

**SURVEY OVERVIEW**

FEBRUARY 1982

**SURVEY OVERVIEW AND GUIDE TO DATA**

### Author's Note

This report is meant for use by researchers working on the Renewable Non-Conventional Energy Project. Approval should be obtained from U.S. Agency for International Development, Bangkok (Rod MacDonald) or Asia Bureau, Washington (Robert Ichord) before quoting any part of this report.

### Acknowledgement

This series of reports was produced through the joint efforts of professors and students from four of Thailand's leading universities, Chulalongkorn University Social Research Institute, Chiangmai University Center for Social Sciences, Khon Kaen University Faculty of Agricultural Economics, and Kasetsart University Faculty of Forestry as well as research personnel from Meta Systems, Inc. Together they were responsible for the design, execution and analysis of the baseline survey.

The text was written by Mr. Arnold and typed by Miss Chalokunwat. Report production was supervised by Ms. Patricia Ferguson and Ladda Vivathanvanich. The dedication, patience, long hours and unflagging sense of humor of all participants is gratefully acknowledged.

LIKE a bird with no nest, time  
Flaps through unmourned days,  
Fluttering its marvellous, magic wings.

Like drops of water,  
The song, the tears, of a gentle breeze,  
Time shuts its eyes and patters pleasantly on-  
And like a knowing guide  
Shows life and death which way to go.

Rendra

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Errata Sheet

LIST OF CHANGWAT OF THAILAND

In this report a variety of spellings have been used for the survey Changwat and village. The correct spelling and some of the variants are shown below.

Changwat

Buri Ram: Buriram, Burirum  
Chanthaburi: Chantaburi  
Chiang Mai: Chiangmai, Chaing Mai,  
Cheing Mai  
Chon Buri: Chonburi  
Kamphaeng Phet: Kamphangphet, Kampaengpet,  
Kamphangphet, Kamphangphet  
Khon Kaen  
Lampang  
Nakhon Ratchisima: Korat  
Nan  
Phetchaburi: Petburi, Petchbura,  
Petchaburi  
Roi et: Roi-et, Roi-Et  
Si Sa Ket: Srisaket, Sisaket  
Udon Thani: Udorn Thani, Udornthani

Villages

Bang Rahong: Bangrahong  
Maikan Sangkan: Mailand Sangan  
Pa Bhu: Pabhu  
Wang Chapou: Wangchapoo  
Klong Bon: Klongbon  
Nong Wangyao: Nongwangyao  
Pa Woe: Paver, Paver  
Pa Han: Pahan  
Pa Nai: Panai  
Si Chiengmai: Srichiengmai,  
Srichaiangmai  
San Pa Tong: San Pa Toung  
Samkhasantisuk: Sam Kha San Tisuk  
Mai Ho Phra: Mae Ho Prz  
Nong Buaeng: Nongbuadeang

OTHER TERMS

Household - Related individuals living in a house and eating together  
House compound - Area around the house which is owned by members of the household and is often demarcated by a fence  
Head of household - Male or female leader of the members of the household, usually the owner of the house  
Head of village - Phuyaiban  
Head of sub-district - Kamnan  
Village - Muban  
District - Amphoe  
Province - Changwat

Errata Sheet (continued)

Phase I - Survey in Petchaburi, Korat, Srisaket, Kampanphet, and Lampang

Phase II - Survey in Songkla, Chantaburi, Roe-et, Udorn Thani, and Chiang Mai

Phase III - Survey in Nan, Burirum, and Chiang Mai

Delivered heat - The amount of energy content in the fuel burned

Captured heat - In cooking the amount of heat which is transferred to the cooking vessel

Moisture content - On a wet basis, weight of water as percentage of total sample weight

Heat or energy content - The high heat content of a substance at 0% moisture as measured in a bomb calorimeter

1 Unit of electricity - 1 kilowatt-hour, a billing unit used by the Provincial Electric Authority

6 1/4 rai = 2 1/2 acres = 1 hectare

jar lamp - small wick lamps

wick lamp - chimney or hurricane lamps

Rice Products - Straw residue in field,  
- Stalk residue from threshing,  
- Husk shell residue from milling  
- Bran edible residue from milling

NEA - National Energy Administration of Thailand

NSO - National Statistics Organization of Thailand

PEA - Provincial Electricity Authority

## 1. Purpose of the Baseline Survey

The baseline survey had two goals. The first was to provide general data on village activities and energy-use patterns which might be changed by the introduction of renewable energy technologies. This data was used for the selection of sites where the technologies would be demonstrated and for comparison with data to be gathered in evaluation surveys following the demonstrations. The second goal was to provide basic research data for the participants in various components of the project. The baseline survey was extended to include: collection and analysis of biomass samples for the biomass assessment component, observation and measurement of the uses and availability of different species of trees for the woodlot component, experiments on stove operation and efficiency for the stove component, observation and measurement of charcoal making for the charcoal kiln component, observation and measurement of rural industry for the industrial conservation component, survey questions on water supply and irrigation for the waterlifting component, measurement and analysis of animal dung production for the biogas component, survey questions on electricity use and community organization for the microhydro component and survey questions on local examples of appropriate technology and local sources of credit for all technology components.

## 2. Survey History and Location

The survey was performed in three phases. In the first phase teams were sent to Petchaburi, Korat, Srisaket, Kamphangphet, and Lampang during the period March-April, 1981. In the second phase teams were sent to Songkla, Chantaburi, Roi-et, Udorn Thani and Chiang Mai during May, 1981 (see table 1). In the third phase teams were sent to Nan, Borirum and Chiang Mai during September-October, 1981. Preparation of the survey documents, pretesting and training survey teams occurred from mid-February until the beginning of the phase I survey. Data processing commenced after phase I but did not become a full-time activity until the middle of June. The analysis of all data except computerized questionnaire data was completed by the end of July, and the computer data was processed from September to December, 1981.

