuasion level of 8 questions (16 scores), decision level of 5 questions (10 scores), adoption level of 8 questions (16 scores), and confirmation level of 5 questions (10 scores) reveals that the overall scores of adoption are averaged at 7.68, with highest scores at 36, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-32 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (33-48 scores)
Attitude at High Level: scores higher than 75 percent of total scores (49-64 scores)

According to the above criteria, most samples at 98.7 percent have adoption in high efficiency kiln Burning at low level, whilst only 1.3 percent have adoption in the high efficiency kiln Burning at intermediate level. (Table 4.8)

**Table 4.8 Percentage of Inhabitants' adoption in Using high efficiency kiln Burning**

| Adoption Check | Adoption Level | | | Total |
|---|---|---|---|---|
| | Low | Medium | High | |
| Overall Adoption (64 Scores) | 98.7 | 1.3 | 0.0 | 100.0 |
| Mean = 7.68, S.D.= 7.70, Min.= 0, Max = 36 | | | | |
| * Adoption at Knowledge Level (12 Scores) | 100.0 | 0.0 | 0.0 | 100.0 |
| Mean = 1.85, S.D.= 1.67, Min.= 0,Max = 6 | | | | |
| * Adoption at Persuasion Level (16 Scores) | 98.7 | 1.3 | 0.0 | 100.0 |
| Mean = 1.68, S.D. = 1.92, Min. = 0, Max = 9 | | | | |
| * Adoption at Decision Level (10 Scores) | 100.0 | 0.0 | 0.0 | 100.0 |
| Mean = 1.06, S.D. = 1.23, Min. = 0, Max = 5 | | | | |
| * Adoption at Adoption Level (16 Scores) | 98.1 | 1.0 | 0.0 | 100.0 |
| Mean = 1.76, S.D.= 2.29,Min. = 0, Max = 11 | | | | |
| * Adoption at Confirmation Level (10 Scores) | 98.7 | 1.3 | 0.0 | 100.0 |
| Mean = 0.94, S.D.= 1.44, Min. = 0,Max = 6 | | | | |

Remark: Maximum percentages are underlined

### 4.5.2 Adoption by Inhabitants of Using high efficiency kiln Burning at Knowledge Level

The measurement of people's adoption of using high efficiency kiln Burning at knowledge level includes installation procedures for the kiln and its usefulness, of 6 questions (12 scores). The study reveals that the scores of adoption are averaged at 1.85, with highest scores at 6, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-3 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (4 scores)
Attitude at High Level: scores higher than 75 percent of total scores (5-6 scores)

According to the above criteria, 100% of the samples have adoption in high efficiency kiln Burning at low level (Table 4.8). When considering the percentage of the respondents of questionnaires about each adoption topic, the researcher found that 60.0-80.0 percent of the samples have no knowledge about the installation procedures of the high efficiency kiln Burning, and 75.3 percent have not knowledge about its usefulness. (Table 4.9)

**Table 4.9 Percentage of adoption in Using high efficiency kiln Burning Classified by Adoption Level**

| Item | Adoption | Score Level | | | $\bar{X}$ | S.D. |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | | |
| | Adoption at Knowledge Level | | | | | |
| 1 | Installation Method of high efficiency kiln | 72.1 | 27.9 | 0.0 | 0.28 | 0.45 |
| 2 | Installation Method of high efficiency kiln | 57.1 | 37.0 | 5.8 | 0.49 | 0.60 |
| 3 | Installation Method of high efficiency kiln | 81.8 | 17.5 | 0.6 | 0.19 | 0.40 |
| 4 | Installation Method of high efficiency kiln | 74.0 | 20.1 | 5.8 | 0.32 | 0.58 |
| 5 | Installation Method of high efficiency kiln | 68.2 | 31.2 | 0.6 | 0.32 | 0.48 |
| 6 | Installation Method of high efficiency kiln | 75.3 | 24.7 | 0.0 | 0.25 | 0.43 |
| | Adoption at Persuasion Level | | | | | |
| 7 | Production Costs and Break-Even Point | 74.0 | 26.0 | 0.0 | 0.26 | 0.44 |
| 8 | Reduction of Forest Resource Consumption | 90.9 | 7.8 | 1.3 | 0.10 | 0.34 |
| 9 | Operating Life | 63.6 | 35.1 | 1.3 | 0.38 | 0.51 |
| 10 | Installation Area | 81.2 | 17.5 | 1.3 | 0.20 | 0.43 |
| 11 | By-Products | 69.5 | 30.5 | 0.0 | 0.31 | 0.46 |
| 12 | By-Products | 85.7 | 13.0 | 1.3 | 0.16 | 0.39 |
| 13 | Safety from Operating and Using Kiln | 90.9 | 9.1 | 0.0 | 0.09 | 0.28 |
| 14 | Safety from Operating and Using Kiln | 81.8 | 17.6 | 0.6 | 0.27 | 0.40 |
| | Adoption at Decision Level | | | | | |
| 15 | Buying High-Efficiency Kiln Installation Equipment | 73.4 | 26.6 | 0.0 | 0.10 | 0.44 |
| 16 | Using high efficiency kiln in Households | 90.3 | 9.7 | 0.0 | 0.19 | 0.29 |

**Table 4.9 Percentage of Adoption in Using high efficiency kiln Burning Classified by Adoption Level (Cont.)**

| Item | Adoption | Score Level | | | $\bar{X}$ | S.D. |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | | |
| 17 | Continuous Adoption of Kiln in Communities | 81.8 | 16.9 | 1.3 | 0.15 | 0.42 |
| 18 | Continuous Adoption of Kiln in Communities | 85.1 | 14.9 | 0.0 | 0.35 | 0.35 |
| 19 | Continuous Adoption of Kiln in Communities | 66.2 | 32.5 | 1.3 | 0.13 | 0.50 |
| | Adoption at Adoption Level | | | | | |
| 20 | Resulting Convenience in Kiln Installation | 89.6 | 7.8 | 2.6 | 0.18 | 0.40 |
| 21 | Resulting Speediness in Producing Kilns | 83.8 | 14.9 | 1.3 | 0.25 | 0.41 |
| 22 | Resulting By-Products | 77.9 | 19.5 | 2.6 | 0.24 | 0.48 |
| 23 | Hurdles in Using high efficiency kiln | 77.9 | 20.1 | 1.9 | 0.22 | 0.47 |
| 24 | Accidents During Installation and Operation | 78.6 | 20.8 | 0.6 | 0.24 | 0.43 |
| 25 | Accidents During Installation and Operation | 78.6 | 1.8 | 2.6 | 0.22 | 0.48 |
| 26 | Resulting Amount of Forest Resources in Communities | 78.6 | 20.8 | 0.6 | 0.29 | 0.43 |
| 27 | Resulting Amount of Forest Resources in Communities | 72.7 | 40.0 | 1.3 | 0.14 | 0.48 |
| | Adoption at Confirmation Level | | | | | |
| 28 | Awareness to Usefulness of Kiln Burning | 87.7 | 11.0 | 1.3 | 0.25 | 0.38 |
| 29 | Suggesting or Persuading Others to Use Kiln | 75.3 | 24.7 | 0.0 | 0.25 | 0.43 |
| 30 | Awareness to Usefulness of Kiln Burning | 79.2 | 20.8 | 0.0 | 0.21 | 0.40 |
| 31 | Awareness to Usefulness of Kiln Burning | 85.1 | 12.3 | 2.6 | 0.18 | 0.44 |
| 32 | Suggesting or Persuading Others to Use Kiln | 83.8 | 14.9 | 1.3 | 0.18 | 0.41 |

### 4.5.3 Adoption by Inhabitants of Using high efficiency kiln Burning at Persuasion Level

The study of people's adoption of using high efficiency kiln Burning at persuasion level containing persuasive questionnaires about production costs and break-even point, reduction of forest resource consumption, operating life, kiln installation place, by-products and safety from operating and using the kiln, of 8 questions (16 scores), reveals that the scores of adoption are averaged at 1.68, with highest scores at 9, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-8 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (9-12 scores)
Attitude at High Level: scores higher than 75 percent of total scores (13-16 scores)

According to the above criteria, most samples at 98.7 percent have adoption in the kiln at low level, followed by 1.3 percent at intermediate level (Table 4.8). When considering the percentage of the respondents of questionnaires about each adoption topic, people's adoption in all topics were found to be at low level. The least adoption goes to the reduction of forest resources and safety from operating and using the kiln at 90.9 percent, followed by-products at 85.7 percent and 69.5 percent, safety from operating and using the kiln at 81.8 percent, kiln installation place at 81.2 percent, production costs and break-even point at 74.0 percent, and operating life at 63.6 percent. (Table 4.9)

### 4.5.4 Adoption by Inhabitants of Using high efficiency kiln Burning at Decision Level

The measurement of people's adoption in using high efficiency kiln Burning at decision level covers such topics as buying kiln installation equipment, using the kiln in households and continuous adoption of kiln in communities, of 5 questions (10 scores). The

study reveals that most samples have scores of adoption averaged at 1.06, with highest scores at 5, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-5 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (6-7 scores)
Attitude at High Level: scores higher than 75 percent of total scores (8-10 scores)

According to the above criteria, 100% of the samples have adoption in high efficiency kiln Burning at decision level at low level (Table 4.8). When considering the percentage of the respondents of questionnaires about each adoption topic, the low adoption goes most to such topic as using the kiln in households at 90.3 percent, followed by continuous adoption of the kiln in communities at 66.2 percent, 81.8 percent and 85.1 percent, and buying kiln installation equipment at 73.4 percent. (Table 4.9)

### 4.5.5 Adoption by Inhabitants of Using high efficiency kiln Burning at Adoption Level

The measurement of people's adoption in using high efficiency kiln Burning at adoption level covers such topics as resulting convenience of kiln installation, speediness of its production process, by-products, hurdles and amount forest resources in communities, 8 questions (16 scores). The study reveals that most samples have scores of adoption averaged at 1.76, with highest scores at 11, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-8 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (9-12 scores)
Attitude at High Level: scores higher than 75 percent of total scores (13-16 scores)

According to the above criteria, most samples at 98.1 percent have adoption in the kiln at low level, followed by 1.0 percent at intermediate level (Table 4.8). When considering the percentage of the respondents of questionnaires about each adoption

topic, people's adoption were found to be at low level in all topics more than 70.0 percent.(Table 4.9)

### 4.5.6 Adoption by Inhabitants of Using high efficiency kiln Burning at Confirmation Level

The study of people's adoption of using high efficiency kiln Burning at confirmation level containing awareness to the usefulness of the kiln and suggesting or persuading others to use the kiln, of 5 questions (10 scores), reveals that most samples have scores of adoption averaged at 0.94, with highest scores at 6, and lowest scores at 0. The score classification criteria used are as follows:

Attitude at Low Level: scores less than 50 percent of total scores (0-5 scores)
Attitude at Intermediate Level: scores at 50-75 percent of total scores (6-7 scores)
Attitude at High Level: scores higher than 75 percent of total scores (8-10 scores)

According to the above criteria, most samples at 98.7 percent have adoption in the kiln at confirmation level at low level, followed by 1.3 percent at intermediate level (Table 4.8). When considering the percentage of the respondents of questionnaires about each adoption topic, most people's adoption in all topics were found to be at low level. The awareness to the usefulness of the kiln accounts to 87.7 percent, 85.1 percent and 79.2 percent, whilst the suggesting or persuading others to use the kiln accounts to 83.8 percent and 75.3 percent. (Table 4.9)

## 4.6 Problems, Obstacles and Recommendations with respect to Adoption of Using high efficiency kiln Burning

### 4.6.1 Problems and Obstacles against Adoption by Inhabitants of Using high efficiency kiln Burning

The study indicates that lack of personal budgets for investing in kiln installation equipment is the obstacle most samples at 19.45 percent are most concerned, followed by the small size of the kiln at 18.8 percent, less amount of kilns obtained at 11.0 percent, lack of knowledge and understanding in the burning procedure and method at 10.4 percent, smoke produced at 5.8 percent, difficulty in finding kiln assembly equipment at 5.2 percent, few availability of wood raw materials at 3.9 percent, unawareness of the kiln's usefulness at 3.3 percent, lack of public relation at 1.9 percent, area size required for Burnings at 1.3 percent, and constant maintenance required at 0.7 percent. (Table 4.10)

**Table 4.10 Problems and Obstacles against Adoption by Inhabitants of Using high efficiency kiln Burning**

| Problems & Obstacles | Person(s) | Percentage |
|---|---|---|
| 1. Lack of personal budgets for investing in kiln installation equipment | 30 | 19.5 |
| 2. Small size of high efficiency kiln | 29 | 18.8 |
| 3. Less amount of kilns obtained | 17 | 11.0 |
| 4. Lack of knowledge and understanding in burning procedure and method | 16 | 10.4 |
| 5. Smoke produced | 9 | 5.8 |
| 6. Difficulty in finding kiln assembly equipment | 8 | 5.2 |
| 7. Few availability of wood raw materials | 6 | 3.9 |
| 8. Unawareness of kiln's usefulness | 5 | 3.3 |
| 9. Lack of Public Relation | 3 | 1.9 |
| 10. Area size for Burnings | 2 | 1.3 |
| 11. Constant maintenance required | 1 | 0.7 |
| 12. No answer | 41 | 26.6 |
| **Total** | **154** | **100.0** |

### 4.6.2 Recommendations for Adoption of Using high efficiency kiln Burning

Although the use of high efficiency kiln Burning faces problems and obstacles, the samples gave 6 recommendations in persuading people to change their attitudes and accept

the use of the kiln, i.e. public relation should be conducted to make people know the usefulness of the kiln Burning in such various aspects as raw materials and equipment, production process, quality of productivity and investment, knowledgeable body should be sent to teach about the steps, methods, as well as providing training and demonstration, government-subsidized funds, joint commissioning, making the kiln bigger, including public relation through public address system. (Table 4.11)

**Table 4.11 Recommendations for Adoption of Using high efficiency kiln Burning by People Who Use Kiln Burning**

| Recommendation | Person(s) | Percentage |
|---|---|---|
| 1. Public relation to make kiln's usefulness in various aspects known | 88 | 57.1 |
| 2. Knowledgeable body provided for teaching, training and demonstrating | 17 | 11.0 |
| 3. Government-subsidized funds | 9 | 5.8 |
| 4. Joint commissioning | 5 | 3.3 |
| 5. Making kiln bigger | 1 | 0.7 |
| 6. Public relation through public address system | 1 | 0.7 |
| 7. No recommendation | 75 | 48.7 |
| **Total** | **154** | **100.0** |

### 4.6.3 Advantages of high efficiency kiln Burning Over Traditional One

The study of advantages of high efficiency kiln Burning reveals that the samples has indicated its 11 advantages: better quality of kilns obtained, time saving, convenient use and installation, by-product obtained as wood vinegar, environmental and health friendly, worth kilns obtained from each burning session, less labours, applicability of small woods, less installation space required, easily sought materials and equipment, and controllable burning temperature .(Table 4.12)

**Table 4.12 Advantages of high efficiency kiln Burning Over Traditional One Commented by People Who Use Kiln Burning**

| Advantage | Person(s) | Percentage |
|---|---|---|
| 1. Kilns of better quality | 40 | 26.0 |
| 2. Time saving | 37 | 24.0 |
| 3. Convenient use and installation | 23 | 15.0 |
| 4. By-product obtained as wood vinegar | 12 | 7.8 |
| 5. Environmental and health friendly | 11 | 7.1 |
| 6. Worth kilns obtained | 10 | 6.5 |
| 7. Less labours required | 10 | 6.5 |
| 8. Applicability of small woods | 4 | 2.6 |
| 9. Less installation space required | 3 | 2.0 |
| 10. Easily sought materials | 2 | 1.3 |
| 11. Controllable burning temperature | 1 | 0.7 |
| 12. No Answer | 55 | 35.7 |
| **Total** | **154** | **100.0** |

### 4.6.4 Disadvantages of high efficiency kiln Burning Over Traditional One

Although the samples can see the advantages of high efficiency kiln Burning, it also has disadvantages in their opinion, which can be concluded into 7 aspects: less kilns obtained from each burning session 22.7 percent, less capacity 16.2 percent, equipment investment required 12.3 percent, inapplicability of big woods 5.2 percent, smoke produced 4.6 percent , impaired quality of kilns obtained if mistakenly con session reveals that the samples has indicated its 11 advantages: better quality of kilns obtained if mistakenly burned 0.7 percent, and full attention required 0.7 percent.(Table 4.13)

**Table 4.13 Disadvantages of high efficiency kiln Burning Over Traditional One Commented by People Who Use Kiln Burning**

| Disadvantage | Person(s) | Percentage |
|---|---|---|
| 1. Less kilns obtained | 35 | 22.7 |
| 2. Less capacity | 25 | 16.2 |
| 3. Equipment investment required | 19 | 12.3 |
| 4. Inapplicability of big woods | 8 | 5.2 |
| 5. Smoke produced | 7 | 4.6 |
| 6. impaired quality of kilns obtained if mistakenly burned | 1 | 0.7 |
| 7. Full Attention Required | 1 | 0.7 |
| 8. No Answer | 89 | 57.8 |
| **Total** | **154** | **100.0** |

## 4.7 Comparison of Individual Factors and Openness to Receipt of Information Update about Energy Planning and High efficiency kiln Burning of Those Who Use and Do Not Use high efficiency kiln Burning

The study of comparison between users and non-users of high efficiency kiln Burning was set to conduct comparisons of 2 areas as follows:

### 4.7.1 Individual Factors

The study of comparison between users and non-users of high efficiency kiln Burning was set to conduct a comparison of 2 areas as follows:

According to the comparison of individual factors of users and non-users of high efficiency kiln Burning, number of household labours of the two groups are similar. The user group has household labours of 1-3 persons, accounting to 37.7 percent, whilst the non-user group has household labours of 1-3 persons, accounting to 43.5 percent. The user group has labours of 4-6 persons, accounting to 59.7 percent, whilst the non-user group has labours of 4-6 persons, accounting to 55.9 percent. However, the number of household labours of

user group with more than 7 members accounts to 2.6 percent, whilst the non-user group with more than 7 members accounts only to 0.6 percent. (Table 4.14)

Classified by their main occupations, the users and non-users of the kiln Burning mostly are agriculturists of similar proportion at 71.4 percent and 80.5 percent respectively, and similarly, public servants at 5.8 percent for the user group and 4.5 percent for non-user group. General engagement, however, differs in proportion, i.e. 18.2 percent for the user group and 9.7 percent the non-user group. As for merchandising and owned businesses, the proportion between the user and non-user group was found to equal at 1.9 percent. The non-user group has housewives at 0.6 percent whilst the user group has no housewife. (Table 4.14)

Classified by their annual net household income with respect to the use of the kiln Burning, the user and non-user group have similar annual net household income of 50,000 Baht or less at 37.0 percent and 43.5 percent respectively, and of 50,001 Baht or more at 63.0 percent and 56.5 percent. (Table 4.14)

**Table 4.14 Comparison of Number and Percentage of Individual Factors between User and Non-User of high efficiency kiln Burning**

| Individual Factor | User Group ( n = 154 ) | | Non-User Group ( n = 154 ) | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Number of Household Labours | | | | |
| 1-3 persons | 58 | 37.7 | 67 | 43.5 |
| 4-6 persons | 92 | 59.7 | 86 | 55.9 |
| 7 persons up | 4 | 2.6 | 1 | 0.6 |
| Main Occupation | | | | |
| Agriculturist | 110 | 71.4 | 124 | 80.5 |
| Public Servant | 9 | 5.8 | 7 | 4.5 |
| Merchandising, Owned Business | 3 | 1.9 | 3 | 1.9 |
| General Engagement | 28 | 18.2 | 15 | 9.7 |
| Housewife | 0 | 0.0 | 1 | 0.6 |

**Table 4.14 Comparison of Number and Percentage of Individual Factors between User and Non-User of high efficiency kiln Burning (cont.)**

| Individual Factor | User Group ( n = 154 ) | | Non-User Group ( n = 154 ) | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Others | 4 | 2.6 | 4 | 2.6 |
| Annual Net Household Income | | | | |
| 50,000 Baht or less | 57 | 37.0 | 67 | 43.5 |
| 50,001 Baht or up | 97 | 63.0 | 87 | 56.5 |

### 4.7.2 Receipt of Information

The researcher divided the study into 2 issues – local energy planning and high efficiency kiln Burning project. The study covered receipt of information, frequency of information receipt, type of media used for receiving information, and needs for additional information. The study results are detailed below:

The study of openness to receiving information by users and non-users of the kiln Burning indicates that most user and non-user group have opened to receive information about local energy planning accounting to 94.2 percent and 89.0 percent respectively. Both groups have information receipt frequency about 1-3 times per week and of similar proportion at 90.3 percent and 93.4 percent respectively. At other frequencies, the percentages of the user group were found to be higher than those of the non-user group. The user group opens to receive information about local energy planning for more than 6 times per week at 6.9 percent whilst the non-user group has never opened to receive the information at such frequency at all. Furthermore, the user group was found to have never had the information receipt frequency at les than once per week. (Table 4.15)

The type of media most used by the user group for receiving energy planning information is government authority, followed by energy project officer, television, neighbour and information leaflet. Whilst the type of media most used by the non-user group is government authority, followed by television, energy project officer, friend/neighbour and radio.(Table 4.15)

When classified by the needs for additional information about local energy planning, the user and non-user group both have needs and do not have need for additional information at the same proportion. The members requiring additional information account to 149 persons and those without requirement accounts to 5 persons. (Table 4.15)

**Table 4.15 Comparison of Number and Percentage of Samples Who are Users and Non-Users of the Kiln Burning Regarding Openness to Local Energy Planning Information**

| Openness to Local Energy Planning Information | User Group | | Non-User Group | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Openness to Information | | | | |
| Ever | 145 | 94.2 | 137 | 89.0 |
| Never | 9 | 5.8 | 17 | 11.0 |
| **Total** | **154** | **100.0** | **154** | **100.0** |
| Openness to Information | | | | |
| Ever | 145 | 94.2 | 137 | 89.0 |
| Never | 9 | 5.8 | 17 | 11.0 |
| **Total** | **154** | **100.0** | **154** | **100.0** |
| Information Receipt Frequency per Week | | | | |
| Less than once/week | 0 | 0.0 | 7 | 5.1 |
| 1-3 times/week | 131 | 90.3 | 128 | 93.4 |
| 4-6 times/week | 4 | 2.8 | 2 | 1.5 |
| 6 times up | 10 | 6.9 | 0 | 0.0 |
| **Total** | **145** | **100.0** | **137** | **100.0** |

**Table 4.15 Comparison of Number and Percentage of Samples Who are Users and Non-Users of the Kiln Burning Regarding Openness to Local Energy Planning Information (cont.)**

| Openness to Local Energy Planning Information | User Group | | Non-User Group | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Type of Information Media | | | | |
| Television | 18 | 12.4 | 36 | 26.3 |
| Radio | 2 | 1.4 | 10 | 7.3 |
| Newspaper | 1 | 0.7 | 0 | 0.0 |
| Billboard | 1 | 0.7 | 0 | 0.0 |
| Information Leaflet | 5 | 3.4 | 3 | 2.2 |
| Government Official | 81 | 55.9 | 54 | 39.4 |
| Relatives & Siblings | 0 | 0.0 | 1 | 0.7 |
| Friends/Neighbours | 9 | 6.2 | 12 | 8.8 |
| Energy Project Planning Officer | 28 | 19.3 | 21 | 15.3 |
| **Total** | **145** | **100.0** | **137** | **100.0** |
| Needs for Additional Information | | | | |
| Yes | 149 | 50.0 | 149 | 50.0 |
| No | 5 | 50.0 | 5 | 50.0 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

The study of openness to receiving information of the user and non-user group reveals that most of the two groups open to receiving information about high efficiency kiln Burning at 90.3 percent and 92.2 percent respectively. Their openness frequencies of 1-3 times per week are close at 4.3 percent and 4.9 percent respectively, 4-6 times per week at 3.6 percent and 0.7 percent. The user group has no frequency of more than 6 times per week whilst the non-user group has such frequency at 1.4 percent. The user group and non-user group has the frequency of less than once a week at 92.1 percent and 93.0 percent respectively. (Table 4.16)

The 5 topmost types of media used by the user group for information about high efficiency kiln Burning are government authority, energy project officers, radio, friends, television and information leaflet respectively. Whilst the 5 topmost types of

media used by the non-user group is government authority, energy project officers, radio, friends, television and information leaflet respectively. (Table 4.16)

When classified by the needs for additional information about high efficiency kiln Burning, the user and non-user group both have needs and do not have need for additional information at the same proportion. The user group and non-user group requiring additional information account to 96.8 percent and 94.2 percent. The user group and non-user group not requiring additional information account to 3.2 percent and 5.8 percent. (Table 4.16)

**Table 4.16 Comparison of Number and Percentage of Samples Who are Users and Non-Users of the Kiln Burning Regarding Openness Information about high efficiency kiln Burning**

| Openness to High efficiency kiln Burning | User Group | | Non-User Group | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Openness to Information | | | | |
| Ever | 139 | 90.3 | 142 | 92.2 |
| Never | 15 | 9.7 | 12 | 7.8 |
| **Total** | **154** | **100.0** | **154** | **100.0** |
| Information Receipt Frequency per Week | | | | |
| Less than once/week | 128 | 92.1 | 132 | 93.0 |
| 1-3 times/week | 6 | 4.3 | 7 | 4.9 |
| 4-6 times/week | 5 | 3.6 | 1 | 0.7 |
| More than 6 times | 0 | 0.0 | 2 | 1.4 |
| **Total** | **139** | **100.0** | **142** | **100.0** |
| Type of Information Media | | | | |
| Radio | 8 | 5.8 | 22 | 15.5 |
| Newspaper | 1 | 0.7 | 0 | 0.0 |
| Magazine | 2 | 1.4 | 1 | 0.7 |
| Information Leaflet | 6 | 4.3 | 15 | 10.6 |
| Government Official | 80 | 57.6 | 60 | 42.3 |
| Relatives & Siblings | 4 | 2.9 | 4 | 2.8 |
| Friend | 6 | 4.3 | 17 | 12.0 |

**Table 4.16 Comparison of Number and Percentage of Samples Who are Users and Non-Users of the Kiln Burning Regarding Openness Information about high efficiency kiln Burning (cont.)**

| Openness to High efficiency kiln Burning | User Group | | Non-User Group | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Energy Project Officer | 32 | 23.0 | 23 | 16.2 |
| **Total** | **139** | **100.0** | **142** | **100.0** |
| Needs for Additional Information | | | | |
| Yes | 149 | 96.8 | 145 | 94.2 |
| No | 5 | 3.2 | 9 | 5.8 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

**Correlation Analysis**

In the study of "Adoption of high efficiency kiln Burning by Inhabitants in North-Eastern Region", 6 research hypotheses were tested and the testing results are as follows:

**Hypothesis 1**: Samples having agricultural occupation should have more adoption in using high efficiency kiln Burning than that of those samples not having agricultural occupation.

Classified by their main occupations into 2 groups, there are 110 persons, or 71.4 percent, of the samples of agricultural occupation, and 44 persons, or 28.6 percent (Table 4.17), of non-agricultural occupation. The adoption of using high efficiency kiln Burning was divided into 5 levels. The groups above of agricultural and non-agricultural occupation have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 2.08, 1.25
- Persuasion Level $\overline{X}$ = 1.78, 1.43
- Decision Level $\overline{X}$ = 1.16, 0.80
- Adoption Level $\overline{X}$ = 2.00, 1.16

- Confirmation Level $\overline{X}$ = 1.08, 0.59 (Table 4.18)

**Table 4.17 Status of Using high efficiency kiln Burning Classified by Main Occupation**

| Main Occupation | User Group ( n=154) | | Non-User Group ( n=154) | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Agriculture | 110 | 71.4 | 124 | 80.5 |
| Others | 44 | 28.6 | 30 | 19.5 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

**Table 4.18 Results of Comparison of Averages of Adoption of high efficiency kiln Burning by Samples with and without Agricultural Occupation**

| Adoption of high efficiency kiln Burning | Agricultural Occupation (n=110) | | Non-agricultural Occupation (n=44) | | Total (n=154) | | t | p. |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 2.08 | 1.83 | 1.25 | 0.99 | 1.84 | 1.68 | 3.61 | 0.00* |
| Persuasion Level | 1.78 | 2.10 | 1.43 | 1.38 | 1.68 | 1.92 | 1.01 | 0.31 |
| Decision Level | 1.16 | 1.29 | 0.80 | 1.04 | 1.06 | 1.23 | 1.67 | 0.09 |
| Adoption Level | 2.00 | 2.57 | 1.16 | 1.21 | 1.76 | 2.29 | 2.74 | 0.02* |
| Confirmation Level | 1.08 | 1.58 | 0.59 | 0.94 | 0.94 | 1.44 | 2.35 | 0.06 |

* Statistical Significance 0.05

The hypothesis testing results indicate that the samples of agricultural occupation have more adoption in high efficiency kiln Burning than that of the samples of non-agricultural occupation with statistical significance at 0.05 in 3 levels as follows:

- Knowledge Level t=3.61, p.=0.00
- Adoption Level t=-2.74, p.= 0.00
- Confirmation Level t=2.35, p.=0.02 (Table 4.18)

**Hypothesis 2**: Samples having more household labours should have more adoption in using high efficiency kiln Burning than that of those samples having less household labours.

Classified by their number of household labours into 2 groups, there are 110 persons, or 71.4 percent, of the samples having few or less than 4 household labours, and 44 persons, or 28.6 percent (Table 4.19), having many or more than 5 household labours. The adoption of using high efficiency kiln Burning was divided into 5 levels. The groups above of having less and more household labours have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 1.88, 1.75
- Persuasion Level $\overline{X}$ = 1.66, 1.73
- Decision Level $\overline{X}$ = 1.12, 0.91
- Adoption Level $\overline{X}$ = 1.76, 1.75
- Confirmation Level $\overline{X}$ = 1.00, 0.80 (Table 4.20)

**Table 4.19 Status of Using high efficiency kiln Burning Classified by Number of Household Labours**

| Number of Household Labours | User Group ( n=154) | | Non-User Group ( n=154) | |
|---|---|---|---|---|
| | **Person(s)** | **Percentage** | **Person(s)** | **Percentage** |
| Less Labours (1-4 persons) | 110 | 71.4 | 121 | 78.6 |
| Many Labours (5-8 persons) | 44 | 28.6 | 33 | 21.4 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

**Table 4.20 Results of Comparison of Averages of Adoption of high efficiency kiln Burning by Samples with Less and Many Household Labours**

| Adoption of high efficiency kiln Burning | Less Household Labours (n=110) | | Many Household Labours (n=44) | | Total (n=154) | | t | p. |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 1.88 | 1.72 | 1.75 | 1.58 | 1.84 | 1.68 | 0.43 | 0.66 |
| Persuasion Level | 1.66 | 1.99 | 1.73 | 1.77 | 1.68 | 1.92 | -0.18 | 0.85 |
| Decision Level | 1.12 | 1.29 | 0.91 | 1.07 | 1.06 | 1.23 | 1.02 | 0.30 |
| Adoption Level | 1.76 | 2.43 | 1.75 | 1.93 | 1.76 | 2.29 | 0.03 | 0.97 |
| Confirmation Level | 1.00 | 1.52 | 0.80 | 1.25 | 0.94 | 1.44 | 0.79 | 0.43 |

The hypothesis testing results indicate that the adoptions by the samples with many and less household labours of high efficiency kiln Burning are not different with statistical significance at 0.05 at every level. (Table 4.20)

**Hypothesis 3**: Samples having less annual household income should have more adoption in using high efficiency kiln Burning more than that of those samples having much annual household income

Classified by their annual net household income into 2 groups, there are 124 persons, or 40.3 percent, of the samples having less household income, and 184 persons, or 59.7 percent (Table 4.21), having much or more than 50,001 Baht of household income. The adoption of using high efficiency kiln Burning was divided into 5 levels. The groups above of less and more household income have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 1.84, 1.68
- Persuasion Level $\overline{X}$ = 1.68, 1.92
- Decision Level $\overline{X}$ = 1.06, 1.23
- Adoption Level $\overline{X}$ = 1.76, 2.29

- Confirmation Level $\overline{X}$ = 0.94, 1.44 (Table 4.22)

**Table 4.21 Status of Using high efficiency kiln Burning Classified by Annual Net Household Income**

| Annual Net Household Income | User Group ( n=154) | | Non-User Group ( n=154) | |
|---|---|---|---|---|
| | **Person(s)** | **Percentage** | **Person(s)** | **Percentage** |
| Below 50,000 Baht | 57 | 37.0 | 67 | 43.5 |
| 50,001 Baht up | 97 | 63.0 | 87 | 56.5 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

**Table 4.22 Results of Comparison of Averages of Adoption of high efficiency kiln Burning by Samples with Less and Much Household Income**

| Adoption of high efficiency kiln Burning | Less Household Income (n=57) | | Much Household Income (n=97) | | Total (n=154) | | t | p. |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 1.90 | 1.90 | 1.69 | 1.52 | 1.84 | 1.68 | 1.46 | 0.14 |
| Persuasion Level | 1.71 | 1.93 | 1.67 | 1.93 | 1.68 | 1.92 | 0.09 | 0.92 |
| Decision Level | 1.21 | 1.16 | 0.97 | 1.27 | 1.06 | 1.23 | 1.20 | 0.23 |
| Adoption Level | 1.88 | 2.32 | 1.69 | 2.28 | 1.76 | 2.29 | 0.48 | 0.63 |
| Confirmation Level | 1.09 | 1.47 | 0.86 | 1.42 | 0.94 | 1.44 | 0.95 | 0.34 |

* Statistical Significance 0.05

The hypothesis testing results indicate that the samples with less household income have adoption in high efficiency kiln Burning not different from that of the samples of with much household income with statistical significance at 0.05 at every level.(Table 4.22)

**Hypothesis 4**: Receipt of information about local energy planning should relate positively to the adoption of using high efficiency kiln Burning

With regard to the openness to receiving information about local energy planning, there are 282 persons, or 91.6 percent, of the samples having received such information, whilst the rest of 26 persons, or 8.4 percent (Table 4.23), has never received. The adoption of using high efficiency kiln Burning was divided into 5 levels. The groups above of having and not having received the information have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 1.87, 1.44
- Persuasion Level $\overline{X}$ = 1.66, 2.11
- Decision Level $\overline{X}$ = 1.06, 1.00
- Adoption Level $\overline{X}$ = 1.73, 2.22
- Confirmation Level $\overline{X}$ = 0.93, 1.11 (Table 4.24)

**Table 4.23 Status of Using 200-Litre Kiln Burning Classified by Receipt of Local Energy Planning Information**

| Receipt of Local Energy Planning Information | User Group ( n=154) | | Non-User Group ( n=154) | |
|---|---|---|---|---|
| | Person(s) | Percentage | Person(s) | Percentage |
| Ever | 145 | 94.2 | 137 | 89.0 |
| Never | 9 | 5.8 | 17 | 11.0 |
| **Total** | **154** | **100.0** | **154** | **100.0** |