The first phase of the survey was conducted during the dry season. The only interruption occurred during the period of the abortive April 1 coup attempt. The second phase occurred at the beginning of the rainy season in all provinces except Roi-et. The third phase occurred at the end of the rainy season.

The survey documents and procedures were to a large extent derived from on-going research activities in Thailand. The basic household survey evolved in four stages. First, existing household survey documents developed by the participating universities were reviewed and a composite document was prepared by the survey supervisors. To this was appended Thai translations of an energy survey which had been used in Indonesia and a water supply survey derived from research in South America. The completed document was reviewed by the survey co-ordinators in a three-day workshop. The revised document was then field tested in the central region of

Thailand by the survey supervisors and a final revised version printed for phase I of the survey. Following phase I, the document was reviewed by the survey supervisors and co-ordinators in three day workshop. Inappropriate or meaningless questions were eliminated, vague questions were reworded, additional questions evolved in phase I were incorporated. The revised document was printed for use in phase II. A final workshop was held with the co-ordinators and supervisors at the end of phase II to determine basic problems with the survey document and procedures as well as with the planning and implementation of the survey.

The methodology and procedures for the measurement, collection and analysis of biomass samples and mapping of village land use were prepared by participating researchers from the Faculty of Forestry at Kasetsart University whose expertise included forestry, scatology and watershed management. They prepared a manual of instruction for collection of different types of biomass and instructed the supervisors on these techniques. Following phase I these techniques were reviewed by the researchers and the supervisors, and revisions in procedure were made. Also, at the researcher's suggestion, five forestry students were recruited to assist the survey teams in cartography and identification and measurement of local wood sources. Following phase II, meetings were held with the researchers to discuss additional problems. A summary of these problems is included in the volume, "Biomass Samples".

The methodology and documents for the stove testing activity were derived from the work of Stephen Joseph and his colleagues at the Intermediate Technology Development Group. For the charcoal-making activity procedures and documents were prepared by research personnel from Meta Systems Inc.. The rural industry survey methodology and documents were developed from a similar survey conducted in Indonesia.

Additional survey documents were developed by the survey co-ordinators and researchers, field tested by the survey supervisors and revised based on the experiences of phase I.

The training of the survey supervisors in survey procedures was performed by the survey co-ordinators and research personnel. All documents and all instruction were in Thai with the exception of instruction in stove testing, charcoal making, mapping and general measurement procedures which was in English and Thai.

### 3.1 Changes Between Phases

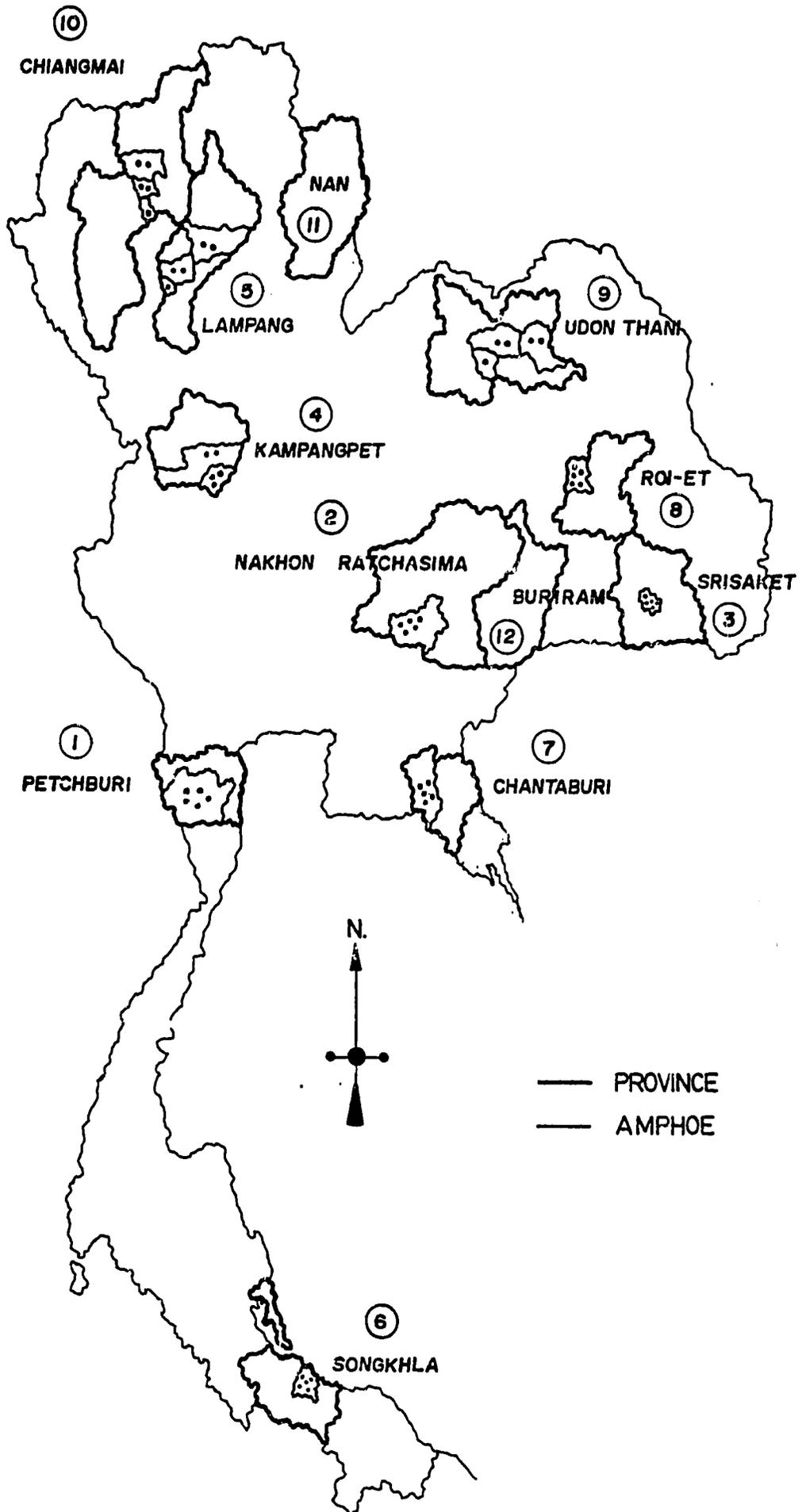
The household questionnaire was edited between phase I and II in order to account for problems in phase I and to expand on certain areas such as credit and transport. A section on the use of biomass was added in phase III.