**Table 4.24 Relationships Between Receipt of Local Energy Planning Information and Adoption of high efficiency kiln Burning**

| Adoption of high efficiency kiln Burning | Receive (n=282) | | Not Receive (n=26) | | Total (n=308) | | r | p. |
|---|---|---|---|---|---|---|---|---|
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 1.87 | 1.67 | 1.44 | 1.81 | 1.84 | 1.68 | -0.05 | 0.23 |
| Persuasion Level | 1.66 | 1.89 | 2.11 | 2.42 | 1.68 | 1.92 | 0.05 | 0.24 |
| Decision Level | 1.06 | 1.23 | 1.00 | 1.32 | 1.06 | 1.23 | -0.12 | 0.44 |
| Adoption Level | 1.73 | 2.24 | 2.22 | 3.19 | 1.76 | 2.29 | 0.05 | 0.26 |
| Confirmation Level | 0.93 | 1.39 | 1.11 | 2.20 | 0.94 | 1.44 | 0.02 | 0.35 |

The hypothesis testing results indicate that the receipt of information about local energy planning does not relate positively to the adoption of using high efficiency kiln Burning with statistical significance at 0.05 in every aspect. (Table 4.24)

**Hypothesis 5**: Knowledge about high efficiency kiln Burning should relate positively to the adoption of using high efficiency kiln Burning

With regard to knowledge about high efficiency kiln Burning, there are 25 persons, or 16.2 percent, of the samples having less knowledge, 62 persons, or 40.3 percent, having intermediate knowledge, and 67 persons, or 43.5 percent, having much knowledge (Table 4.25). The adoption of using high efficiency kiln Burning was divided into 5 levels. The three groups above of less, intermediate and much knowledge have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 2.64, 1.71, 1.67
- Persuasion Level $\overline{X}$ = 2.28, 1.66, 1.48
- Decision Level $\overline{X}$ = 1.12, 1.21, 0.90
- Adoption Level $\overline{X}$ = 2.76, 1.87, 1.28
- Confirmation Level $\overline{X}$ = 1.44, 0.98, 0.72 (Table 4.25)

**Table 4.25 Grouping by Total Knowledge Scores**

| Adoption Level | | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Knowledge Level | Less Knowledge (below 11 scores) | 25 | 2.64 | 2.413 | 0 | 6 |
| | Intermediate Knowledge (12-17 scores) | 62 | 1.71 | 1.673 | 0 | 6 |
| | Much Knowledge (18 scores up) | 67 | 1.67 | 1.248 | 0 | 6 |
| | **Total** | **154** | **1.84** | **1.681** | **0** | **6** |
| Persuasion Level | Less Knowledge (below 11 scores) | 25 | 2.28 | 2.542 | 0 | 8 |
| | Intermediate Knowledge (12-17 scores) | 62 | 1.66 | 2.103 | 0 | 9 |
| | Much Knowledge (18 scores up) | 67 | 1.48 | 1.407 | 0 | 6 |
| | **Total** | **154** | **1.68** | **1.926** | **0** | **9** |
| Persuasion Level | Less Knowledge (below 11 scores) | 25 | 1.12 | 1.453 | 0 | 5 |
| | Intermediate Knowledge (12-17 scores) | 62 | 1.21 | 1.332 | 0 | 5 |
| | Much Knowledge (18 scores up) | 67 | 0.90 | 1.046 | 0 | 4 |
| | **Total** | **154** | **1.06** | **1.238** | **0** | **5** |
| Adoption Level | Less Knowledge (below 11 scores) | 25 | 2.76 | 3.032 | 0 | 9 |
| | Intermediate Knowledge (12-17 scores) | 62 | 1.87 | 2.596 | 0 | 11 |
| | Much Knowledge (18 scores up) | 67 | 1.28 | 1.423 | 0 | 6 |
| | Total | 154 | 1.76 | 2.295 | 0 | 11 |
| Confirmation Level | Less Knowledge (below 11 scores) | 25 | 1.44 | 1.938 | 0 | 5 |
| | Intermediate Knowledge (12-17 scores) | 62 | 0.98 | 1.563 | 0 | 6 |
| | Much Knowledge (18 scores up) | 67 | 0.72 | 1.042 | 0 | 4 |
| | **Total** | **154** | **0.94** | **1.447** | **0** | **6** |

**Table 4.26 Relationships Between Level of Knowledge About high efficiency kiln Burning and its Adoption**

| Adoption of high efficiency kiln Burning | Knowledge About High efficiency kiln Burning | | | | | | | | r | p. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Less Level (n=25) | | Intermediate Level (n=62) | | Much Level (n=67) | | Total (n=308) | | | |
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 2.24 | 2.41 | 1.71 | 1.67 | 1.67 | 1.24 | 1.84 | 1.68 | -0.16 | 0.01* |
| Persuasion Level | 2.28 | 2.54 | 1.66 | 2.10 | 1.48 | 1.40 | 1.68 | 1.92 | -0.13 | 0.04* |
| Decision Level | 1.12 | 1.45 | 1.21 | 1.33 | 0.90 | 1.04 | 1.06 | 1.23 | -0.09 | 0.12 |
| Adoption Level | 2.76 | 3.03 | 1.87 | 2.59 | 1.28 | 1.42 | 1.76 | 2.29 | -0.22 | 0.00* |
| Confirmation Level | 1.44 | 1.93 | 0.98 | 1.56 | 0.72 | 1.04 | 0.94 | 1.44 | -0.17 | 0.01* |

* Statistical Significance 0.05

The hypothesis testing results indicate that the knowledge about high efficiency kiln Burning has no positive relationship with the adoption of using high efficiency kiln Burning with statistical significance at 0.05 at every level. However, negative relationships with the use of high efficiency kiln Burning exist in 4 levels as follows:

- Knowledge Level r= -0.16, p.=0.01
- Persuasion Level r= -0.13, p.=0.04
- Decision Level r= -0.22, p.=0.00
- Adoption Level r= -0.17, p.=0.01 (Table 4.26)

**Hypothesis 6**: Attitudes of the samples towards high efficiency kiln Burning should relate positively to the adoption of using high efficiency kiln Burning

With regard to attitudes of the samples towards high efficiency kiln Burning, there are 6 persons, or 3.9 percent, of the samples having low attitude, 109 persons, or 70.8

percent, having intermediate attitude, and 39 persons, or 25.3 percent, having high attitude (Table 4.27). The adoption of using high efficiency kiln Burning was divided into 5 levels. The groups above of low, intermediate and high attitude have average adoption of using the kiln Burning at each level as follows:

- Knowledge Level $\overline{X}$ = 3.17, 2.14 , 0.82
- Persuasion Level $\overline{X}$ = 2.50, 1.94, 0.82
- Decision Level $\overline{X}$ = 1.83, 1.18, 0.59
- Adoption Level $\overline{X}$ = 2.17, 2.06, 0.85
- Confirmation Level $\overline{X}$ = 0.83, 1.10 , 0.51 (Table 4.28)

**Table 4.27 Grouping by Total Attitude Scores**

| Adoption Level | | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Knowledge Level | Low Agreeing Attitude (below 60 scores) | 6 | 3.17 | 0.753 | 2 | 4 |
| | Intermediate Agreeing Attitude (61-90 scores) | 109 | 2.14 | 1.766 | 0 | 6 |
| | High Agreeing Attitude (91 scores up) | 39 | .82 | .914 | 0 | 3 |
| | **Total** | **154** | **1.84** | **1.681** | **0** | **6** |
| Persuasion Level | Low Agreeing Attitude (below 60 scores) | 6 | 2.50 | 0.837 | 1 | 3 |
| | Intermediate Agreeing Attitude (61-90 scores) | 109 | 1.94 | 2.155 | 0 | 9 |
| | High Agreeing Attitude (91 scores up) | 39 | 0.82 | 0.756 | 0 | 3 |
| | **Total** | **154** | **1.68** | **1.926** | **0** | **9** |
| Decision Level | Low Agreeing Attitude (below 60 scores) | 6 | 1.83 | 0.753 | 1 | 3 |
| | Intermediate Agreeing Attitude (61-90 scores) | 109 | 1.18 | 1.375 | 0 | 5 |
| | High Agreeing Attitude (91 scores up) | 39 | 0.59 | 0.595 | 0 | 2 |
| | **Total** | **154** | **1.06** | **1.238** | **0** | **5** |

**Table 4.27 Grouping by Total Attitude Scores (cont.)**

| Adoption Level | | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Adoption Level | Low Agreeing Attitude (below 60 scores) | 6 | 2.17 | 0.408 | 2 | 3 |
| | Intermediate Agreeing Attitude (61-90 scores) | 109 | 2.06 | 2.583 | 0 | 11 |
| | High Agreeing Attitude (91 scores up) | 39 | 0.85 | 1.040 | 0 | 3 |
| | **Total** | **154** | **1.76** | **2.295** | **0** | **11** |
| Confirmation Level | Low Agreeing Attitude (below 60 scores) | 6 | 0.83 | 0.753 | 0 | 2 |
| | Intermediate Agreeing Attitude (61-90 scores) | 109 | 1.10 | 1.581 | 0 | 6 |
| | High Agreeing Attitude (91 scores up) | 39 | 0.51 | 0.997 | 0 | 3 |
| | **Total** | **154** | **0.94** | **1.447** | **0** | **6** |

**Table 4.28 Relationships Between Level of Attitude Towards high efficiency kiln Burning and its Adoption**

| Adoption of high efficiency kiln Burning | Attitude Towards High efficiency kiln Burning | | | | | | | | r | p. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low Level (n=6) | | Intermediate Level (n=109) | | Much Level (n=39) | | Total (n=308) | | | |
| | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | $\overline{X}$ | S.D. | | |
| Knowledge Level | 3.17 | 0.75 | 2.14 | 1.76 | 0.82 | 0.91 | 1.84 | 1.68 | -0.37 | 0.00* |
| Persuasion Level | 2.50 | 0.83 | 1.94 | 2.15 | 0.82 | 0.75 | 1.68 | 1.92 | -0.26 | 0.00* |
| Decision Level | 1.83 | 0.75 | 1.18 | 1.37 | 0.59 | 0.59 | 1.06 | 1.23 | -0.24 | 0.00* |
| Adoption Level | 2.17 | 0.40 | 2.06 | 2.58 | 0.85 | 1.04 | 1.76 | 2.29 | -0.21 | 0.00* |
| Confirmation Level | 0.83 | 0.75 | 1.10 | 1.58 | 0.51 | 0.99 | 0.94 | 1.44 | -0.14 | 0.03* |

* Statistical Significance 0.05

The hypothesis testing results indicate that the attitude towards high efficiency kiln Burning has no positive relationship with the adoption of using high efficiency kiln Burning with statistical significance at 0.05 at every level. However, negative relationships with the use of high efficiency kiln Burning exist at every level as follows:

- Knowledge Level r= -037, p.=0.00
- Persuasion Level r= -0.26, p.=0.00
- Decision Level r = -0.24, p.=0.00
- Adoption Level r= -0.21, p.=0.00
- Confirmation Level r = -0.14, p.= 0.03 (Table 4.28)

The correlation analysis and analysis of difference between the averages of the two group of samples (t-test) conclude that the samples of agricultural occupation have more adoption in high efficiency kiln Burning than that of non-agricultural occupation with statistical significance at 0.05 in 3 levels – knowledge level, adoption level and confirmation level. The samples having more and less household labours have adoption in high efficiency kiln Burning of no difference with statistical significance at 0.05 in every level. The samples with less household income have adoption in high efficiency kiln Burning of not different from those samples having more household income with statistical significance at 0.05 in every level. The receipt of information about local energy planning has no positive relationship with the adoption of high efficiency kiln Burning with statistical significance at 0.05 in every level. The level of knowledge about high efficiency kiln Burning has no positive relationship with the adoption of high efficiency kiln Burning with statistical significance at 0.05, but has negative relationships at 4 levels – knowledge level, persuasion level, adoption level and confirmation level. The level of attitude towards high efficiency kiln Burning also has no positive relationship with the adoption of high efficiency kiln Burning with statistical significance at 0.05, but with negative relationships with high efficiency kiln Burning with statistical significance at 0.05 in every level.

# CHAPTER 5
# RESULT DISCUSSION

## 5.1 The adoption of high efficiency kiln burning

The research results indicate that most of the samples at 98.7 percent accept the use of high efficiency kiln burning at low level. When considering the samples' The adoption of the Kiln at such 5 levels as knowledge level, persuasion level, decision level, adoption level and confirmation level, it indicates that most of the samples also have The adoption of the use of high efficiency kiln burning in such 5 levels at low level at 98.7 percent.

The researcher found that the reasons of the samples accepting the use of high efficiency kiln burning at low level are attributed to various problems and obstacles. The inability of the samples to afford their own budgets to buy Kiln assembly components is the most concerned issue, followed by the Kiln's small size resulting in less produced charcoals, lack of knowledge and understanding in the burning method, problem from produced smokes, Kiln components unreadily available, wood materials unreadily available, unawareness of the Kiln's benefits, lack of public relation, including size of Kiln installation place and constant maintenance required.

The fact that most samples accept the use of high efficiency kiln Burning at low level is due to some samples being unknowledgeable in the Kiln, and being knowledgeable in the Kiln but considering it unbeneficial to them. Consequently, the concept about using the Kiln stands still at this stage and does not go further other stages, hence the low level of acceptance.

The researcher found that the reason resulting in the acceptance by most samples of high efficiency kiln Burning at low level is attributed to the reduction of forest resource consumption and safety from operating and using the Kiln which contribute most to the acceptance of the Kiln at the persuasion level, followed by the by-product derived from charcoal burning (Wood Vinegar), safety from operating and

using the Kiln, Kiln installation place, production costs and break-even point and its operating life. The researcher comments that the forest resources used as the raw materials can still be easily found in the communities and that most samples cut big trees not merely for the purpose of charcoal burning. In addition, with respect to operating safety, the samples comments that throughout the Kiln installation and assembly process, it is easy to be carried out and accidents are also unlikely, hence low level of acceptance at this level.

With respect of The adoption of the high efficiency kiln Burning at decision level, most samples have acceptance at low level. More than 90.0 percent of most samples have decided to use the Kiln for household purpose, and more than 80.0 percent to use the Kiln continually in their communities. With respect of decision to buy Kiln assembly components, more than 70.0 percent have decided to go with it.

The samples are, in the researcher's opinion, still unconfident in the benefits in many respects to be gained from opting for the Kiln, lacking knowledge and understanding, lacking pubic relation and transferred knowledge about the Kiln, thus resulting in its unpopularity in the communities and in their hesitance to make Kiln-use decision.

With respect to acceptance of the high efficiency kiln Burning at adoption level, most samples have acceptance at low level as well. More than 70.0 percent of the samples accept the use of the Kiln in terms of installation convenience, speediness of the burning process and by-product derived from charcoal burning (Wood Vinegar). Nevertheless, the samples also substantially foresee charcoal burning obstacles, accidents caused by Kiln installation and during operation, and affected amount of forest resources.

With respect to the acceptance of the high efficiency kiln Burning at confirmation level, most samples at 98.7 percent have acceptance of the high efficiency kiln Burning at low level. The samples accepting the use of the Kiln at confirmation level account to 1.3 percent. No sample accepts such use of the Kiln at confirmation level at high level. Most samples accept the use of the Kiln at confirmation level at low level in every topic, including awareness of the Kiln's

benefits, and recommendations and persuasion made to others to use the Kiln, at more than 75.3 percent.

The researcher found that the reasons of the samples accepting the use of high efficiency kiln Burning at low level are attributed to various problems and obstacles. The inability of the samples to afford their own budgets to buy Kiln assembly components is the most concerned issue, followed by the Kiln's small size resulting in less produced charcoal, lack of knowledge and understanding in the burning method, problem from produced smokes, Kiln components unreadily available, wood materials unreadily available, unawareness of the Kiln's benefits, lack of public relation, including size of Kiln installation place and constant maintenance required.

## 5.2 Individual Factors Affecting the Acceptance of high efficiency kiln Burning

In studying individual factors affecting the acceptance of high efficiency kiln Burning, the researcher used such 3 variables as occupation, number of household labours and annual net household income. The studying results can be discussed respectively as follows:

### 5.2.1 Occupation

The study indicates that the samples' occupations affect the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at knowledge and adoption levels, which is in alignment with the hypothesis set by the researcher. This is possibly due to the fact that the samples of agricultural occupation know and are close to the Kiln assembly materials, supported by the ease of these samples to find such materials as woods for burning charcoal, including by those samples of agricultural occupation who are sufficiently available to assemble the Kiln and look after it all the times throughout the charcoal burning period.

### 5.2.2 Number of Household Labours

The study indicates that the number of household labours has no effect to the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at all five levels. Such study is not in alignment with the hypothesis set by the researcher that samples having more household labours will have more acceptance of the use of high efficient kiln Burning than those having less household labours.

This is possibly due to the fact that the samples determine that whatever number of household labours used in the operation contributes no obstacle to the construction of the Kiln and, as the Kiln can be easily assembled, the finding of burning materials can be accomplished simply by single person.

### 5.2.3 Annual Net Household Income

The study indicates that the number of household labours has no effect to the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at all five levels. Such study is not in alignment with the hypothesis set by the researcher that samples having more household labours will have more acceptance of the use of high efficiency kiln Burning than those having less household labours.

This is possibly due to the fact that the samples determine that whatever number of household labours used in the operation contributes no obstacle to the construction of the Kiln and, as the Kiln can be easily assembled, the finding of burning materials can be accomplished by single person.

## 5.3 Stimulating Factors Affecting the Acceptance of high efficiency kiln Burning

### 5.3.1 Receipt of Information

**Receipt of Information Update about Local Energy Planning**

The study of variables in respect of receipt of local energy planning indicates that they has no effect to the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at all five levels. This is not in alignment with the set hypothesis that the receipt of information about local energy planning has positive

relationship with the acceptance of high efficiency kiln Burning. This is possibly due to the fact that the samples do not realize the importance of such receipt of information locally and most of them are still desirous to such receipt in respect of benefits gained from local energy planning, local energy planning method, pros and cons of local energy planning, authority providing local energy planning information and others such as information received from the community's public address system, supporting budgets allocated by relevant bodies to conduct meetings, field trips and continual evaluation etc.