The sample collection procedures were modified between phase I and phase II because of problems of deterioration in samples which were stored in the field for long periods without being dried. Specifically the dung and recently cut biomass samples were sun-dried before being placed in containers in phase II.

TABLE 1  
AREAS SURVEYED

<u>PETCHBURI</u> (17 March-17 April)	<u>POPULATION</u>	<u>SONGKHLA</u> (4-29 May)	<u>POPULATION</u>
MAE PRACHAN (1)	750	PACHING	500
WANG KAI	700	TUNGPHRA	300
NONG KATUMP	600	PABHU	300
TAHUALOB	800	SAI KHUNG	319
MAE PRACHAN (2)	602	CHAI NA	250
<u>KORAT</u> (17 March-17 April)		<u>CHANTABURI</u> (4-29 May)	
NONG SALA	300	BANG RAHONG	420
NON LEUM	800	NAZA	480
NON NGUE	850	BAN GROG	400
SRA NOI	580	KLONG BON	420
SRA NOI	450	PAK TAPON	250
<u>SRISAKET</u> (20 March-20 April)		<u>ROI-ET</u> (7-29 May)	
KAO	580	NONG VANGYAO	658
KOK	853	PA NAI	532
PRAN	520	PA VER	462
MAIKAND - SANGKAN	582	BAN KUAJ	420
PONG	575	BAN KO	917
<u>KAMPANGPHET</u> (25 March-22 April)		<u>UDORN THANI</u> (7-29 May)	
PREUKMAKUD	550	NONG BUADEANG	1019
HUATUNGNOI	600	KHA WUA	631
WANGCHAPOO	2100	BAN MEN	568
BO - TUM	1900	SAM KHA SAN TISUK	953
HADCHAOM	1200	KHOK SRICHEINGMAI	1440
<u>LAMPANG</u> (25 March-22 April)		<u>CHIANG MAI</u> (7-29 May)	
MAEPUNG	500	MAI HO PRA	731
LAI HIEN	1857	KHEELEK LUANG	700
SALADONGLAN	1011	SANPATOUNG	600
RAINANOI	2012	BAN HONG	535
BAN PAO	604	TONG GUY	1159
<u>NAN</u> (September)		<u>PONG</u> (October)	
BAN DON KAEU	534	YANGNOK	1373
BAN HUA NAM	262	PAKJA	-
BAN KLANG	500	<u>BURIRUM</u> (October)	
BAN DON KAEU (PUA)	580	NONG PUNG	780
BAN MON	574	BAN WAN	1778

# BASELINE SURVEY SITES



The mapping and forest survey procedures remained unchanged from phases I to II, however in the later phase graduate forestry students from Kasetsart were brought in to assist each team. The increase in quality of data collection was significant.

Other procedures and activities were unchanged between the first and second phases.

The writing of essays as a mechanism for data collection was introduced after the first phase, but the enumerators were unprepared to answer accurately many of the questions posed in the essay outlines. Following phase II the enumerators were much better prepared.

The sample size was cut by 10% from phase I to phase II and the census was eliminated due to time constraints imposed on the enumerators by the end of their vacation period. The charcoal-making observations were reduced because of limited activity during the start of the rainy season. Field residues were also less available in the second phase. In phase III the sample size was increased but biomass samples were not collected, and the stove and charcoal-making observations were eliminated.

#### 4. Description of Survey Components

The survey as conducted by the enumerators, supervisors and coordinators involved a number of activities. These activities included interviews, physical measurements, and participant observation. A summary of these activities is presented below :

1. HOUSEHOLD QUESTIONNAIRE - 2232 households in 59 villages in 12 changwat were interviewed. The subjects covered included employment, agricultural practices, energy use for cooking and lighting, cooking and stove characteristics, credit, water supply, community participation, transport, livestock ownership, use of fish ponds, tree crops, home industry, possessions, and house construction.
2. INFORMANT INTERVIEWS - Unstructured interviews were conducted with local leaders including the village headman, abbot, teacher, health worker, C.D. worker, agricultural extension agent, agricultural bank manager, and energy sellers.
3. LAND USE INVENTORY - Maps were prepared of the land use within the village. An inventory of the land use within the blocks of a  $\frac{1}{2}$  by 1 kilometer grid was made by the enumerators.
4. CHARCOAL MAKING OBSERVATIONS - Measurements were made of the amount of fuelwood used to make charcoal and the amount of charcoal produced. Samples were collected to be analyzed for moisture and energy content. The process, length of time and amount of labor required were also recorded. Sixty-seven charcoal-making activities were observed.