### 5.3.2 Knowledge about high efficiency kiln Burning

The study of variables in respect of the high efficiency kiln Burning indicates that they do have an effect to the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at all four levels - knowledge level, persuasion level, adoption level and confirmation level. However, they have negative relationship with the acceptance of the Kiln i.e. the more knowledgeable samples accept the use of the Kiln at low level. The Kiln-knowledge variables contribute no any effect only to the decision level, which is not in alignment with the set hypothesis that the knowledge in respect of the high efficiency kiln Burning has positive relationship with the acceptance of the use of the Kiln.

This is possibly due to the fact that the samples have different level of understanding in the Kiln and in receiving information facts, including the ways the information is acquired giving rise to differently perceived proper information and to no effect to the acceptance of the use of the Kiln.

### 5.3.3 Attitudes toward the Use of high efficiency kiln Burning

The study of attitude variables in respect of the high efficiency kiln Burning indicates that they do have an effect to the acceptance of high efficiency kiln Burning with statistical significance level at 0.05 at all levels, but have negative relationship with it, which is not in alignment with the hypothesis set by the researcher that the

attitudes of the samples toward the Kiln have positive relationship with the acceptance of the kiln.

This is possibly due to the fact that the samples determine that the Kiln has benefits in several areas such as investment, productivity and by-product, and environment. However, the samples might deem the weakness important as well like the accident likely to occur during the Kiln assembly process. This could be one of the reasons that the samples accept the use of the kiln at low level.

# CHAPTER 6
# CONCLUSION AND RECOMMENDATION

In The Study about The Northeast region's acknowledgement of using high efficiency kiln on the purpose for studying about the acknowledgement level and The factor that has the result in the inhabitants usage of the high efficiency kiln by using the questionnaires which consist of the high efficiency kiln project, the Acknowledgement Questionnaire**,** the Acknowledgement Evaluation Form about high efficiency kiln in order to be the research tools for inquiring the samples of 4 provinces study area. Those are Nakhornratchasrima, Khonkean, Surin and Ubonratchathani with 308 samples that divide into 2 groups of each 154 samples using and not using the high efficiency kiln. At any rate, the researcher had checked the questionnaires and analyzed the information by using SPSS for Windows software for bringing up information with percentage statistic, Arithmetic Sharing Value, the highest and lowest value, the difference analysis of sharing value of 2 population samples. And the coefficient correlation analysis and its data analysis by categories as follow**:**

## 6.1 The Research Results

### 6.1.1 Individual Factors

The samples are divided into the status of using and not using status of high efficiency kiln in equal of 50%. Most of the sample groups have 4-6 household labors in 57.8%. And found that most 16.0% of majority of the samples earn the living in Agricultural Section and having net income more than 15,001 Baht and above per year.

### 6.1.2 The Local Energy planning of Information Realization

The result indicated that the 91.6% of the majority of the samples used to get the information about the Local Energy Planning and the frequency of starting information Realization of Local Energy Planning and dissevered that the 91.8 of the samples started to realize in information 1-3 times per week.

### 6.1.3 The Knowledge about high efficiency kiln

The results indicated that 43.5% of the samples have knowledge about the high efficiency kiln in a high level which had the sharing score of the high efficiency kiln at 16.47 points from 23 points.

### 6.1.4 The Attitude of using high efficiency kiln

The results indicated that 70.8% of the samples having good attitude of using high efficiency kiln in medium way. Which have an attitude score of using the high efficiency kiln at 84.03 points from 120 points.

### 6.1.5 The Acknowledgement of using high efficiency kiln

The results indicated that 98.7% of the samples having the attitude about using the high efficiency kiln in a low level at 7.65 points from 64 points.

### 6.1.6 The Impact Factors of the Acknowledgement of using high efficiency kiln

From The results indicated that occupation, the high efficiency kiln knowledge and the attitude of using the high efficiency kiln have an affect to the high efficiency kiln statistically acknowledgement at the level of 0.05.

By the found that the majority of the samples are earn the living in agricultural section and having the acknowledgement to the use of high efficiency kiln more than any other occupations.

And from the result also indicated that the knowledge and attitude about using the high efficiency kiln have the negative relation with the high efficiency kiln acknowledgement.

About the leftover variables which are the member in household, the household net income and the local energetic planning acknowledgement found that have no result with the samples of the use of high efficiency kiln in a different way in a statistically significance. (Table 6.1)

**Table 6.1 the use of the high efficiency kiln Factor Result**

| Variables | Statistic significances Level from inhabitant's Assumption Test |
|---|---|
| **Occupation** | |
| - Knowledge Step | 0.00* |
| - Motivation Step | 0.31 |
| - Decision Step | 0.09 |
| - Utilization Step | 0.00* |
| - Using Confirmation Step | 0.02* |
| **Household labor number** | |
| - Knowledge Step | 0.66 |
| - Motivation Step | 0.85 |
| - Decision Step | 0.30 |
| - Utilization Step | 0.97 |
| - Using Confirmation Step | 0.43 |
| **Household Annual Net Income** | |
| - Knowledge Step | 0.12 |
| - Motivation Step | 0.92 |
| - Decision Step | 0.24 |
| - Utilization Step | 0.63 |
| - Using Confirmation Step | 0.34 |
| **Receipt Information about Local Energetic Planning** | -0.23 |
| - Knowledge Step | 0.24 |
| - Motivation Step | -0.44 |
| - Decision Step | 0.26 |
| - Utilization Step | 0.35 |
| - Using Confirmation Step | |

**Table 6.1 the use of the high efficiency kiln Factor Result (cont.)**

| Variables | Statistic significances Level from inhabitant's Assumption Test |
|---|---|
| **The High efficiency kiln Knowledge** | |
| - Knowledge Step | -0.01* |
| - Motivation Step | -0.04* |
| - Decision Step | 0.12 |
| - Utilization Step | -0.00* |
| - Using Confirmation Step | -0.01* |
| **The High efficiency kiln Attitude** | |
| - Knowledge Step | -0.00* |
| - Motivation Step | -0.00* |
| - Decision Step | -0.00* |
| - Utilization Step | -0.00* |
| - Using Confirmation Step | -0.03* |

**Remark**: * has a Statistically Significance at level 0.05

### 6.1.7 Problems and Obstacles about using the high efficiency kiln

From The Study indicated that 19% of the majority samples have opinion about not having the individual equipment purchasing investment is the most problem and obstacle for the use of high efficiency kiln. Following by have opinion about the stove have a small size and would make a small quantity of charcoal, acknowledged in installation and step, the smoke from the burning, abbreviated equipment for installing the stove including the lack of wood for burning, the unknown advantage of the stove. In addition, the results found that the lack of publicity and having time for tendency are completely also the problems and obstacles of the use of high efficiency kiln acknowledgement.

### 6.1.8 The individual Comparison and the Receipt of Information about Energy Planning and the high efficiency Kiln Project between user group and not user group of high efficiency kiln

From the individual comparison of the user and not user groups found that 2 groups have a proportion of household labors in approximate level. Which the majority of user group has 59.7% of 4-6 household labors and the majority of not user group has the same number at 55.9 % also.

When classifying the majority occupation according to the user and not user group of high efficiency kiln found that all 2 groups earn the living in agricultural section at 71.4 % and 80.5 % subsequently.

About the household annual net income aspect by the using status result indicate that the user and not user group of high efficiency kiln have household annual net income 15,001 Baht or above in approximately at 63.0% and 56.5% subsequently.

The study result of local energy planning Information Adoption found that all of the user and not user group of the use of high efficiency kiln used to adopted the information in approximately proportion that are 94.2% and 89.0% subsequently. By the frequency of the most information adoption of 2 groups is 1-3 time a week and the most information adoption media of those groups is government staff, followed by the energy project staff, Television, Neighbors, and radio. Besides, these 2 groups are still having more appetence in the same rank.

## 6.2 Recommendation

### 6.2.1 The Research Recommendation

1. Even if the samples are having high knowledge rank, but have a low rank of acknowledgement. This cause is showed that there is necessary to having publicity ahead progressive from the community itself and the involved government and private sectors. Because of the user and not user group comparison study indicated that the frequency of information adoption about the high efficiency kiln is 1-3 time a week in average. Thus, all the involved section should publicize to both knowledge of strong and weak points, the benefits of the high efficiency kiln in order to generate the good attitude to community. In consideration of the government and the energy planning project staff's information adoption medias are the most first sequence that can be

appreciated to all inhabitants which cause to the acknowledgement. And also having the continuously and will be the Two-way Communication questionable.

2. This campaign of using the high efficiency kiln for inhabitants should let the adopted and having using habit continuously first to be the center of educate in the advantages when changing to use the high efficiency kiln. For example, better charcoal, timesaving burning, easy Installation and usability and the by-product from the kiln burning is wood vinegar. The knowledge center should be the agriculturist samples because from the assumption test found that the agriculturist samples have more acknowledgment of using the high efficiency kiln than any other occupations. Including making good attitude of using the high efficiency kiln to people that have not used the stove yet and broaden out more the former mainstay for more high efficiency kiln utilization.

3. From the study of problems and obstacles of the high efficiency kiln acknowledgement indicated that the very important obstacle factor is investment. Therefore, the subsidizing and supporting should conduct together with all government and private sections. That will be the factor that makes people turn to use the high efficiency kiln. Furthermore, the problem and obstacle of installation accident, the smoke from burning and preserve the wood vinegar are enlarge more responsibility as the important problem and obstacle also. In consequence, Should be a staff for taking care and give information regularly.

4. The inhabitant's motivation of using the high efficiency kiln by publicity about the strong points of using this stove. Especially decrease deforestation. Because the high efficiency kiln can use the smaller wood such as tamarind bough, mango bough, eucalyptus bough or the sprouted timber for instance and will decrease bressummer deforestation, smudged deforestation. Because from the study found that the majority samples have more good attitude as stated.

5. From the result of the Northeast region's using of the high efficiency kiln acknowledgement generally found that the knowledge has negative relation with the high efficiency kiln acknowledgement. The researcher found that it might be cause from the question proportion which leans to 16 contents of the high efficiency kiln's advantages. But the affect of maintenance proportion and caution from kiln burning

and curing process from kiln burning have less question contents; 7 contents which reflect that people has knowledge about the advantages of the high efficiency kiln in a tolerable level. But it's not able to summarize the other 3 sections in the same way because having under content and the knowledge evaluation form is leaned to the advantage issue more than 3 other issues. Therefore, should give more education in various ways e.g. published broadcast document, the high efficiency kiln processing demonstration training for after 3 issues for example will make the positive relation for the high efficiency kiln acknowledgement.

### 6.2.2 Recommendation for the next research

1. Because of this study found that knowledge and attitude had an affect to using of the high efficiency kiln acknowledgement and correlated in positive relation. So the next research should aim at behavior level that has any consistency with the acknowledgement or not. Because of inhabitant's behavior of using the high efficiency kiln will be evaluate how well of the energy conserve project of using the high efficiency kiln.

2. The high efficiency kiln project is just one of the local energy conservation projects. There are more projects which are supported the energy conservation for study such as the efficiency stove, economic stove, biological stove, Bio-diesel, solar cell board, water pump turbine, water pump bicycle. For any other issues such as the advantage comparison study of each project, the environmental aftereffect of each project for examples for the usefulness of local development planning and energy conservation in advance.

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# APPENDIX

# APPENDIX A

# ILLUSTRATION STUDY ABOUT HIGH EFFICIENCY KILN BURNING

1 2 3

Figure 2.2 showing the variety of wood vinegar from high efficiency kiln burning
Bottle 1: Settled wood vinegar
Bottle 2: Haven't settled yet
Bottle 3: Had distilled already

ที่มา : สมาคมเทคโนโลยีที่เหมาะสม , 2546ง : 1

Figure 2.3 High efficiency kiln burning in each step and gathering wood vinegar from burned kiln.

Figure 2.3a Wood arrangement into the kiln

Figure 2.3b Wood arrangement into and ready to close the kiln

Figure 2.3c Closing the air passage of the kiln with mud soil

Figure 2.3d Lighting the kiln with fuel

Figure 2.3e Combusting processing of the kiln

Figure 2.3f Closing air passage for controlling the air in order to complete burning


Figure 2.3g closing the kiln in order to decrease temperature in the kiln

Figure 2.3h completed burning Processing

ที่มา : สมาคมเทคโนโลยีที่เหมาะสม : 2546ง , 1

# APPENDIX B
# SPECIALIST BIOGRAPHIES

| | |
|---|---|
| NAME | Mrs. Pussatee Mornshorn |
| POSITION | Assistance Professor |
| OFFICE | Faculty of Humanity and Social Science |
| | Mahidol University |
| EDUCATIONAL | Bachelor of Sociology |
| QUALIFICATION | Master of Occupational Health (M.O.H) |
| EXPERIENCE | Lecturer in Faculty of Humanity and Social Science |

| | |
|---|---|
| NAME | Mr. Charnchai Limpiyakorn |
| POSITION | a Director of Energetic Ashram |
| OFFICE | The Appropriate Technology Association |
| EDUCATIONAL | Bachelor of Engineering |
| QUALIFICATION | (Machinery) 1967 |
| | Chulalongkorn University |
| | M.S. Mechanical Engineering 2512 University of Kansas |
| EXPERIENCE | Lecturer in Faculty of Engineering, Chulalongkoen University (1971 – 1999) |
| | The Appropriate Technology Association Founder (1982 –till now) |
| | Science and Technology for Country Coordinator, the Office of Science and Technology Development, Ministry of Science (1987 till now) |

# APPENDIX C

# SPECIALIST ACKNOWLEDGEMENT AND ATTITUDE EVALUATION SUMMARY FORM

## 1. แบบสอบถามเกี่ยวกับลักษณะบุคคล

| เนื้อหาแบบสอบถามเกี่ยวกับลักษณะบุคคล | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. จำนวนสมาชิกในครัวเรือน | 1 | ✓ | | |
| 2. จำนวนสมาชิกในครัวเรือนที่มีอายุ 15-65 ปี | 2 | | ✓ | - ควรใช้การถามอายุจริง แล้วจึงจัดเป็นช่วงภายหลัง จะทำให้ง่ายต่อการวิเคราะห์<br>- เพิ่มเติม ชื่อ ที่อยู่ และเพศของผู้ให้ข้อมูล<br>- ปรับเป็น “ประเภทของการใช้ / ไม่ใช้เตาเผาถ่าน 200 ลิตร” |
| 3. อาชีพหลักของครัวเรือน | 3 | ✓ | | |
| 4. รายได้ของครัวเรือน | 4 | | ✓ | - ควรปรับเนื้อหาในตารางในแบบสอบถามให้ละเอียดตรงกัน |

## 2. แบบสอบถามเกี่ยวกับการรับรู้ข่าวสาร

| เนื้อหาแบบสอบถามเกี่ยวกับการรับรู้ข่าวสาร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. การรับรู้ข่าวสารเกี่ยวกับการวางแผนพลังงานระดับท้องถิ่น | 1 - 4 | | ✓ | - ควรมีระดับความถี่ในการรับรู้ข่าวสารเกี่ยวกับการวางแผนพลังงานระดับท้องถิ่น ให้เลือกตอบ<br>- ควรเรียงลำดับการใช้ประเภทของสื่อจากมากไปหาน้อยด้วย |
| 2. การรับรู้ข่าวสารเกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 5 - 8 | | ✓ | - ควรมีระดับความถี่ในการรับรู้ข่าวสารเกี่ยวกับโครงการเตาเผาถ่าน 200 ลิตร ให้เลือกตอบ<br>- ควรเรียงลำดับการใช้ประเภทของสื่อจากมากไปหาน้อยด้วย |

## 3. แบบวัดความรู้เรื่องเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

| เนื้อหาแบบวัดความรู้เรื่องเตาเผาถ่าน 200 ลิตร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. คุณลักษณะของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | | | | |
| 1.1 ลักษณะเด่นของเตาเผาถ่าน 200 ลิตร | 1,2 | | ✓ | - ควรตัดคำว่า"เท่านั้น" ออกจากประโยคในตัวเลือก (ง) ในข้อที่ 2 |
| 1.2 ขั้นตอนการติดตั้งเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 3,4 | | | - ควรเพิ่มรายละเอียดของขั้นตอนสั้นๆ ประกอบด้วย ในข้อที่ 3 |
| 1.3 ผลผลิตที่ได้จากเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 5 | ✓ | | |
| 1.4 ผลพลอยได้จากการเผาถ่านโดยใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 6 - 9 | | ✓ | - ปรับเป็น "การนำน้ำส้มควันไม้ไปใช้ด้านการเกษตรด้วยวิธีใด เป็นการช่วยเร่งการเจริญเติบโตของพืช" ในคำถามข้อที่ 8 |
| 1.5 วัตถุดิบที่ใช้ในการเผาถ่าน | 10 -12 | ✓ | | |
| 1.6 ประสิทธิภาพของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 13-16 | ✓ | | - ปรับเป็น"อายุการใช้งานของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ขึ้นอยู่กับปัจจัยใด" ในคำถามข้อที่ 14 |

| เนื้อหาแบบวัดความรู้เรื่องเตาเผาถ่าน 200 ลิตร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| **2.** การบำรุงรักษาและข้อควรระวัง | | | | |
| 2.1 การบำรุงรักษาตัวเตา | 17 | ✓ | | |
| 2.2 ข้อควรระวังในระหว่างการปฏิบัติงาน | 18 | ✓ | | |
| **3.** ผลกระทบที่เกิดขึ้นจากการเผาถ่าน | | | | |
| 3.1 ผลกระทบต่อสิ่งแวดล้อม | 19 | | ✓ | - ควรใช้คำว่า “ใน” แทนคำว่า “และ” |
| 3.2 ผลกระทบต่อชุมชน | 20,21 | | ✓ | - ควรใช้คำว่า “กลางวัน” แทนคำว่า “ช่วงเช้า” |
| **4.** แนวทางแก้ไขผลกระทบที่เกิดขึ้นจากการเผาถ่าน | 22,23 | | ✓ | - ควรใช้คำว่า “ป้องกัน” แทนคำว่า “แก้ไข” และ ควรใช้คำว่า “มิให้” แทนคำว่า “เมื่อ” ในคำถามข้อที่ 23 |