5. STOVE TESTS - Three tests were conducted on selected household stoves: a boiling water test to determine absolute efficiency, a cooking test to determine relative efficiency and a cooking observation test to determine how villagers use their stoves for normal cooking activities. These observations were made for different types of stoves and different types of fuels. In total 130 stoves were tested.
6. BIOMASS SAMPLE COLLECTION - Samples were collected including dung, fuelwood, charcoal, agricultural residues; these were tested for moisture and energy content. About 1000 samples were tested for moisture content and about 150 for energy content.
7. DUNG COLLECTION - Data was collected on the amount of dung produced by buffaloes, cows and pigs. Samples were collected for testing. Data on the species, size and sex of the animals was recorded.
8. FOREST SURVEY - Wooded areas supplying fuel for the villagers were surveyed to determine the amount of standing biomass and the species. Data was also collected on the uses for different species.
9. FIELD RESIDUE SURVEY - Field residues (following recent harvest activities) were measured to determine the amount of biomass available from a harvested field. Samples of potential fuels were collected for analysis.
10. PHOTOGRAPHIC SURVEY - About 2000 photographs were taken of the stove and charcoal-making tests, the land use, village technologies, rural and home industries, and village architecture and layout.
11. RURAL INDUSTRY SURVEY - Small-scale rural industries were observed in each changwat. A total of 55 establishments were visited and the managers were interviewed about their operations. The amount of fuel used as related to the product produced was measured. Fuel samples were collected where biomass fuels were used.
12. APPROPRIATE TECHNOLOGIES - Local technologies and renewable energy technologies were selected in each changwat and interviews were conducted with the owners.
13. ENERGY SELLER - A structured interview was conducted with tradesmen who sold fuels in the survey villages.
14. CENSUS - A short census was made in the first phase survey villages.

## 5. Description of Data Analysis

### 5.1 Computerized Questionnaire Data

A large part of the data collected in the household questionnaires has been machine-coded for computer processing.

The data which was captured on the computer is marked on the questionnaire forms in the volume "Researcher's Guide". The format in which this data is stored is also presented in this report.

The data was initially entered through a data entry system and then transferred from diskette to tapes. The tapes are 9 track, 1,600 EPI, EBDIC-coded records. The basic record structure was formatted according to the pages of the questionnaire records and these were sorted according to village and changwat.

The data on the tape has been checked in four ways; first by the supervisors spot-checking the questionnaires in the field, second through verification of the data during key-punching, third by visual inspection of the resulting data, and fourth through a series of consistency checks performed by the computer. Where problems were identified, the original questionnaires have been consulted and corrections made where indicated. Where the data reported on the questionnaire and entered onto the tapes is illogical, the entry record has been marked. Where pages were missing from a questionnaire a code has been added to indicate that the data was not available. This is distinguished from questionnaire pages in which no answers were given because the questions were not applicable to the household.

The computerized data was transferred to disk at the Asian Institute of Technology. Data processing was done using the SPSS software system. Programming was performed by project research assistants.

Forty questionnaires were prepared for each of the villages in the first five changwat. The exception is village number 4 in Srisaket where only 30 households were interviewed. Thirty-six questionnaires were prepared in each of the villages in the second group of five changwat with the exception of village 2 in Roi-et where only 18 questionnaires were prepared. Forty questionnaires were prepared for each village in the last three changwat (see table 2). Households were selected by the survey personnel in consultation with the village leader. The population was divided into three classes of wealth and into agricultural and non-agricultural families by the village leader and the survey sample was chosen on a proportional basis.

The questionnaires are identified by a basic code which indicates the changwat, the village and the number of the family. A translation of this code together with the sample size is shown in table 2. The questionnaire page record numbers are identified by a separate code. This code and a description of what is contained in the record is included in the volume "Researcher's Guide".

TABLE 2  
VILLAGE SAMPLE SIZE

<u>Code</u>	<u>Name</u>	<u>Sample Size</u>	<u>Total Household</u>
<u>1. Petchburi</u>			
11	MAE PRACHAN (1)	40	124
12	MAE PRACHAN (2)	40	73
13	WANG KAI	40	109
14	NONG KATUMP	40	83
15	TAHUALOB	40	163
<u>2. Korat</u>			
21	NONG SALA	40	67
22	NON LEUM	40	140
23	NON NGUE	40	155
24	SRA NOI	40	85
25	SRA NOI	40	78
<u>3. Srisaket</u>			
31	KAO	40	85
32	KOK	40	134
33	PRAN	40	82
34	MAIKAND-SANGKAN	40	87
35	PONG	40	86
<u>4. Kampanphet</u>			
41	PREUKMAKUD	40	100
42	HUATUNGNOI	40	120
43	WANGCHAPOO	40	447
44	BO - TUM	40	340
45	HAKCHAOM	40	150
<u>5. Lampang</u>			
51	MAEPUNG	40	100
52	LAI HIEN	40	327
53	SALADONGLAN	40	272
54	RAINANOI	40	334
55	BANPAO	40	123

TABLE 2 (cont'd)  
VILLAGE SAMPLE SIZE

<u>Code</u>	<u>Name</u>	<u>Sample Size</u>	<u>Total Household</u>
6. <u>Songkhla</u>			
61	PACHING	36	140
62	TUNGPHRA	36	76
63	PABHU	36	100
64	SAI KHUNG	36	115
65	CHAI NA	36	60
7. <u>Chantaburi</u>			
71	BANG RAHONG	36	77
72	NAZA	36	85
73	BAN GROG	36	73
74	KLONG BON	36	80
75	PAK TAPON	36	45
8. <u>Roi-et</u>			
81	NON VANG YAO	36	94
82	PA NAI	18	76
83	PA VER	36	66
84	BAN KUAJ	36	60
85	BAN KO	36	131
9. <u>Udon Thani</u>			
91	NONG BU/ADEANG	36	105
92	KHU WUA	36	86
93	BAN MEN	36	78
94	SAMKHA SANTISUK	36	100
95	KHOK SRICHEINGMAI	36	180
10. <u>Chiang Mai</u>			
01	MAI HO PRA	36	160
02	KHEE LEK LUANG	36	176
03	SANPATOONG	36	141
04	BAN HONG	36	107
05	TONG GUY	36	236
06	PONG YANGNOK	40	148
07	PAKIA	40	100

TABLE 2 (cont'd)  
VILLAGE SAMPLE SIZE

<u>Code</u>	<u>Name</u>	<u>Sample Size</u>	<u>Total Household</u>
	11. <u>Nan</u>		
16	BAN DON KAEO	40	75
17	BAN HUA NAM	40	65
18	BAN KLANG	40	97
19	DON KAEO (PUA)	40	127
10	BAN MON	40	139
	12. <u>Burirum</u>		
26	NONG PUNG	40	134
27	BAN WAN	40	209

## 5.2 Essays for Non-household Data

Information about the village rather than the individual households was collected through informant interviews and participation observation. The data from the informant interviews was initially recorded in field notebooks. After returning from the field the enumerators were asked to prepare a series of essays on specific topics related to energy use and renewable energy technologies. The essay outlines covered most of the questions asked in the informant interviews. Where additional data was needed to complete the essays the enumerators had to rely on their field notebooks. The essays were prepared jointly by the two enumerators that worked in each village.

The nine essay topics were :

1. Basic Data-describing the village and basic demographic data
2. Agricultural Crops and Activities
3. Agricultural Processing and Marketing
4. Energy Supply and Demand
5. Woodlots-describing the resources available for establishing woodlots and the need for the woodlot
6. Cooking Stoves and Charcoal Kilns-describing the types of stoves and kilns used in the village and their use
7. Biomass, Pyrolysis and Gasification-sources of biomass and their potential use for pyrolysis and gasification
8. Solar, Crop Drying, Water Distillation, Water lifting and Microhydro
9. Village Development-describing village leadership and paths of innovation.

In addition, questionnaires for listing village problems and useful project technologies and rank ordering them for each village were filled out by the enumerators.

## 5.3 Ancillary Questionnaires

The questionnaires used in addition to the household questionnaire included those used to interview operators of rural industry, owners of appropriate technology, energy sellers, and energy administrators. The data from all of these questionnaires was manually processed.

The data on rural industries included information on technologies, processes, utilization of labor and fuel, and sources of capital. The findings from some 55 establishments were compared with earlier survey work undertaken by

the NEA in Thailand.

The questionnaire regarding appropriate technology presented problems because of difficulties in defining AT. Among the technologies examined were powered water pumps, portable power units, biogas digesters, stoves using rice husk and sawdust, water lifting devices, small-scale generators, foot-powered threshers, small transport units, small crop-processing units, and water filters. The owners' responses regarding the uses, benefits and disadvantages of these technologies were summarized in the interim report.

The questions asked of the energy sellers and administrators concerned current and future problems affecting the supply of and demand for energy. The majority of the energy sellers handled petroleum products. The energy administrators included the village headman and the district officers.

#### 5.4 Biomass Samples

Five types of biomass samples were collected during the survey:

1. fuels used in stove tests and charcoal-making tests,
2. agricultural field residues,
3. animal dung,
4. cooking fuels other than those used in the stove tests,
5. fuels used in rural industries.

The samples were collected and placed in plastic bags or aluminium foil. The weight of the sample and the container was recorded as well as the reason for collection. The samples were then brought back to the laboratory where they were weighed a second time and transferred to drying ovens. The losses of weight between collection and transfer to the laboratory and while in the drying ovens were added and compared with the initial sample weight to determine the moisture content. The samples were then screened and a sub-sample selected for testing in a bomb calorimeter to determine their heat value\*.

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\* The information determined from a bomb calorimeter is properly referred to as the calorific value or heat value, however, in parts of this report the terms energy content or heat content are used as synonyms though in fact they are not.

The data on moisture content was used directly in energy calculations concerning the samples. Since only a subset of the samples was tested for heat value, an attempt was made to determine standard values. The data on heat values of the dried matter were analyzed for consistency for each type of biomass and between points of collection. Where the energy content for a given type or species of samples proved to have a low variance, a standard number was calculated and used in the energy calculations for the untested samples.

#### 5.5 Stove Tests

Two stove tests, one for calculating absolute and the other relative efficiency, were conducted on 72 charcoal stoves and 58 wood stoves. For the first, the heat captured in the boiling water tests was computed by recording the increase in temperature of the water and the amount of water evaporated during the test. The calculation of heat released from the fuel was computed from the heat value and moisture content of the fuel and the amount burned. Where not directly measured, the heat value was estimated from the standard number for that fuel. The information on efficiency of different units was aggregated according to basic stove and fuel types. The reasons for variation in efficiency were examined to determine the important variables affecting stove operation.

#### 5.6 Charcoal Making Tests

The observations of charcoal making included the measurement of the fuel input to the process and the charcoal produced. This data was calculated on a weight and energy content basis for both inputs and outputs. The energy content was computed by taking samples of both the input fuels and the charcoal and performing tests for moisture and heat content. The information on the quality of charcoal (as measured by heat value and moisture content) and the efficiency of conversion (as measured by energy input versus energy output) was aggregated according to type of input fuels and kilns. The variables associated with the production process were then examined to determine their effect on the conversion efficiency and quality.

#### 5.7 Agricultural Field Residues

Where recent harvest activities had taken place or were about to occur, measurements were made of the amount of plant residue left in the field following harvest. A fixed area was demarcated and the residue within that area collected and weighed. A sample of the residue was taken and processed in the laboratory to determine the energy and moisture content. The energy content per unit area was calculated and statistics prepared for the same species in different locations. Factors affecting the variation in these statistics including density of planting and plant height were analyzed.