**4. แบบวัดทัศนคติต่อการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร**

| เนื้อหาแบบวัดทัศนคติต่อการใช้เตาเผาถ่าน 200 ลิตร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. ทัศนคติด้านความสะดวก | | | | |
| 1.1 ด้านการใช้แรงงานน้อย | 1 | ✓ | | |
| 1.2 การลดการสูญเสียเวลาในการเผา | 2 | ✓ | | |
| 1.3 การแก้ปัญหาสถานที่การติดตั้งเตา | 3 | ✓ | | |
| 1.4 ความรวดเร็วในกรรมวิธีการติดตั้งเตา | 4 | ✓ | | |
| 2. ทัศนคติด้านเศรษฐกิจ | | | | |
| 2.1 ด้านราคาอุปกรณ์ที่ใช้ในการประกอบเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 5,6 | ✓ | | |
| 2.2 จุดคุ้มทุนจากการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 7,8 | ✓ | | |
| 3. ทัศนคติด้านสุขภาพ | 9 | | ✓ | - ควรขยายความให้ชัดเจน เพื่อให้เกิดความเข้าใจ |
| 4. ทัศนคติด้านผลผลิต | 10 -13 | ✓ | | |

| เนื้อหาแบบวัดทัศนคติต่อการใช้เตาเผาถ่าน 200 ลิตร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 5. ทัศนคติด้านความปลอดภัย | | | | |
| 5.1 อุบัติเหตุจากการติดตั้งเตา | 14 | | ✓ | - ควรอธิบายลักษณะการเกิดอุบัติเหตุให้ชัดเจน เพื่อให้เกิดความเข้าใจ |
| 5.2 ด้านวัตถุดิบที่ใช้ในการเผา | 15 | | ✓ | - ปรับเป็น “ด้านวัสดุอุปกรณ์ในการประกอบเตา” และ “การใช้วัสดุอุปกรณ์ตามกำหนด จะทำให้ได้เตาที่ได้มาตรฐานและปลอดภัยต่อการใช้” |
| 6. ทัศนคติด้านสิ่งแวดล้อม | | | | |
| 6.1 ควันที่เกิดขึ้นจากการเผาถ่าน | 16,17 | ✓ | | |
| 6.2 การอนุรักษ์ทรัพยากรป่าไม้ | 18,19 | | ✓ | - ปรับเป็น “เตาเผาถ่าน 200 ลิตร ใช้ไม้ที่มีขนาดเล็กหรือไม้จากการตัดแต่งกิ่งไม้ จึงน่าจะช่วยลดการตัดต้นไม้ที่มีขนาดใหญ่ได้” ในคำถามข้อที่ 18 |

| เนื้อหาแบบวัดทัศนคติต่อการใช้เตาเผาถ่าน 200 ลิตร | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 7. ทัศนคติด้านค่านิยม | | | | |
| 7.1 การมีส่วนร่วมอนุรักษ์ทรัพยากรป่าไม้ | 20 | | ✓ | - ปรับเป็น “ควรสนับสนุนคนให้ใช้เตาเผาถ่าน 200 ลิตรมากกว่าการใช้เตาเผาถ่านประเภทอื่น” |
| 7.2 การเสริมสร้างนิสัยประหยัดมัธยัสถ์ | 21 | ✓ | | |
| 7.3 การเป็นผู้นำหรือเป็นคนดีที่อนุรักษ์ชุมชนของตนเอง | 22 -24 | | ✓ | - ปรับเป็น “ปัญหาการใช้ทรัพยากรป่าไม้ที่เกิดขึ้นในชนบทเป็นปัญหาที่หน่วยงานของรัฐเท่านั้นที่ต้องรับผิดชอบและดำเนินการแก้ไข” ในประโยคคำถามข้อที่ 23 |

## 5. แบบวัดการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ของประชาชน

| เนื้อหาแบบวัดการยอมรับการใช้เตาเผาถ่าน 200 ลิตรของประชาชน | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. ขั้นความรู้ | | | | |
| 1.1 วิธีการติดตั้งเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร อย่างถูกต้อง | 1-5 | ✓ | | |
| 1.2 ประโยชน์ของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 6 | ✓ | | |
| 2. ขั้นจูงใจ | | | | |
| 2.1 ในแง่ของต้นทุนการผลิตและจุดคุ้มทุน | 7 | ✓ | | |
| 2.2 ลดปัญหาการใช้ทรัพยากรป่าไม้ | 8 | ✓ | | |
| 2.3 อายุการใช้งาน | 9 | ✓ | | |
| 2.4 พื้นที่การติดตั้งเตา | 10 | ✓ | | |
| 2.5 ผลพลอยได้จากการเผาถ่าน | 11,12 | ✓ | | |
| 2.6 ความปลอดภัยเนื่องจากการปฏิบัติและใช้งานเตา | 13,14 | ✓ | | |

| เนื้อหาแบบวัดการยอมรับการใช้เตาเผาถ่าน 200ลิตรของประชาชน | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 3. ขั้นการตัดสินใจ | | | | |
| 3.1 การซื้ออุปกรณ์เพื่อติดตั้งเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 15 | ✓ | | |
| 3.2 การใช้เตาเผาถ่านประสิทะภาพสูง ขนาด 200 ลิตร ในครัวเรือน | 16 | ✓ | | |
| 3.3 การตัดสินใจใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตรอย่างต่อเนื่องในชุมชน | 17,18 19 | ✓ | | |
| 4. ขั้นการนำไปใช้ | | | | |
| 4.1 ผลของการใช้เตาเผาถ่าน 200 ลิตร ด้านความสะดวกในการติดตั้งเตา | 20 | ✓ | | |
| 4.2 ผลของการใช้เตาเผาถ่าน 200 ลิตร ด้านความรวดเร็วในกรรมวิธีการผลิตถ่าน | 21 | ✓ | | |
| 4.3 ผลของการใช้เตาเผาถ่าน 200 ลิตรด้านผลพลอยได้จากการเผาถ่าน | 22 | | ✓ | - ปรับเป็น “การใช้เตาเผาถ่าน 200 ลิตร จะได้ผลผลิตถ่านและน้ำส้มควันไม้ซึ่งเป็นผลพลอยได้ที่สามารถใช้ประโยชน์ในการใช้เป็นสารเร่งการเจริญเติบโตของพืช เป็นอาหารเสริมสำหรับสัตว์เลี้ยง เป็นต้น” |

| เนื้อหาแบบวัดการยอมรับการใช้เตาเผาถ่าน 200 ลิตรของประชาชน | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 4.4 อุปสรรคในการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 23 | ✓ | | |
| 4.5 อุบัติเหตุจากการติดตั้งเตาและระหว่างการปฏิบัติงาน | 24,25 | | ✓ | - ควรตัดคำว่า “ร้ายแรง” ออกจากประโยคคำถามข้อ 25<br>ปรับเป็น “ผู้ที่มีความรู้และทักษะในทุกขั้นตอนของการติดตั้งเตาเผาถ่าน 200 ลิตร จะทำให้ไม่เกิดอุบัติเหตุแก่ผู้ติดตั้ง” ในข้อ 26 |
| 4.6 ผลทางด้านปริมาณทรัพยากรป่าไม้ในชุมชน | 26,27 | ✓ | | |
| 5. ขั้นยืนยันการใช้ | | | | |
| 5.1 การตระหนักถึงคุณประโยชน์ของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 28,30<br>31 | ✓ | | |
| 5.2 การแนะนำหรือชักชวนให้ผู้อื่นใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | 29,32 | ✓ | | |

## 6. ปัญหาอุปสรรค และข้อเสนอแนะในการยอมรับเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ของประชาชน

| เนื้อหาแบบสอบถามปัญหาอุปสรรคและข้อเสนอแนะในการยอมรับ | ข้อที่ | เหมาะสม | ปรับปรุง | ข้อเสนอแนะเพื่อการปรับปรุงแก้ไข |
|---|---|---|---|---|
| 1. ปัญหาและอุปสรรคที่ทำให้ประชาชนไม่ยอมรับการใช้เตาเผาถ่าน 200 ลิตร | 1 | ✓ | | |
| 2. ข้อเสนอแนะที่จะจูงใจให้ประชาชนเปลี่ยนทัศนคติและยอมรับการใช้เตาเผาถ่าน 200 ลิตร | 2 | | ✓ | - ควรเพิ่มเติมข้อคำถามเปรียบเทียบสำหรับผู้ที่เคยใช้เตาเผาถ่านแบบเดิมกับเตาเผาถ่าน 200 ลิตร ว่ามีจุดใดบ้างที่ยอมรับเตาเผาถ่าน 200 ลิตร แทน |

# APPENDIX D
# THE INFORMATION SURVEY FIELDWORK

**แบบสอบถามเรื่อง การยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ของประชาชนในพื้นที่ภาคตะวันออกเฉียงเหนือ**

**คำชี้แจง** แบบสอบถามฉบับนี้ มีทั้งสิ้น 6 ตอน กรุณาตอบให้ครบทุกข้อ ผู้วิจัยจะใช้ข้อมูลของท่านเพื่อการศึกษาเท่านั้น โดยจะเก็บข้อมูลส่วนบุคคลของท่านไว้เป็นความลับ

| | | |
|---|---|---|
| ตอนที่ 1 | แบบสอบถามเกี่ยวกับลักษณะส่วนบุคคล | จำนวน 4 ข้อ |
| ตอนที่ 2 | แบบสอบถามการรับรู้ข่าวสารด้านการวางแผนพลังงานระดับท้องถิ่นและโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | จำนวน 8 ข้อ |
| ตอนที่ 3 | แบบวัดความรู้เรื่องเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | จำนวน 23 ข้อ |
| ตอนที่ 4 | แบบวัดทัศนคติต่อการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร | จำนวน 24 ข้อ |
| ตอนที่ 5 | การยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตรของประชาชน | จำนวน 32 ข้อ |
| ตอนที่ 6 | ปัญหาอุปสรรค และข้อเสนอแนะในการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ของประชาชน | จำนวน 4 ข้อ |

ขอขอบพระคุณทุกท่านอย่างสูงที่ให้ความร่วมมือตอบแบบสอบถามในการวิจัยครั้งนี้

ขอแสดงความนับถือ

( นางสาวปวรวรรณ สายพันธุ์ )
นักศึกษาสาขาการวางแผนสิ่งแวดล้อมเพื่อพัฒนาชุมชนและชนบท
คณะสิ่งแวดล้อมและทรัพยากรศาสตร์
มหาวิทยาลัยมหิดล

## ตอนที่ 1 ข้อมูลส่วนบุคคล

<u>คำชี้แจง</u> กรุณาเติมข้อความลงในช่องว่างที่เว้นไว้ให้ หรือทำเครื่องหมาย ✓ ในช่อง ( ) ที่ท่านพิจารณาแล้วว่าตรงกับข้อมูลจริงหรือความคิดของท่านมากที่สุด

ผู้ให้ข้อมูล……..……..อายุ……..ปี

เพศ……..……

ที่อยู่……..……

1. ในครอบครัวของท่านมีสมาชิกทั้งหมด……คน ( รวมทั้งตัวท่านเองด้วย )

| ความสัมพันธ์กับหัวหน้าครัวเรือน | อายุ (ปี) | เพศ | | สถานภาพสมรส | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ชาย | หญิง | โสด | สมรส | หย่าร้าง | ม่าย | อื่นๆ |
| | | | | | | | | |
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| | | | | | | | | |

2. ปัจจุบันครอบครัวของท่านมีการใช้งานเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร หรือไม่

( ) ใช้ ( ) ไม่ใช้

3. ปัจจุบันท่านประกอบอาชีพหลัก

( ) เกษตรกรรม ( ) รับราชการ

( ) ค้าขาย / ธุรกิจส่วนตัว ( ) รัฐวิสาหกิจ

( ) รับจ้างทั่วไป ( ) ทำงานบริษัทเอกชน

( ) แม่บ้าน / พ่อบ้าน ( ) อื่นๆ โปรดระบุ……

4. รายได้หักค่าลงทุนของท่านและสมาชิกในครอบครัว

<table>
<tr><th>ประเภทของอาชีพ</th><th>รายละเอียดของอาชีพ</th></tr>
<tr><td><u>อาชีพเกษตรกรรม</u></td><td>ครอบครัวท่านทำการเพาะปลูกหรือไม่ ( ) ปลูก ( ) ไม่ปลูก<br>ชนิดพืชที่ปลูก……..
<table>
<tr><th>รายละเอียด/ชนิดพืชที่ปลูก</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>พื้นที่เพาะปลูก(ไร่)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>จำนวนครั้งที่ทำต่อปี</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่าเตรียมพื้นที่</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่าเมล็ดพันธุ์</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่าปุ๋ย</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่ายาฆ่าแมลง</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>อื่นๆ……</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รวมลงทุน</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ผลผลิตรวมต่อปี</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ราคาต่อหน่วย</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รวมเป็นเงิน</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รวมรายได้หักค่าใช้จ่าย / ปี</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td><u>อาชีพเลี้ยงสัตว์</u></td><td>ครอบครัวของท่านเลี้ยงสัตว์หรือไม่ ( ) เลี้ยง ( ) ไม่เลี้ยง
<table>
<tr><th rowspan="2">ประเภทของสัตว์ที่เลี้ยง</th><th colspan="6">จำนวนตัว</th></tr>
<tr><th>วัว</th><th>ควาย</th><th>เป็ด</th><th>ไก่</th><th>หมู</th><th>อื่นๆ</th></tr>
<tr><td>เลี้ยงเพื่อขาย</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>เลี้ยงเพื่อบริโภค</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่าใช้จ่ายต่อปี(บาท)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รายได้จากการขาย</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ให้เช่า (บาท)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รายได้สุทธิต่อปี</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
</table>

<table>
<tr><th>ประเภทของอาชีพ</th><th>รายละเอียดของอาชีพ</th></tr>
<tr><td><u>อาชีพประมง</u><br><br>( ) ไม่ได้ประกอบอาชีพประมง</td><td>ในเวลา 1 ปี ท่านจับปลา.....เดือน เดือนที่จับปลา ( ระบุ )……..<br>ใน 1 เดือนท่านจับปลา.....วัน<br>ใน 1 วันท่านจับปลาได้เฉลี่ย.....กิโลกรัม<br>ราคาโดยประมาณของปลาที่ท่านจับได้เฉลี่ยกิโลกรัมละ.....บาท<br>ค่าใช้จ่ายในการจับปลาโดยเฉลี่ย.....บาท/ปี<br>รวมรายได้สุทธิจากอาชีพประมง.....บาท/ปี</td></tr>
<tr><td><u>อาชีพรับราชการ</u><br><br>( ) มี.....คน ( ) ไม่มี</td><td><table><tr><th>รายละเอียด/บุคคลที่</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr><tr><td>รายได้ต่อเดือน</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>ค่าล่วงเวลา</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>รวมรายได้ (บาท/ปี)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td><u>อาชีพค้าขาย</u><br><br>( ) ไม่ประกอบอาชีพนี้</td><td>ท่านขายได้วันละ.....บาท (รวมต้นทุน)<br>ใน 1 ปี ท่านขาย.....เดือน ใน 1 เดือน ท่านขาย.....วัน<br>รวมขายได้.....บาท/เดือน ค่าลงทุนต่อวัน.....บาท<br>รวมรายได้สุทธิจากการค้าขาย.....บาท/ปี</td></tr>
<tr><td><u>อาชีพธุรกิจส่วนตัว</u><br><br>( ) ไม่มี ( ) มี</td><td>ระบุประเภทของธุรกิจ.....<br>รายได้จากการประกอบอาชีพต่อวัน.....บาท<br>ใน 1 เดือน ทำงาน.....วัน ใน 1 ปี ทำงาน.....เดือน<br>รายได้รวมต่อปี .....บาท/ปี<br>รายจ่ายรวมต่อปี .....บาท/ปี<br>รายได้สุทธิ .....บาท</td></tr>
<tr><td><u>อาชีพรัฐวิสาหกิจ</u><br><br>( ) มี.....คน<br>( ) ไม่ประกอบอาชีพนี้</td><td>ระบุประเภทของรัฐวิสาหกิจ.....<table><tr><th>รายละเอียด/บุคคลที่</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr><tr><td>รายได้ต่อเดือน</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>ค่าล่วงเวลา</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>รวมรายได้ (บาท/ปี)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
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<table>
<tr><th>ประเภทของอาชีพ</th><th>รายละเอียดของอาชีพ</th></tr>
<tr><td><u>อาชีพรับจ้าง</u><br>สมาชิกในครัวเรือนของท่านประกอบอาชีพรับจ้างแรงงานหรือไม่<br>( ) มี ( ) ไม่มี</td><td>
<table>
<tr><th>รายละเอียด/บุคคลที่</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>เวลาทำงาน (เดือน/ปี)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>เวลาทำงาน (วัน/เดือน)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รายได้วันละ (บาท/วัน)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รายจ่ายในการทำงาน(บาท/วัน)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รวมรายได้สุทธิ (บาท/ปี)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td><u>อาชีพทำงานบริษัทเอกชน</u><br>( ) มี……..คน ( ) ไม่มี</td><td>
<table>
<tr><th>รายละเอียด/บุคคลที่</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>รายได้ต่อเดือน</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ค่าล่วงเวลา</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>รวมรายได้ (บาท/ปี)</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
<br>รายได้รวมทั้งหมดของครัวเรือน……บาท/ปี
</td></tr>
</table>

รวมรายได้หักค่าลงทุน……บาท / เดือน

## ตอนที่ 2 การรับรู้ข่าวสาร

<u>คำชี้แจง</u> กรุณาทำเครื่องหมาย ✓ ในช่อง ( ) ที่ท่านพิจารณาแล้วว่าตรงกับข้อมูลจริงของท่านมากที่สุด หรือเติมคำตอบลงในช่องว่างที่เว้นไว้ให้

2.1 <u>การรับรู้ข่าวสารเกี่ยวกับการวางแผนพลังงานระดับท้องถิ่น</u>

1. ท่านเคยได้รับข่าวสารต่างๆ เกี่ยวกับการวางแผนพลังงานระดับท้องถิ่น หรือไม่

( ) เคย

( ) ไม่เคย ( ข้ามไปตอบข้อ 4 )

2. ท่านได้รับข่าวสารต่างๆเกี่ยวกับการวางแผนพลังงานระดับท้องถิ่น กี่ครั้งต่อสัปดาห์

( ) 1 – 3 ครั้ง/สัปดาห์ ( ) 4 – 6 ครั้ง/สัปดาห์

( ) มากกว่า6 ครั้ง/สัปดาห์ ( ) ไม่เคยได้รับข่าวสาร

3. ประเภทสื่อที่ท่านได้รับข่าวสาร และจัดอันดับการใช้ประเภทสื่อจากมากไปหาน้อย 1 ถึง 5

( ) โทรทัศน์ ( ) วิทยุ

( ) หนังสือพิมพ์ ( ) นิตยสาร / วารสาร

( ) ป้ายโฆษณา ( ) เอกสารเผยแพร่

( ) เจ้าหน้าที่ของรัฐ / อบต. / รัฐวิสาหกิจ ( ) ญาติพี่น้อง / บุตรหลาน

( ) เพื่อน / เพื่อนบ้าน / เพื่อนร่วมงาน ( ) อื่นๆ โปรด

ระบุ……..

4. ท่านต้องการได้รับข่าวสารเกี่ยวกับการวางแผนพลังงานระดับท้องถิ่นเพิ่มเติมหรือไม่

( ) ต้องการ ( ) ไม่ต้องการ

กรณีที่ท่านต้องการ ท่านต้องการได้รับข่าวสารเพิ่มเติมในเรื่อง

……..วิธีการในการวางแผนพลังงานระดับท้องถิ่น

……..ประโยชน์ที่ได้รับจากการวางแผนพลังงานระดับท้องถิ่น

……...ผลดี ผลเสียที่เกิดขึ้นจากการวางแผนพลังงานระดับท้องถิ่น

……...หน่วยงานที่สามารถให้ข้อมูลด้านการวางแผนพลังงานระดับท้องถิ่น

……...อื่นๆ โปรดระบุ……..……...……

……..

……...……..

2.2 <u>การรับรู้ข่าวสารเกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร</u>

5. ท่านเคยได้รับข่าวสารต่างๆ เกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร หรือไม่

( ) เคย

( ) ไม่เคย ( ข้ามไปตอบข้อ 8 )

6. ท่านได้รับข่าวสารต่างๆ เกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร กี่ครั้งต่อสัปดาห์

( ) 1 – 3 ครั้ง/สัปดาห์ ( ) 4 – 6 ครั้ง/สัปดาห์

( ) มากกว่า6 ครั้ง/สัปดาห์ ( ) ไม่เคยได้รับข่าวสาร

7. ท่านได้รับข่าวสารต่างๆ เกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร จากสื่อชนิดใด และจัดอันดับการใช้ประเภทสื่อจากมากไปหาน้อย 1 ถึง 5

( ) วิทยุ ( ) หนังสือพิมพ์

( ) นิตยาสาร / วารสาร ( ) เอกสารเผยแพร่

( ) เจ้าหน้าที่ของรัฐ / อบต. / รัฐวิสาหกิจ ( ) ญาติพี่น้อง / บุตรหลาน

( ) เพื่อน / เพื่อนบ้าน / เพื่อนร่วมงาน ( ) อื่นๆ โปรดระบุ……..

8. ท่านต้องการได้รับข่าวสารเกี่ยวกับโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร เพิ่มเติมหรือไม่

( ) ต้องการ ( ) ไม่ต้องการ

กรณีที่ท่านต้องการ ท่านต้องการได้รับข่าวสารเพิ่มเติมในเรื่อง

……..วิธีการที่ได้มาซึ่งเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ในโครงการ

……..ผลดี ผลเสียที่เกิดขึ้นจากโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

……...ประโยชน์ที่ได้รับจากโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

……...หน่วยงานที่สามารถให้ข้อมูลด้านโครงการเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

……...อื่นๆ โปรดระบุ……...……

……..

……..

**ตอนที่ 3 แบบวัดความรู้เรื่องเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร**

<u>คำชี้แจง</u> กรุณาทำเครื่องหมาย ✓ ในช่อง ( ) หน้าคำตอบที่ถูกต้องที่สุดเพียงข้อเดียว

1. คุณลักษณะใดต่อไปนี้เป็นลักษณะเด่นของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

( ) ใช้เวลาในการเผาถ่านประมาณ 3 – 5 วัน

( ) การลงทุนสูง เหมาะกับการใช้งานในครัวเรือน

( ) ถ่านที่ได้มีคุณภาพสูง เพราะมีปริมาณน้ำมันดินน้อย

( ) ใช้ต้นไม้ที่มีขนาดใหญ่ในการเผาถ่าน

**ตอบถูก จำนวน 128 คน ร้อยละ 83.1**

**ตอบผิด จำนวน 26 คน ร้อยละ 16.9**

2. คุณลักษณะเด่นด้านกรรมวิธีการผลิตเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร คือ คุณลักษณะในข้อใด

( ) อายุการใช้งานของเตาเผาถ่านประมาณ 1 ปี

( ) ควบคุมอากาศในการเผาไหม้ได้ตามต้องการ

( ) ใช้แรงงาน 3 – 5 คน ในกระบวนการเผา

( ) มีขี้เถ้าจากการเผาถ่านในปริมาณมาก

**ตอบถูก จำนวน 114 คน ร้อยละ 74.0**

**ตอบผิด จำนวน 40 คน ร้อยละ 26.0**

3. ขั้นตอนในการเผาถ่านด้วยเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร นั้น ประกอบไปด้วยขั้นตอนการเผาถ่านกี่ขั้นตอน

( ) 1 ขั้นตอน ได้แก่ ช่วงไม้เริ่มกลายเป็นถ่าน

( ) 2 ขั้นตอน ได้แก่ ช่วงไล่ความชื้น และช่วงทำให้ถ่านบริสุทธิ์

( ) 3 ขั้นตอน ได้แก่ ช่วงไม้เริ่มกลายเป็นถ่าน ช่วงทำให้ถ่านบริสุทธิ์ และช่วงทำให้ถ่านในเตาเย็นลง

( ) 4 ขั้นตอน ได้แก่ ช่วงไล่ความชื้น ช่วงไม้เริ่มกลายเป็นถ่าน ช่วงทำให้ถ่านบริสุทธิ์ และช่วงการทำให้ถ่านในเตาเย็นลง

**ตอบถูก จำนวน 134 คน ร้อยละ 87.0**

**ตอบผิด จำนวน 20 คน ร้อยละ 13.0**

4. ขั้นตอนใดในการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตร ที่จะต้องให้ความสำคัญและมีความชำนาญเป็นพิเศษ

( ) ช่วงไล่ความชื้น

( ) ช่วงไม้เริ่มกลายเป็นถ่าน

( ) ช่วงทำให้ถ่านบริสุทธิ์

( ) ช่วงการทำให้ถ่านในเตาเย็นลง

**ตอบถูก จำนวน 73 คน ร้อยละ 47.4**

**ตอบผิด จำนวน 81 คน ร้อยละ 52.6**

5. ข้อใดคือคุณสมบัติของผลผลิตที่ได้จากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตร

( ) ถ่านที่ได้มีคุณภาพเหมือนกับถ่านที่ได้จากเตาดินแบบโดม

( ) ได้ปริมาณผลผลิตถ่านประมาณ 10 – 15 %

( ) ได้ถ่านเป็นผลิตภัณฑ์ที่ได้จากการเผาเพียงอย่างเดียว

( ) ถ่านที่ได้มีปริมาณน้ำมันดิน ( ทาร์ ) น้อย

**ตอบถูก จำนวน 118 คน ร้อยละ 76.6**

**ตอบผิด จำนวน 36 คน ร้อยละ 23.4**

6. ผลิตภัณฑ์ที่สามารถนำไปใช้ประโยชน์ได้ นอกเหนือจากถ่านที่ได้จากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตร คือ ผลิตภัณฑ์ใด

( ) น้ำมันดิน ( ) ขี้เถ้า

( ) น้ำส้มควันไม้ ( ) สารระเหยง่าย

**ตอบถูก จำนวน 151 คน ร้อยละ 98.1**

**ตอบผิด จำนวน 3 คน ร้อยละ 1.9**

7. ข้อใดคือวิธีการที่ทำให้น้ำส้มควันไม้บริสุทธิ์เพื่อการนำไปใช้ประโยชน์ในด้านต่างๆ

( ) การตั้งทิ้งไว้ 5 – 10 นาที

( ) การปล่อยให้ตกตะกอน การกรอง และการกลั่น

( ) การต้มให้เดือด 5 – 10 นาที

( ) การแกว่งด้วยสารส้ม

**ตอบถูก จำนวน 140 คน ร้อยละ 90.9**

**ตอบผิด จำนวน 14 คน ร้อยละ 9.1**

8. การนำน้ำส้มควันไม้ไปใช้ด้านการเกษตรด้วยวิธีใด เป็นการช่วยเร่งการเจริญเติบโตของพืช

( ) การใช้น้ำส้มควันไม้ฉีดพ่นที่ใบของพืช

( ) การใช้น้ำส้มควันไม้รดตามลำต้นของพืช

( ) การใช้น้ำส้มควันไม้ฉีดพ่นที่ผลและดอกของพืช

( ) การใช้น้ำส้มควันไม้ราดในดินที่ปลูกพืช

**ตอบถูก จำนวน 67 คน ร้อยละ 43.5**

**ตอบผิด จำนวน 87 คน ร้อยละ 56.5**

9. การใช้ประโยชน์จากน้ำส้มควันไม้ นอกจากด้านการเกษตร ปศุสัตว์และอุตสาหกรรมแล้ว ยังสามารถใช้ประโยชน์ในด้านใดได้อีก

( ) ใช้ทารักษาผด ผื่นคันตามร่างกาย

( ) การดักเก็บน้ำส้มควันไม้เพื่อไปจำหน่าย สร้างรายได้ให้แก่ครอบครัว

( ) นำไปผสมน้ำให้เจือจางเพื่อใช้ในการซักล้างแทนผงซักฟอก

( ) ช่วยในการฟักไข่ของแมลงในมูลสัตว์ ทำให้ปริมาณของแมลงในบริเวณฟาร์มเพิ่มขึ้น

**ตอบถูก จำนวน 99 คน ร้อยละ 64.3**

**ตอบผิด จำนวน 55 คน ร้อยละ 35.7**

10. ไม้ฟืนที่จะนำมาเป็นวัตถุดิบที่จะเผาถ่าน ควรจะเป็นไม้โตเร็ว เพราะเหตุใด

( ) มีขนาดความโตของไม้มากกว่า 2 นิ้ว

( ) เป็นไม้สดที่มีความชื้นสูง

( ) เมื่อตัดแล้ว สามารถแตกกิ่งก้านได้ดี

( ) ลำต้นสั้น เตี้ย ง่ายในการตัด

**ตอบถูก จำนวน 102 คน ร้อยละ 66.2**

**ตอบผิด จำนวน 52 คน ร้อยละ 33.8**

11. ลักษณะไม้ที่จะนำมาเผาถ่าน ควรมีลักษณะใดเป็นสำคัญ

( ) ขนาดความโตไม่ควรเกิน 2 นิ้ว และเป็นไม้สดที่เพิ่งตัดใหม่

( ) ขนาดความโตไม่ควรเกิน 2 นิ้ว และผึ่งแดดให้หมาด

( ) ขนาดความโตมากกว่า 2 นิ้ว และเป็นไม้สดที่เพิ่งตัดใหม่

( ) ขนาดความโตมากกว่า 2 นิ้ว และผึ่งแดดให้หมาด

**ตอบถูก จำนวน 96 คน ร้อยละ 62.3**

**ตอบผิด จำนวน 58 คน ร้อยละ 37.7**

12. เชื้อเพลิงที่จะนำไปจุดเตา ควรเป็นเชื้อเพลิงประเภทใด

( ) เศษไม้ เศษหญ้า ( ) โฟม

( ) พลาสติก ( ) วัสดุอื่นๆ ที่มีส่วนประกอบของสารสังเคราะห์

**ตอบถูก จำนวน 153 คน ร้อยละ 99.4**

**ตอบผิด จำนวน 1 คน ร้อยละ 0.6**

13. เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร มีอายุการใช้งานเฉลี่ยเท่าไร

( ) 6 เดือน – 1 ปี ( ) 2 – 3 ปี

( ) 1 – 2 ปี ( ) 5 ปี

**ตอบถูก จำนวน 83 คน ร้อยละ 53.9**

**ตอบผิด จำนวน 71 คน ร้อยละ 46.1**

14. อายุการใช้งานของเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ขึ้นอยู่กับปัจจัยใด

( ) ขนาดความกว้างของเตา

( ) ปริมาณไม้ที่นำมาเผา

( ) เชื้อเพลิงหน้าเตาที่นำมาใช้

( ) ความถี่ในการใช้งาน

**ตอบถูก จำนวน 18 คน ร้อยละ 11.7**

**ตอบผิด จำนวน 136 คน ร้อยละ 88.3**

15. ท่านทราบหรือไม่ว่าถ่านที่นำไปใช้งานในการปิ้ง ย่าง แล้วไม่เป็นอันตรายต่อผู้บริโภคนั้น มีคุณลักษณะอย่างไร

( ) การเกิดเถ้าน้อย คาร์บอนในถ่านสูงและมีปริมาณน้ำมันดินต่ำ

( ) การเกิดเถ้าน้อย คาร์บอนในถ่านต่ำและมีปริมาณน้ำมันดินต่ำ

( ) การเกิดเถ้าน้อย คาร์บอนในถ่านสูงและมีปริมาณน้ำมันดินสูง

( ) การเกิดเถ้ามาก คาร์บอนในถ่านต่ำและมีปริมาณน้ำมันดินต่ำ

**ตอบถูก จำนวน 94 คน ร้อยละ 61.0**

**ตอบผิด จำนวน 60 คน ร้อยละ 39.0**

16. สารก่อมะเร็งที่ปนมากับถ่านที่ได้จากการเผาถ่าน หมายถึงข้อใด

( ) ขี้เถ้า ( ) น้ำส้มควันไม้

( ) โวลาไทล์ ( สารระเหยง่าย ) ( ) ทาร์ ( น้ำมันดิน )

**ตอบถูก จำนวน 121 คน ร้อยละ 78.6**

**ตอบผิด จำนวน 33 คน ร้อยละ 21.4**

17. บุคคลในข้อใดต่อไปนี้ที่มีการบำรุงรักษาตัวเตาได้อย่างถูกต้อง

( ) สมชายใช้น้ำฉีดล้างตัวเตาตลอดการใช้งาน

( ) สมยงปล่อยให้น้ำมันดินเกาะแข็งอยู่ผนังด้านในเตาและท่อปล่องควัน

( ) สมจิตใช้น้ำรดผนังเตาขณะที่เตาร้อนจัด

( ) สมบูรณ์เอาเสียมเซาะน้ำมันดินที่เกาะแข็งอยู่ผนังด้านในเตาและท่อปล่องควัน

**ตอบถูก จำนวน 134 คน ร้อยละ 87.0**

**ตอบผิด จำนวน 20 คน ร้อยละ 13.0**

18. การปฏิบัติในข้อใดที่ปฏิบัติได้ถูกต้อง

( ) ควรใส่เชื้อเพลิงหน้าเตามากเพราะจะทำให้ไม้ด้านหน้าเตากลายเป็นขี้เถ้าก่อน

( ) การสังเกตสีของควันที่ปล่อง ให้มองในตำแหน่งที่ย้อนแสงหรือไม่ย้อนแสงก็ได้

ไม่มีผลทำให้การมองเห็นสีได้ แตกต่างกัน

( ) ผู้ใช้สามารถสัมผัสตัวเตาได้ตลอดเวลาที่ทำการเผา เพราะอุณหภูมิไม่สูงมาก

( ) พยายามหลีกเลี่ยงการสูดดมควันในขณะที่ทำการเผาถ่าน

**ตอบถูก จำนวน 112 คน ร้อยละ 72.7**

**ตอบผิด จำนวน 42 คน ร้อยละ 27.3**

19. ข้อใดต่อไปนี้เป็นผลกระทบต่อสิ่งแวดล้อมในชุมชนที่เกิดขึ้นจากการเผาถ่าน

( ) เศษวัสดุที่เหลือจากการประกอบเตา ทำให้ปริมาณขยะในชุมชนเพิ่มขึ้น

( ) ควันที่เกิดจากการเผาถ่าน ทำให้รบกวนผู้อยู่อาศัยภายในบ้านและชุมชนใกล้เคียง

( ) ขี้เถ้าที่เกิดขึ้นจากการเผาถ่าน ทำให้ปริมาณฝุ่นละอองในชุมชนเพิ่มขึ้น

( ) ระยะเวลาในการคืนทุนนานเกินไป ไม่คุ้มค่าต่อการลงทุน

**ตอบถูก จำนวน 144 คน ร้อยละ 93.5**

**ตอบผิด จำนวน 10 คน ร้อยละ 6.5**

20. ท่านทราบหรือไม่ว่า ควรทำการติดตั้งเตาเผาถ่านให้ห่างจากชุมชนหรือบ้านเรือนใกล้เคียงเป็นระยะประมาณเท่าใด