### 5.8 Animal Dung

Data on the amount of dung produced for different animals was collected by hiring villagers to observe the number of times during a day that the animals produced dung and then weighing typical feces. A sample was collected from these feces and sent to the laboratory for moisture and heat value measurements. This data was then used to calculate the energy content of the dung produced by the animal. Statistics were collected for the different species. Variations within species were compared with data collected on the size, sex and location of the animals.

### 5.9 Forests and Wooded Areas

The wooded areas which provide fuelwood for the survey villages were surveyed by demarcating a sample plot and inventorying the trees within that area for species, height, and diameter at breast height. This data was used to estimate the biomass productivity of the sample area and by extrapolation to the entire wooded area. Data on the uses of the different species was collected by interviewing villagers. Other sources of wood in tree crop areas, in agricultural fields and within household compounds were surveyed either through field measurements or as part of the household survey. The data included information on species and number of trees.

### 5.10 Graphical Data

Three types of graphical data were collected as part of the survey activity. The first is a land-use map for each village. The maps were drawn by the supervisors in the first phase and the forestry assistants in the second phase. The maps were prepared by direct survey of the area using motor-cycle odometers and compasses to layout the main village road as the baseline. From this baseline a grid pattern was walked by the enumerators with the land use being noted every half kilometer. The measurement of the  $\frac{1}{2}$  kilometer distance was accomplished by fixing the time of the enumerator walking cross-country. The maps with the land use marked on them were prepared in the field. Reproductions of these with a standardized scale and format were prepared by the project draftsmen at 1:10,000 scale. These were further reduced to report size. Copies of maps in the report format are included in the volume "Maps".

The second type of graphical information is the layout of the house compounds. For each house that was interviewed, the enumerator prepared a sketch of the land use within the compound including the buildings. The orientation of the compound with respect to magnetic north was also indicated. These drawings have been collected in their original form by changwat and are stored in folders at the project office.

The third type of graphical data are dimensioned field drawings of stoves, pots and charcoal kilns. These were prepared as part of the stove testing and charcoal making observation activities. These drawings are included with the backup data for the stove and charcoal files in the project office.

#### 5.11 Photographic Documentation

Each survey team was provided with a camera and film. They were instructed to take pictures of all stoves and charcoal kilns which were tested. In addition they took pictures of the village layout and architecture, major sources of biomass, appropriate technologies, and scenes of general interest. The supervisors and coordinators who took part in the rural industry survey were also provided with cameras and film and were instructed to take pictures of the establishment and the production activity. The film was Kodacolor II and prints were produced from all developable negatives. The negatives were catalogued by changwat, roll number and negative number and a brief description of the subject of each picture was provided. The prints were labelled as to the negative number, roll number, changwat number, and subject and were stored in photo albums. The albums were separated according to subject as follows :

Stoves

Charcoal making

Rural industry

General - Petchburi and Korat

- Korat, Kampanghet and Lampang

- Songkhla, Chantaburi, and Roi-et

- Udorn Thani and Chiang Mai

Training and personal

#### 6. Location of Data

About 60% of the information on the household questionnaires was entered on to computer tapes at the Asian Institute of Technology. A description of this data base and the means for analyzing are included in the "Researcher's Guide". Copies of the tape and access to the data are available for use by project and non-project researchers under the supervision of Robert Vernstrom, the project manager, and the research assistants responsible for programming.

The remaining 40% of the data collected in the questionnaire was manually processed by the survey staff. The data tables are stored in project files.

The nonhousehold questionnaires have been manually analyzed and the data work sheets are stored in project files. All completed questionnaires, household and nonhousehold, are stored in boxes at the project office.

A series of data files were compiled for the physical data collection activities. These include the data collection forms, backup calculation sheets, and preliminary graphics. The files are divided according to subject matter and stored at the project offices. The subjects are as follows:

1. Charcoal-Making
2. Stove Testing
3. Biomass Samples
4. Dung
5. Field Residues
6. Forests and Woodlots

A complete collection of prints and negatives for all photographs taken by the survey personnel is stored in photo albums and binders.

Typed copies of the essays prepared by the enumerators are stored in the project files by subject, changwat and village. The classification of the answers given in these essays is stored with the essay as are a limited number of English translations of the better essays.

Maps for each of the fifty-nine villages in report format were prepared with legends to describe the land use within the village. The field originals and report originals are stored in tubes at the project office.

## 7.0 Survey Reports

The integration of the various survey activities with the project renewable energy technology components is shown in Table 2. A series of 15 reports were prepared for the engineers and scientists participating in these components. A list of these reports is given in Table 4. The following paragraphs describe these reports.

### 7.1 Biomass Samples

This volume describes the collection of samples of various type of biomass including wood and charcoal fuels, agricultural residues, and dung from various types of animals. This report provides basic data on the energy content of different types of biomass in terms of calorific value at zero percent moisture content. The analysis of these samples and the evaluation of the methods of collection and analysis are meant to serve as a basis for further work on the project component "Biomass Surveys."

## 7.2 Trees

This volume contains the data collected concerning the availability and use of different species of wood within the survey villages. Also included are the observation of survey personnel as to the appropriateness of introducing woodlots into these villages. This report is meant to provide background information to those involved in the planning and introduction of village woodlots.

## 7.3 Stoves

This volume contains a summary of the results of the stove tests undertaken in the survey villages. The results include an analysis of the measured efficiency and rates of fuel consumption for the different types of stoves, a review of the different ways in which stoves are used, and the different types of foods and methods of cooking used with these stoves. This report is meant to provide basic information for the engineers involved in designing improved cookstoves.

## 7.4 Charcoal Kilns

This volume contains a description of the charcoal-making activities in the different surveyed villages. The kilns are subdivided according to technology and a comparison is made among them as to their operating characteristics and observed efficiencies. This report describes the charcoal making process and the manpower requirements for the different types of kilns. This report is meant to provide background data to the engineers involved in improving the efficiency of charcoal kilns.

## 7.5 Rural Industry

This volume contains the results of the rural industry survey which was conducted in parallel with the village energy survey. Included in this report is an analysis of the operating characteristics of the various types of rural industries. An analysis is made of the quantity of fuel and energy required to produce a fixed quantity of output in each of the industries. This report is meant to provide information for the engineers involved in industrial conservation about the quantity of energy consumed in rural industries.

## 7.6 Village Problems and Technology Selection

This volume contains a summary of the data collected from the observations and reports submitted by the survey supervisors. The information in these reports is meant to provide background data for all phases of the project. Included are the survey staff's evaluation of the

problems which are most important in each village and assessment of the appropriateness of each of the renewable energy technologies for these problems. Also included are observations regarding the existing paths of innovation in the village. Finally this report provides background information for the engineers working on solar drying and distilling and water-lifting.

### 7.7 Socioeconomic Data

This volume is the first of four describing the computer analysis of the questionnaire data. This report contains an analysis of the data on the age, education, activities, possessions, and employment of the members of the survey households in each of the villages. The data is summarized by changwat. Also included is an analysis of land holdings and land tenure systems in the villages. This report is meant to provide information on the land and labor resources in the villages which could be used by the renewable energy technologies.

### 7.8 Cooking, Lighting, and Heating

This volume describes the energy requirements of the three major domestic activities which consume fuels. This description includes the type of activities, the frequency of occurrence, and the amount of energy required for cooking, lighting and heating. Also included is an analysis of the physical measurement of household fuel-use. This report is meant to provide background information for the designers of stoves, charcoal kilns, and woodlots on the quantity of energy used in the typical household.

### 7.9 Agricultural and Livestock Data

This volume describes the agricultural activities in the survey villages including growing crops and raising livestock. The cultivation of crops is described in terms of the inputs of land, labor, and agro-chemicals and the output yields. The livestock data describes the pattern of ownership for different types of animals as well as the use of these animals for labor, food and income, and as a source of manure. This report is meant to provide additional data on the use of land and labor as well as the availability of residues for the project components concerning biogas and gasification.

### 7.10 Community Structure, Credit, Health, Water Supply and Transportation

This volume concludes the series on computer analysis of the questionnaire data. Contained in this report is information on village groups, activities and development projects which is meant to provide insight into the social organization of the village in which the renewable energy technologies are being introduced. Data is also provided on existing sources of credit which could be utilized for financing the more capital-intensive renewable energy projects. The data on the type and

location of water suppliers is analyzed to provide background data for the engineers involved in the project component on waterlifting. The data on health and transportation have no direct relevance for the renewable energy technologies. However, the former provides insight into health problems in the village, the use of different health care delivery systems and access to modern technology which improves the quality of life. The latter identifies a major energy-consuming activity which may benefit from future developments in gasification and alcohol production.

#### 7.11 Questionnaires

This volume is prepared in both English and Thai and contains copies of all documents used for data collection in the field survey.

#### 7.12 Amphoe Profiles

This volume, available only in Thai, contains background data on the amphoes in which the survey villages are located. These essays were prepared by the field supervisors from data available through observation and from the local government offices. They are meant to provide background information for planners involved in introducing the renewable energy technologies into the villages and their surrounding areas.

#### 7.13 Base Maps

This volume contains maps of the 59 villages surveyed. The maps are drawn to scale and include land use within the village. These maps are meant to provide general geographic information for the planners involved in introducing the renewable energy technologies.

#### 7.14 Phase III

Whereas the first ten volumes describe the results of the Phase I and Phase II surveys in ten provinces and 50 villages, this report presents the data from the Phase III study in Nan, Burirum and Chiang Mai which was being conducted while the other reports were being prepared. The data presented in this report includes the computer analysis of the questionnaire data, as well as the manually processed questionnaire data and the categorization of the surveyors' essays. The format of the presentation is similar to that of the previous texts except that no text is included in the report.

#### 7.15 Researchers Guide

This volume provides computer documentation on the file structure of the data, the software used for analysis and the procedures for using the AIT/IBM computer system. This guide is meant to assist researchers in accessing the data base to perform additional analyses or to produce data summaries on a village rather than changwat basis.

The originals and a limited number of working copies of the reports are stored in the project office. A summary of the location of all data is shown in Table 5.

The individuals who participated in this survey effort are from a variety of technical backgrounds. Their contributions, great and small, are too numerous to mention. The roster in Table 6 is a small recognition of their immense contribution.

Table 3  
Projects Integration Surveys

Data Collection	Data Processing	Application To Components	Follow-Up Activities
<u>Household Survey</u>			
1. Employment	Computer statistical analysis	Social and physical resources for all components.	Evaluation surveys (post implementation)
2. Cooking, Lighting	" "	Rural cookstoves	" "
3. Agriculture	" "	Biomass survey, gasification, bio-gas	" "
4. Livestock	" "		" "
5. Water	" "	Waterlifting	" "
6. Social Structure	" "		" "
7. Credit	" "	Social and financial resources for all components	Introduction and dissemination of new technologies
8. Health	" "		
9. Fuel Use		Woodlots, charcoal kilns	
<u>Participant Observation</u>	Essay analysis	Waterlifting, solar crop drying, biomass survey, cookstoves, charcoal kilns, gasification	Selection and introduction of new technologies
<u>Biomass Collection</u>	Laboratory	Biomass survey, biogas gasification	
<u>Stove Experiments</u>	Graphical and statistical analysis	Rural cookstoves	