( ) 10 เมตร ( ) 50 เมตร

( ) 30 เมตร ( ) เท่าใดก็ได้

**ตอบถูก จำนวน 116 คน ร้อยละ 75.3**

**ตอบผิด จำนวน 38 คน ร้อยละ 24.7**

21. เหตุผลในข้อใดถูกต้องที่สุดในการเลือกเวลาในการเผาถ่านเป็นช่วงกลางวัน

( ) ควันจะลอยตัวขึ้นข้างบน ไม่รบกวนผู้อยู่อาศัยภายในบ้านและบริเวณใกล้เคียง

( ) เป็นช่วงเวลาที่อากาศไม่ร้อนและไม่ค่อยมีแดด ทำให้รู้สึกสบายในการปฏิบัติงาน

( ) ช่วงกลางวันเป็นช่วงที่มีลมโกรก ช่วยทำให้อากาศเข้าไปในเตาได้มากขึ้น

( ) เวลาช่วงกลางวันเป็นช่วงเวลาที่ไม่มีผู้รบกวนระหว่างการปฏิบัติงาน

**ตอบถูก จำนวน 117 คน ร้อยละ 76.0**

**ตอบผิด จำนวน 37 คน ร้อยละ 24.0**

22. ถ้าหากพบปัญหาถ่านลุกเป็นไฟอีกครั้งเมื่อเปิดเตาเพื่อที่จะเก็บถ่าน วิธีการแก้ไขปัญหาที่เหมาะสมได้แก่ข้อใด

( ) ใช้น้ำเย็นราด เพื่อดับไฟที่ลุก แล้วจึงทำการเก็บถ่านต่อได้

( ) นำดินทรายกลบทับ เมื่อไฟดับแล้วจึงทำการเก็บถ่านได้

( ) ทำการเผาถ่านซ้ำอีกครั้ง แล้วจึงทำการเก็บถ่าน

( ) ปล่อยให้ถ่านเย็นและดับสนิทก่อน จึงทำการเก็บถ่านได้

**ตอบถูก จำนวน 98 คน ร้อยละ 63.6**

**ตอบผิด จำนวน 56 คน ร้อยละ 36.4**

23. วิธีการใดเป็นวิธีการป้องกันปัญหาที่ดีที่สุด มิให้ควันที่เกิดขึ้นจากการเผาถ่านนั้นถูกร่างกายและเสื้อผ้า

( ) หลีกเลี่ยงการอยู่ใกล้และสัมผัสควันโดยตรง

( ) อยู่ห่างจากเตาเผาถ่านประมาณ 10 เมตรก็พอ ในระหว่างการทำการเผาถ่าน

( ) ทำการเผาถ่านในช่วงเย็น เพราะควันจะลอยตัวขึ้นข้างบน

( ) ใช้แผ่นกระเบื้องปิดปล่องควัน เพื่อไม่ให้ควันลอยออกมาระหว่างการเผาถ่าน

**ตอบถูก จำนวน 124 คน ร้อยละ 80.5**

**ตอบผิด จำนวน 30 คน ร้อยละ 19.5**

## ตอนที่ 4 แบบวัดทัศนคติต่อการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

คำชี้แจง กรุณาทำเครื่องหมาย ✓ ในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด

| ข้อความ | ระดับการเห็นด้วย | | | | | ไม่ตอบ |
|---|---|---|---|---|---|---|
| | มากที่สุด | มาก | ปานกลาง | น้อย | น้อยที่สุด | |
| | จำนวน (ร้อยละ) | จำนวน (ร้อยละ) | จำนวน (ร้อยละ) | จำนวน (ร้อยละ) | จำนวน (ร้อยละ) | จำนวน (ร้อยละ) |
| 1. เตาเผาถ่าน 200 ลิตร เป็นเตาเผาถ่านที่ได้เปรียบกว่าเตาเผาถ่านประเภทอื่นเพราะสามารถปฏิบัติงานเพียงคนเดียวได้ | 56 (36.4) | 74 (48.1) | 21 (13.6) | 1 (0.6) | 2 (1.3) | 0 (0.0) |
| 2. ถ้ามีการส่งเสริมให้คนในชุมชนหันมาใช้เตาเผาถ่าน 200 ลิตร จะทำให้ลดการสูญเสียเวลาในการเผาถ่านลงได้มาก | 36 (23.4) | 86 (55.8) | 59 (18.8) | 2 (1.3) | 0 (0.0) | 1 (0.6) |
| 3. การใช้เตาเผาถ่าน 200 ลิตรไม่ค่อยสะดวกนัก เพราะต้องหาสถานที่ในการติดตั้งเตาให้ห่างจากชุมชนอย่างน้อย 50 เมตร | 14 (9.1) | 54 (35.1) | 40 (26.0) | 25 (16.2) | 13 (8.4) | 8 (5.2) |
| 4. กรรมวิธี/ขั้นตอนการติดตั้งเตาเผาถ่าน 200 ลิตรที่รวดเร็วกว่า ทำให้ครัวเรือนที่เลือกใช้เตาประเภทนี้ลดการสูญเสียเวลาในการปฏิบัติงานได้ | 39 (25.3) | 76 (49.4) | 26 (16.9) | 10 (6.5) | 1 (0.6) | 2 (1.3) |
| 5. เตาเผาถ่าน 200 ลิตร มีค่าใช้จ่ายในการลงทุนถูกกว่าการลงทุนในอุปกรณ์เตาเผาถ่านประเภทอื่น | 34 (22.1) | 44 (28.6) | 48 (31.2) | 18 (11.7) | 3 (1.9) | 7 (4.5) |
| 6. การที่สามารถหาซื้ออุปกรณ์เพื่อประกอบเป็นเตาเผาถ่าน 200 ลิตรได้ตามร้านขายเครื่องก่อสร้างทั่วไป จะช่วยลดความยุ่งยากในขั้นตอนการประกอบใช้เตาเผาถ่าน 200 ลิตรได้ | 29 (18.8) | 48 (31.2) | 47 (30.5) | 18 (11.7) | 5 (3.2) | 7 (4.5) |
| 7. ระยะเวลาคืนทุนจากการลงทุนติดตั้งเตาเผาถ่าน 200 ลิตรที่เร็วกว่าทำให้เกิดความคุ้มค่าในการเลือกใช้เตาประเภทนั้นด้วย | 30 (19.5) | 67 (43.5) | 41 (26.6) | 4 (2.6) | 2 (1.3) | 10 (6.5) |
| 8. ถ้าประชาชนในภาคชนบทหันมานิยมใช้เตาเผาถ่าน 200 ลิตรแทนเตาเผาถ่านประเภทอื่นแล้ว จะทำให้ได้เตาเผาถ่านที่มีอายุการใช้งานที่นานกว่า | 41 (26.6) | 50 (32.5) | 34 (22.1) | 12 (7.5) | 8 (5.2) | 9 (5.8) |
| 9. เตาเผาถ่าน 200 ลิตร เหมาะกับการใช้งานครัวเรือนเพราะผลผลิตถ่านที่ได้มีคุณภาพสูง ดีต่อสุขภาพเพราะถ่านที่ได้มีปริมาณน้ำมันดินน้อย | 49 (31.8) | 70 (45.5) | 28 (18.2) | 0 (0.0) | 6 (3.9) | 1 (0.6) |
| 10. เตาเผาถ่าน 200 ลิตร เป็นเตาเผาถ่านที่ได้ปริมาณผลผลิตถ่านดีกว่าเตาเผาถ่านประเภทอื่น | 43 (27.9) | 81 (52.6) | 27 (17.5) | 3 (1.9) | 0 (0.0) | 0 (0.0) |

| ข้อความ | ระดับการเห็นด้วย | | | | | ไม่ตอบ |
|---|---|---|---|---|---|---|
| | มากที่สุด จำนวน (ร้อยละ) | มาก จำนวน (ร้อยละ) | ปานกลาง จำนวน (ร้อยละ) | น้อย จำนวน (ร้อยละ) | น้อยที่สุด จำนวน (ร้อยละ) | จำนวน (ร้อยละ) |
| 11. น้ำส้มควันไม้เป็นผลิตภัณฑ์ที่ได้จากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตร สามารถใช้ประโยชน์ในการประกอบอาชีพด้านเกษตรกรรมและด้านอื่นๆ | 59 (38.3) | 71 (46.1) | 24 (15.6) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| 12. การนำน้ำส้มควันไม้ที่ได้จากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตรมาจำหน่าย จะช่วยสร้างรายได้ให้เกิดขึ้นภายในครัวเรือนและชุมชนได้ | 23 (14.9) | 57 (37.0) | 53 (34.4) | 9 (5.8) | 7 (4.5) | 5 (3.2) |
| 13. การเก็บน้ำส้มควันไม้ในระหว่างขั้นตอนการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตรนั้น เป็นการเพิ่มภาระการทำงานให้มีมากขึ้น | 11 (7.1) | 30 (19.5) | 57 (37.0) | 33 (21.4) | 18 (11.7) | 5 (3.2) |
| 14. การติดตั้งเตาเผาถ่าน 200 ลิตร อาจเกิดอุบัติเหตุขึ้นได้ในขณะติดตั้งเตาเผาถ่านประเภทนี้ เช่น เกิดบาดแผลจากคมสังกะสี เป็นต้น | 9 (5.8) | 22 (14.3) | 28 (18.2) | 34 (22.1) | 55 (35.7) | 6 (3.9) |
| 15. การใช้วัสดุอุปกรณ์ตามกำหนดจะทำให้ได้เตาเผาถ่าน 200 ลิตรที่มาตรฐานและปลอดภัยต่อการใช้ | 33 (21.4) | 60 (39.0) | 49 (31.8) | 10 (6.5) | 1 (0.6) | 1 (0.6) |
| 16.ควันจากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตรเป็นสาเหตุหนึ่งที่ทำให้เกิดมลพิษทางอากาศขึ้นในชุมชน | 14 (9.1) | 34 (22.1) | 52 (33.8) | 15 (9.7) | 36 (23.4) | 3 (1.9) |
| 17. ผู้ที่เลือกใช้เตาเผาถ่าน 200 ลิตร หากเลือกเวลาในการเผาและสถานที่ติดตั้งเตาที่เหมาะสมแล้ว ก็จะไม่เกิดปัญหาเรื่องควันที่เกิดจากการเผา | 39 (25.3) | 56 (36.4) | 34 (22.1) | 14 (9.1) | 4 (2.6) | 7 (4.5) |
| 18. เตาเผาถ่าน 200 ลิตรใช้ไม้ที่มีขนาดเล็กหรือไม้จากการตัดแต่งกิ่งไม้ จึงน่าจะช่วยลดการตัดต้นไม้ที่มีขนาดใหญ่ได้ | 61 (39.6) | 63 (40.9) | 18 (11.7) | 6 (3.9) | 3 (1.9) | 3 (1.9) |
| 19. ถ้าประชาชนในภาคชนบทหันมานิยมใช้เตาเผาถ่าน 200 ลิตรมากขึ้น ปัญหาการลักลอบตัดไม้ทำลายป่าหรือการตัดต้นไม้ที่มีขนาดใหญ่จะน้อยลง | 44 (28.6) | 68 (44.2) | 28 (18.2) | 4 (2.6) | 10 (6.5) | 0 (0.0) |
| 20. ควรสนับสนุนคนให้ใช้เตาเผาถ่าน 200 ลิตรมากกว่าการใช้เตาเผาถ่านประเภทอื่น | 52 (33.8) | 72 (46.8) | 27 (17.5) | 1 (0.6) | 1 (0.6) | 1 (0.6) |
| 21. การใช้งานเตาเผาถ่าน 200 ลิตร มีความคุ้มค่าในการลงทุน | 39 (25.3) | 73 (47.4) | 33 (21.4) | 8 (5.2) | 0 (0.0) | 1 (0.6) |
| 22. ปัญหาการใช้ทรัพยากรป่าไม้ที่เกิดขึ้นในชนบทเป็นปัญหาที่หน่วยงานของรัฐเท่านั้นที่ต้องรับผิดชอบและดำเนินการแก้ไข | 31 (20.1) | 54 (35.1) | 34 (22.1) | 17 (11.0) | 1 (0.6) | 17 (11.0) |

| ข้อความ | ระดับการเห็นด้วย | | | | | ไม่ตอบ |
|---|---|---|---|---|---|---|
| | มากที่สุด จำนวน (ร้อยละ) | มาก จำนวน (ร้อยละ) | ปานกลาง จำนวน (ร้อยละ) | น้อย จำนวน (ร้อยละ) | น้อยที่สุด จำนวน (ร้อยละ) | จำนวน (ร้อยละ) |
| 23.เตาเผาถ่าน 200 ลิตร เป็นการเลือกใช้อุปกรณ์ที่แปลกใหม่ ยังไม่แพร่หลายในชุมชน | 22 (14.3) | 36 (23.4) | 54 (35.1) | 22 (14.3) | 15 (9.7) | 5 (3.2) |
| 24. การใช้เตาเผาถ่าน 200 ลิตร เป็นอุปกรณ์ที่ยังไม่เป็นที่ยอมรับของชุมชน | 11 (7.1) | 33 (21.4) | 47 (30.5) | 26 (16.9) | 35 (22.7) | 2 (1.3) |

## ตอนที่ 5 การยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ของประชาชน

คำชี้แจง กรุณาทำเครื่องหมาย ✓ ในช่องที่ตรงกับความคิดเห็นของท่านมากที่สุด

| ข้อที่ | คำถาม | ระดับการยอมรับ | | |
|---|---|---|---|---|
| | | ใช่ เห็นด้วย แนะนำ จำนวน (ร้อยละ) | ไม่แน่ใจ จำนวน (ร้อยละ) | ไม่ใช่ ไม่เห็นด้วย ไม่แนะนำ จำนวน (ร้อยละ) |
| 1. | **ขั้นความรู้** แม้ว่าคนในชุมชน จะไม่ได้เป็นผู้คิดค้นเตาเผาถ่าน 200 ลิตรขึ้น แต่เตาประเภทนี้ก็เป็นที่รู้จักในชุมชน | 0 (0.0) | 43 (27.9) | 111 (72.1) |
| 2. | แม้ว่าคนในชุมชน จะไม่ได้เป็นผู้คิดค้นเตาเผาถ่าน 200 ลิตร แต่ก็ใช้ประโยชน์ในชุมชนกันมานานนับปี | 9 (5.8) | 57 (37.0) | 88 (57.1) |
| 3. | เนื่องจากเตาเผาถ่าน 200 ลิตร มีระบบควบคุมอากาศในการเผาไหม้แตกต่างจากเตาเผาถ่านประเภทอื่น ดังนั้นผู้ที่ใช้เตาเผาถ่าน 200 ลิตรต้องรู้ขั้นตอนการติดตั้งเตาเผาถ่าน 200 ลิตรนี้ | 1 (0.6) | 27 (17.5) | 126 (81.8) |
| 4. | ผู้ที่ใช้เตาเผาถ่าน 200 ลิตร ควรเลือกสถานที่ก่อสร้างเตาเผาถ่านได้อย่างถูกต้องและเหมาะสมเพื่อช่วยเพิ่มความปลอดภัยในการปฏิบัติงาน | 9 (5.8) | 31 (20.1) | 114 (74.0) |
| 5. | ขณะที่ทำการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตร ผู้ที่ทำการเผาจะต้องมีความรู้เรื่องระยะเวลาในการเผาถ่าน เป็นอย่างดี | 1 (0.6) | 48 (31.2) | 105 (68.2) |

| ข้อที่ | คำถาม | ระดับการยอรับ | | |
|---|---|---|---|---|
| | | **ใช่ เห็นด้วย แนะนำ** จำนวน (ร้อยละ) | **ไม่แน่ใจ** จำนวน (ร้อยละ) | **ไม่ใช่ ไม่เห็นด้วย ไม่แนะนำ** จำนวน (ร้อยละ) |
| 6. | การใช้เตาเผาถ่าน 200 ลิตร จะได้ถ่านที่ได้มีปริมาณน้ำมันดินน้อย ทำให้ลดอันตรายต่อสุขภาพของผู้ที่ใช้เตา | 0 (0.0) | 38 (24.7) | 116 (75.3) |
| 7. | **ขั้นจูงใจ** เตาเผาถ่าน 200 ลิตรเป็นเตาเผาถ่านที่ลงทุนน้อยและระยะเวลาในการคืนทุนสั้น เมื่อเทียบกับเตาเผาถ่านประเภทอื่น | 0 (0.0) | 40 (26.) | 114 (74.0) |
| 8. | เตาเผาถ่าน 200 ลิตร สะดวกต่อการใช้เนื่องจากสามารถใช้เศษไม้ตามไร่นามาเป็นวัตถุดิบในการเผาถ่าน | 2 (1.3) | 12 (7.8) | 140 (90.9) |
| 9. | การใช้เตาเผาถ่าน 200 ลิตร มีอายุการใช้งานนานกว่าเตาหลุมหรือเตาดินแบบโดม | 2 (1.3) | 54 (35.1) | 98 (63.6) |
| 10. | เตาเผาถ่าน 200 ลิตร เป็นเตาเผาถ่านที่ใช้พื้นที่ในการติดตั้งเตาน้อย | 2 (1.3) | 27 (17.5) | 125 (81.2) |
| 11. | การใช้เตาเผาถ่าน 200 ลิตร จะได้ถ่านที่มีปริมาณน้ำมันดินน้อย ปริมาณผลผลิตถ่านดี ( 20 % ) | 0 (0.0) | 47 (30.5) | 107 (69.5) |
| 12. | นอกเหนือจากถ่านที่ได้จากการเผาถ่านด้วยเตาเผาถ่าน 200 ลิตรแล้ว ยังได้น้ำส้มควันไม้ ซึ่งเป็นผลพลอยได้ที่สามารถนำประโยชน์ได้หลายด้าน | 2 (1.3) | 20 (13.0) | 132 (85.7) |
| 13. | การเลือกใช้เตาเผาถ่าน 200 ลิตร มีลักษณะเด่นด้านกรรมวิธีการผลิตคือ สามารถปฏิบัติงานเพียงคนเดียวได้ทุกขั้นตอน จึงช่วยให้การทำงานสะดวกรวดเร็วยิ่งขึ้น | 0 (0.0) | 14 (9.1) | 140 (90.9) |
| 14. | การที่มีขั้นตอนการติดตั้งเตาเผาถ่าน 200 ลิตรที่ง่าย ทำให้ผู้ที่เลือกใช้เตาประเภทนี้มีความปลอดภัยมากยิ่งขึ้น | 1 (0.6) | 27 (17.5) | 120 (81.8) |
| 15. | ขั้นตัดสินใจ การมีเงินลงทุนเพียงพอ ทำให้ไม่ลังเลที่จะซื้ออุปกรณ์เพื่อติดตั้งเตาเผาถ่าน 200 ลิตร ไว้ใช้ประโยชน์ภายในครัวเรือน | 0 (0.0) | 41 (26.6) | 113 (73.4) |
| 16. | การซื้ออุปกรณ์ติดตั้งเตาเผาถ่าน 200 ลิตร สำหรับใช้ประโยชน์ในครัวเรือน ทำให้ได้เตาเผาถ่านที่มีประสิทธิภาพในการใช้งานที่ดียิ่งขึ้น | 0 (0.0) | 15 (9.7) | 139 (90.3) |