Table 3 (continued)  
Projects Integration Surveys

Data Collection	Data Processing	Application To Components	Follow-Up Activities
<u>Charcoal-Making Observations</u>	Graphical and charcoal kilns statistical analysis		
<u>Woodland Measurements</u>	Statistical analysis	Woodlots	
<u>Land Use Survey</u>	Map making, planimetry	woodlots, all components	
<u>Rural Industry Survey</u>	Graphical and statistical analysis	Industrial Conservation	
<u>Appropriate Technology Survey</u>	Statistical	All	

Table 4  
List of Survey Reports

Survey Guide\*

Biomass Samples

Trees

Stoves

Charcoal Kilns

Rural Industry

Village Problems and Technology Selection

Socio-Economic Data

Cooking, Lighting, Heating

Agricultural and Livestock Data

Community Structure, Health, Water Supply,  
and Credit Transport

Questionnaires\*

Amphoe Profiles<sup>+</sup>

Base Maps: Nation, Changwat, Villages

Phase III: Nan, Burirum, and Chiang Mai

Researcher's Guide

\* Thai and English Versions Available

+ Thai only

Table 5  
LOCATION OF DATA

<u>SUBJECT</u>	<u>LOCATION</u>	<u>FORMAT</u>
Household survey questionnaires	Project offices	Boxed by changwat
Other questionnaires	Project offices	Stored in binders
Essays	Project offices	Typed copies filed by subject, changwat
Calculation sheets for manually processed data	Project offices	in file folders by subject
Photographs	Project offices	in photo albums by subject and changwat
Negatives	Project offices	in plastic holders in notebooks indexed by roll number, changwat
Maps	Project offices	Field originals and report originals stored in tubes, report copies on file
Other graphics	Project offices	Originals in tubes, report copies on file
Survey reports	Project offices	Original stored in files
Household survey data	Project offices	Data tapes stored in files
Data analysis programs and output	Project offices	Stored in binders
Laboratory reports	Project offices	in file folders

Table 6

List of Participants and Organizations  
(in alphabetical order by first name)

Project Supervision

Robert Vernstrom	Meta Systems Inc.
Minh Silawatsnananai	USAID
Dr. Nob Satyasai	Thai Group
Rod MacDonald	USAID
Dr. Russell deLucia	Meta Systems Inc.
Sompongse Chantavorapap	National Energy Administration

<u>Survey Co-ordinators</u>	<u>Organization</u>	<u>Speciality</u>
Dr. Amara Pongsapich	Chulalongkorn University	Anthropology
John Arnold	Meta Systems Inc.	Energy Surveys
Lect. Kassem Burakasikorn	Chiang Mai University	Field Sociological Surveys
Lect. Kobkul Phutaraporn	Chulalongkorn University	Sociological Surveys
Ladda Vivathanavanich	Thai Group	Public administration
Dr. Mary Elmendorf	Meta Systems Inc.	Anthropology
Lect. Sompong Shevasunt	Chiang Mai University	Sociological Survey
Lect. Supachi Suetrong	Khon Kaen University	Agricultural Economics

Research Personnel

Dr. Chocmpol Ngampongsai	Kassetsart University	Scatology
Dr. Kassem Chunkao	Kassetsart University	Watershed Management
Dr. Snit Aksornkoe	Kassetsart University	Forestry
Supot Pakyoo	National Energy Administration	Industrial Engineering

Research Assistants (Survey Supervisors)

Aree Wongnopalert	Chulalongkorn University	Stove testing
Buaphan Pukting	Chiang Mai University	Biomass assessment
Chantana Eanpasirishot	Chulalongkorn University	Sociological Survey
Damrongchai Pumsanguan	Chulalongkorn University	Charcoal-making
Jamlong Tamasorn	Chiang Mai University	Criminal investigation
Lertchai Kwankonchim	Khon Kaen University	Woodlots
Padet Saenpetch	Chulalongkorn University	Solar heating, Pyrolysis
Siluck Ponnoum	Chulalongkorn University	Stove design
Sompong Aiemyjoy	Thammasart University	Sociological survey
Suwanapong Tongpew	Khon Kaen University	Plant biology
Veerasuk Sorralump	Thai Group	Construction
Visoot Visetchinda	Kassetsart University	Computers

Technical Assistants

Manu Vivathanavanich	Thai Group	Public Administration
Adulrat Tungtaevee	Kassetsart University	Forestry
Suparat Somrang	Kassetsart University	Forestry
Siri Akaart	Kassetsart University	Forestry
Narong Mahannop	Kassetsart University	Forestry
Somkit Tarumartsavat	Kassetsart University	Forestry

Laboratory Analysis

Somkit Tarumartsavat  
Suparat Somrang  
Songpol Savatum

Kassetsart University  
Kassetsart University  
Chulalongkorn University

Dr. Kassem Chunkao  
Dr. Poonporn Saengbangpla

Kassetsart University  
Chulalongkorn University

Watershed Managem...t  
Chemical Engineering

EDP Support

Nattachavi Kunaporn  
Chantana Banpasirishot  
Regino Gonzales

Chulalongkorn  
Datamat, Inc.  
A.I.T.

Data entry programming  
Data entry  
Computer administration

Report Production

Patricia Ferguson  
Roongrat Prompriang  
Lyn Pohl  
Jakrit Chernphan  
Watcharee Chalorkunwat  
Gail Peterson  
Melissa Swanke  
Chris Barr  
Mary Rutkovsky

Meta Systems  
Thai Group  
Meta Systems  
Thai Group  
Thai Group  
Meta Systems  
Meca Systems  
Meta Systems  
Meta Systems

Administrator  
Secretary  
Secretary  
Engineering Graphics  
Typist  
Word Processor Operator  
Word Processor Operator  
Word Processor Operator  
Word Processor Operator