| ข้อที่ | คำถาม | ระดับการยอมรับ | | |
|---|---|---|---|---|
| | | ใช่ เห็นด้วย แนะนำ<br>จำนวน (ร้อยละ) | ไม่แน่ใจ<br>จำนวน (ร้อยละ) | ไม่ใช่ ไม่เห็นด้วย ไม่แนะนำ<br>จำนวน (ร้อยละ) |
| 17. | ถ้ามีโครงการสนับสนุนการใช้เตาเผาถ่าน 200 ลิตรในชุมชนของท่าน คนในชุมชนจะให้ความร่วมมือในโครงการนั้นอย่างต่อเนื่อง | 2 (1.3) | 26 (16.9) | 126 (81.8) |
| 18. | ถ้ามีเงินลงทุนสนับสนุนการก่อสร้างเตาเผาถ่าน 200 ลิตรในชุมชน จะทำให้มีเตาประเภทนี้ในจำนวนที่มากขึ้น | 0 (0.0) | 23 (14.9) | 131 (85.1) |
| 19. | ถึงจะไม่มีเงินลงทุนสนับสนุนการก่อสร้างเตาเผาถ่าน 200 ลิตร คนในชุมชนก็ยินดีลงทุนก่อสร้างเตาด้วยตนเองเพื่อให้เกิดการใช้เตาประเภทนี้อย่างต่อเนื่อง | 2 (1.3) | 50 (32.5) | 102 (66.2) |
| 20. | ขั้นการนำไปใช้<br>การเลือกใช้เตาเผาถ่าน 200 ลิตร เป็นการใช้เตาเผาถ่านที่มีความสะดวกในการติดตั้ง | 4 (2.6) | 12 (7.8) | 138 (89.6) |
| 21. | การใช้เตาเผาถ่าน 200 ลิตร มีความรวดเร็วในกรรมวิธีการผลิต เนื่องจากใช้เวลาในการเผาถ่านภายใน 1 วัน | 2 (1.3) | 23 (14.9) | 129 (83.8) |
| 22. | การใช้เตาเผาถ่าน 200 ลิตร จะได้ผลผลิตถ่านและน้ำส้มควันไม้ซึ่งเป็นผลพลอยได้ที่สามารถใช้ประโยชน์ในการใช้เป็นสารเร่งการเจริญเติบโตของพืช เป็นอาหารเสริมสำหรับสัตว์เลี้ยง เป็นต้น | 4 (2.6) | 30 (19.5) | 120 (77.9) |
| 23. | การใช้แรงงานในการปฏิบัติงานเพียงคนเดียวไม่เป็นอุปสรรคในการก่อสร้างเตาเผาถ่าน 200 ลิตรมากไปกว่าการใช้แรงงานมากกว่า 1 คนในการก่อสร้างเตาเผาถ่านประเภทอื่นๆ | 3 (1.9) | 31 (20.1) | 120 (77.9) |
| 24. | ผู้ที่มีความระมัดระวังในการติดตั้งเตาเผาถ่าน 200 ลิตร และจะสามารถปฏิบัติได้โดยไม่เกิดอุบัติเหตุ | 1 (0.6) | 32 (20.8) | 121 (78.6) |
| 25. | ผู้ที่มีความรู้และทักษะในทุกขั้นตอนของการติดตั้งเตาเผาถ่าน 200 ลิตร จะทำให้ไม่เกิดอุบัติเหตุแก่ผู้ติดตั้ง | 4 (2.6) | 29 (1.8) | 121 (78.6) |
| 26. | การใช้เตาเผาถ่าน 200 ลิตรอย่างต่อเนื่อง ทำให้ภายในชุมชนมีการใช้ประโยชน์จากทรัพยากรป่าไม้ได้อย่างคุ้มค่า | 1 (0.6) | 32 (20.8) | 121 (78.6) |

| ข้อที่ | คำถาม | ระดับการยอมรับ | | |
|---|---|---|---|---|
| | | ใช่ เห็นด้วย แนะนำ จำนวน (ร้อยละ) | ไม่แน่ใจ จำนวน (ร้อยละ) | ไม่ใช่ ไม่เห็นด้วย ไม่แนะนำ จำนวน (ร้อยละ) |
| 27. | การใช้เตาเผาถ่าน 200 ลิตรอย่างต่อเนื่อง ทำให้ลดการตัดไม้ที่มีขนาดใหญ่ในชุมชน | 2 (1.3) | 20.8 (40) | 112 (72.7) |
| 28. | ขั้นยืนยันการใช้ การที่ได้รับประโยชน์มากมายจากเตาเผาถ่าน 200 ลิตร ทำให้เลือกที่จะใช้เตาเผาถ่านประเภทนี้ในชีวิตประจำวันต่อไป | 2 (1.3) | 17 (11.0) | 135 (87.7) |
| 29. | ผู้ที่ใช้เตาเผาถ่าน 200 ลิตร จะเป็นผู้ที่สนับสนุนให้คนในชุมชนมีการใช้เตาเผาถ่านประเภทนี้มากยิ่งขึ้น | 0 (0.0) | 38 (24.7) | 116 (75.3) |
| 30. | เตาเผาถ่าน 200 ลิตร เป็นเตาเผาถ่านที่เหมาะสมในการเผาถ่านมากกว่าเตาเผาถ่านประเภทอื่น | 0 (0.0) | 32 (20.8) | 122 (79.2) |
| 31. | ถึงแม้ว่าการใช้เตาเผาถ่าน 200 ลิตรจะมีข้อจำกัดอยู่บ้าง แต่ก็ไม่เป็นอุปสรรคในการใช้มากจนเกินไป | 4 (2.6) | 19 (12.3) | 131 (85.1) |
| 32. | การลดการใช้เตาหลุมกลบดินและเตาดินแบบโดมมานิยมใช้เตาเผาถ่าน 200 ลิตรแทน จะเป็นการแนะนำให้คนอื่นๆ ทั้งในและนอกชุมชนใช้เตาเผาถ่าน 200 ลิตรด้วย | 2 (1.3) | 23 (14.9) | 129 (83.8) |

## ตอนที่ 6 ปัญหาอุปสรรคและข้อเสนอแนะเกี่ยวกับการยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร

1. ท่านคิดว่าปัญหาและอุปสรรคที่สำคัญที่ทำให้ประชาชนไม่ยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร คือ.....
   .....
   .....
2. ท่านมีข้อเสนอแนะที่จะจูงใจให้ประชาชนเปลี่ยนทัศนคติและยอมรับการใช้เตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตร ได้อย่างไร.....
   .....
   .....

3. ท่านคิดว่า เมื่อเปรียบเทียบระหว่างเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตรกับเตาเผาถ่านแบบเดิม เตาเผาถ่าน 200 ลิตรมีข้อได้เปรียบด้านใดบ้าง…….
……
…….

4. ท่านคิดว่า เมื่อเปรียบเทียบระหว่างเตาเผาถ่านประสิทธิภาพสูง ขนาด 200 ลิตรกับเตาเผาถ่านแบบเดิม เตาเผาถ่าน 200 ลิตรมีข้อด้อยด้านใดบ้าง……..…….
……..…….
……..…….

# APPENDIX E
# THE EFFICIENCY SEARCHING OF THE RESEARCHING TOOLS
# DIFFICULTY SEARCHING, ASSORTING POWER AND CONVINCED VALUE OF HIGH EFFICIENCY KILN KNOWLEDGE FORM

**Method**

1. Checking the questionnaires and then bring all points from each samples by arranging in to order from most to less point. After that, divide in 2 groups; high and low point group according to 27% of 30 samples to 9 people per group.

2. Gathering all high point group and low point group in each content for the difficulty searching calculation and assorting power as in table 1.

3. Considering the numbers of Difficulty value between 0.2 -0.8 and assorting power point from 0.2 and above as in table 1. The Consideration found that no correction.

4. Bring all the standard passing numbers to calculate the convinced value by using Kuder and Richardson Formula: KR 20 by the following method:

$$\text{Convinced Value}\,(r_{tt}) = \frac{k}{k-1}\left[1 - \Sigma S_i^2 / S_x^2\right]$$

From the Calculation, we get the knowledge form of 200-liter high efficiency charcoal stove as 1.77 (see table 2)

Variable Value $(S_x^2)$ calculate from the formula

$$S_x^2 = \frac{n\Sigma X_i^2 - (\Sigma X_i)^2}{n(n-1)}$$

**Table 1** Difficulty and Assorting power searching of high efficiency kiln knowledge form

| No. | High correct answer groups ($P_H$) | Low correct answer groups ($P_L$) | Difficulty Value $P=(P_H + P_L) / 2n$ | Assorting Value $P=(P_H - P_L) / n$ |
|---|---|---|---|---|
| 1 | 9 | 3 | 0.67 | 0.67 |
| 2 | 7 | 3 | 0.56 | 0.44 |
| 3 | 7 | 2 | 0.50 | 0.56 |
| 4 | 9 | 1 | 0.56 | 0.89 |
| 5 | 4 | 0 | 0.22 | 0.44 |
| 6 | 5 | 3 | 0.44 | 0.22 |
| 7 | 7 | 5 | 0.67 | 0.22 |
| 8 | 9 | 4 | 0.72 | 0.56 |
| 9 | 6 | 2 | 0.44 | 0.44 |
| 10 | 5 | 1 | 0.33 | 0.44 |
| 11 | 9 | 4 | 0.72 | 0.56 |
| 12 | 6 | 3 | 0.50 | 0.33 |
| 13 | 4 | 0 | 0.22 | 0.44 |
| 14 | 9 | 4 | 0.72 | 0.56 |
| 15 | 8 | 4 | 0.67 | 0.44 |
| 16 | 9 | 5 | 0.78 | 0.44 |
| 17 | 9 | 4 | 0.72 | 0.56 |
| 18 | 4 | 1 | 0.28 | 0.33 |
| 19 | 8 | 5 | 0.72 | 0.33 |
| 20 | 8 | 6 | 0.78 | 0.22 |
| 21 | 4 | 1 | 0.28 | 0.33 |
| 22 | 3 | 0 | 0.17 | 0.33 |
| 23 | 8 | 0 | 0.44 | 0.89 |

**Table 2** The Difficulty searching of high efficiency kiln knowledge form

| No. | Correct answer number(s) (y) | $\overline{X}$ | $S_i^2$ | $S_x^2$ | $r_{tt}$ |
|---|---|---|---|---|---|
| 1 | 20 | 27.68 | 766.00 | 74.36 | 1.77 |
| 2 | 17 | 5.11 | 26.13 | | |
| 3 | 15 | 0.07 | 0.00 | | |
| 4 | 18 | 10.63 | 113.07 | | |
| 5 | 7 | 59.89 | 3587.31 | | |
| 6 | 8 | 45.42 | 2062.60 | | |
| 7 | 22 | 52.72 | 2779.42 | | |
| 8 | 25 | 105.29 | 11085.02 | | |
| 9 | 9 | 32.94 | 1084.89 | | |
| 10 | 7 | 59.89 | 3587.31 | | |
| 11 | 16 | 1.59 | 2.53 | | |
| 12 | 10 | 22.46 | 504.42 | | |
| 13 | 5 | 94.85 | 8996.65 | | |
| 14 | 20 | 27.68 | 766.00 | | |
| 15 | 19 | 18.16 | 329.60 | | |
| 16 | 24 | 85.76 | 7355.41 | | |
| 17 | 22 | 52.72 | 2779.42 | | |
| 18 | 6 | 76.37 | 5832.74 | | |
| 19 | 23 | 68.24 | 4656.97 | | |
| 20 | 20 | 27.68 | 766.00 | | |
| 21 | 7 | 59.89 | 3587.31 | | |
| 22 | 9 | 32.94 | 1084.89 | | |
| 23 | 10 | 22.46 | 504.42 | | |

**Difficulty and Assorting Power Searching about the Attitude test of high efficiency kiln**

**Method**

1. Checking the Attitude Testing and then bring all points from each sample by arranging in to order from most to less point. After that, divide in 2 groups; high and low point group according to 27 % of 30 samples to 9 people per group.
2. Gathering all high point group and low point group in each content for Assorting power calculation with T-Test formula as in table.
3. Considering the assorting power value (T-Test Value) from 1.75 and above. The Consideration found that no correction.
4. Bring all the standard passing numbers to calculate the assorting power value by using Kuder and Richardson Alfa Coefficient formula by the following method:

$$\text{Convinced Value } (r_{tt}) = \frac{k}{k-1} \left[ 1 - \Sigma S_i^2 / S_x^2 \right]$$

Specific Calculation of the 24 passing assorting power questioning Consideration

$\Sigma S_i^2$ = 847652.50

$S_x^2$ = 1431.90

Will get the convinced value ( $r_{tt}$ ) at 5.22

**Table 3** The assorting power researching of high efficiency kiln using attitude knowledge form

| ข้อที่ | $\overline{X}_H$ | $\overline{X}_L$ | $S_H^2$ | $S_L^2$ | t-test |
|---|---|---|---|---|---|
| 1 | 4.9 | 3.7 | 0.1 | 0.8 | 4.1 |
| 2 | 4.6 | 3.3 | 0.5 | 1 | 3.7 |
| 3 | 4.6 | 3.6 | 0.5 | 0.7 | 3.1 |
| 4 | 4 | 2.5 | 0.6 | 1.7 | 3.2 |
| 5 | 4.5 | 3 | 0.5 | 1.4 | 3.7 |
| 6 | 4.1 | 3.5 | 0.5 | 0.7 | 2 |
| 7 | 4.1 | 2.6 | 0.5 | 1.1 | 3.9 |
| 8 | 4.8 | 3.5 | 0.2 | 1.5 | 3.5 |
| 9 | 3.3 | 1.6 | 2.2 | 0.5 | 3.3 |
| 10 | 4.5 | 3.9 | 0.3 | 0.7 | 1.8 |
| 11 | 4.8 | 3.5 | 0.2 | 1.3 | 3.5 |
| 12 | 4.6 | 3.5 | 0.3 | 0.9 | 3.4 |
| 13 | 4.4 | 3.5 | 0.9 | 1.3 | 1.9 |
| 14 | 4.5 | 3.8 | 0.3 | 0.6 | 2.3 |
| 15 | 4.5 | 3.5 | 0.5 | 1.5 | 2.2 |
| 16 | 3.5 | 2.5 | 0.7 | 0.5 | 3.1 |
| 17 | 4.6 | 3.3 | 0.5 | 1 | 3.7 |
| 18 | 4.6 | 3.6 | 0.5 | 0.7 | 3.1 |
| 19 | 4.1 | 3.5 | 0.5 | 0.7 | 2 |
| 20 | 4.1 | 2.6 | 0.5 | 1.1 | 3.9 |
| 21 | 4.8 | 3.5 | 0.2 | 1.5 | 3.5 |
| 22 | 3.3 | 1.6 | 2.2 | 0.5 | 3.3 |
| 23 | 4.5 | 3.9 | 0.3 | 0.7 | 1.8 |
| 24 | 4.8 | 3.5 | 0.2 | 1.3 | 3.5 |

**The Convinced Value searching of high efficiency kiln using acknowledgement Form**

Method

1. Check and score at acknowledgement form by from each point of interviewees

2. Bring all points for convinced value searching by using Kuder and Richardson Alfa Coefficient formula by the following method:

$$r_{tt} = \frac{k}{k - 1} [ 1 - \Sigma S_i^2 / S_x^2 ]$$

at $\Sigma S_i^2 = 311218.25$

$k = 32$

$S_x^2 = 385.69$

Will get the convinced value of acknowledgement at 1.36

# BIOGRAPHY

| | |
|---|---|
| NAME | Miss Prawonwan Saipan |
| DATE OF BIRTH | April 2, 1980 |
| PLACE OF BIRTH | Ubonratchathani Province |
| EDUCATIONAL QUALIFICATION | King Mongkut's Institute of Technology Ladkraban 1998 - 2001<br>Bachelor of Science (agriculture Technology)<br>Mahidol University 2002 - 2007<br>Master of Science (Environment Planning for Community and Rural Development) |
| HOME ADDRESS | 6 Soi Changsanit 9 Changsanit Road Amphur Muang Ubonratchathani Province 34000 |