AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: Social Science

B. SECONDARY: Development Planning

2. TITLE AND SUBTITLE

Social factors in reservoir-settlements and an adaptation of scalogram analysis with application to the Mekong Basin Pa Mong dam project

3. AUTHOR(S)

Voelkner, H.E.; Schwartz, C.M.; Oliveri, W.B.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1972	136 p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Harold E. Voelkner, Consultant

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

This study constructs measures of the degree of institutional complexity in the various village communities of the Pa Mong Reservoir area and then maps them so that the regions and sub-regions show up. It emphasizes the institutional complexity of communities, thus the different levels of development of these communities. Specifically, the objectives were: 1) To apply scalogram analysis (the comparison of certain village structural characteristics with a theoretical model so as to depict the structural development levels of villages and inter-village social systems for the area under study). The theoretical framework used is structural-symbolic theory which claims that the evidence of social life is social symbols. 2) To demonstrate the feasibility of using aerial photography data to derive data for scalogram analysis. 3) To apply the results of the above to relocation planning and costing. 4) To estimate the extent of population and settlements displaced by the Pa Mong Reservoir at both 250 and 230 meters above sea level. Two general conclusions were reached: 1) That the concept of relocation of communities within a regional context be applied to reservoir-displaced populations, and 2) That there are new ways of analyzing data which previously have been considered unusuable for statistical programming and analysis.

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-AAC-248	
12. DESCRIPTORS	13. PROJECT NUMBER
	14. CONTRACT NUMBER: AID/EA-147 (Regional)
	15. TYPE OF DOCUMENT

AID 590-1 (4-74)

TH
301.35
V919

AEN/EA-147
PN-AAC-248

SOCIAL FACTORS IN RESERVOIR - SETTLEMENTS RELOCATION AND COSTING FACTORS

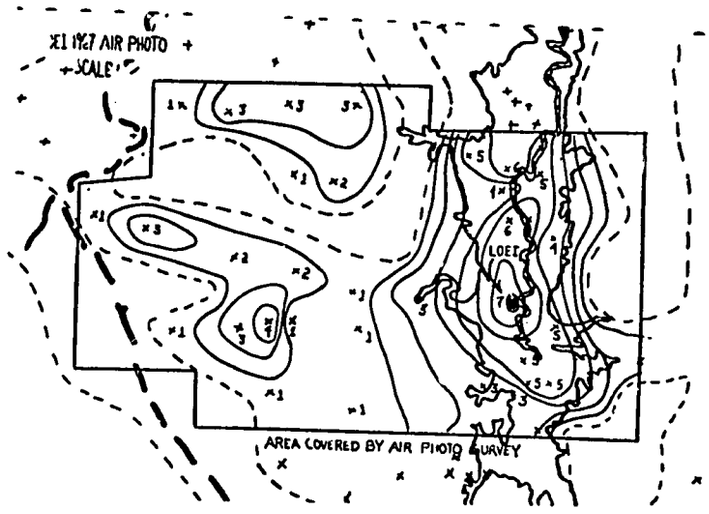
AN ADAPTATION OF SCALEOGRAM ANALYSIS USING AERIAL PHOTOGRAPHY AND GROUND SURVEY DATA

APPLIED TO THE

MEKONG BASIN PA MONG DAM PROJECT

H.E. VOLKNER

1972



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Prepared for
Agency for International Development
Department of State
and
The Mekong Committee

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Applied To The
MEKONG BASIN PA MONG DAM PROJECT

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AID/ea-147

Prepared for the

Agency for International Development
United States Department of State

and

The Mekong Committee

1972

This second printing, May 1972, contains numerous corrections and a re-organization; Section "Sub-regions in the Pa Mong Reservoir Area" has been moved from Chapter III-B to Chapter II-A.

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ACKNOWLEDGEMENTS

In December 1970, the Agency for International Development engaged me by direct contract (contract AID/EA-147(Regional) PIOT-T498-220-3-1004) to conduct a social study of the Pa Mong area in the Mekong Basin. The project included a Participating Agency Services Agreement (PASA EA (DC) 11-71) between AID and the Engineer Agency for Resources Inventories (EARI), under which EARI provided aerial photography, logistics support, facilities and personnel to assist me in my study. This report is the result of that study. It must be emphasized that the views expressed in this report are solely my own and do not represent either those of AID or EARI.

I wish to take this opportunity to acknowledge here the cooperation of the individuals and agencies who contributed to the results of this study.

EARI was particularly helpful and accommodating in extending the use of facilities and resources provided for the project over a longer period than originally planned. I particularly express my gratitude to several individuals at EARI who became involved in the project beyond the obligations of the Participating Agency Services Agreement. Mr. Charles M. Schwartz, assigned Senior Photo Interpreter to the project, was extremely helpful in coordinating project tasks within the agency. He also provided, on his own time, much editorial and research assistance. Mr. Arnold Shadrick assisted me on various mapping and printing matters. At no cost to the project, he obtained the services of the 30th Engineer Battalion whose trainees identified and measured all fields and uncultivated land on the photo mosaics. I want to thank those men in the battalion who thus worked for this project. Mr. Louis Koffman arranged for the use of the computer facility, which was essential to this project, at the National Bureau of Standards.

Several individuals and agencies in Thailand gave invaluable support. I am especially indebted to Dr. James Hoath, Chief of the Research and Evaluation Division of the AID Mission in Thailand, who made needed resources available to me. The reputation of USOM and Dr. Hoath's personal and professional stature in Bangkok facilitated my search for ground data relevant to this study. I am grateful to the Thai National Statistics Office (NSO), specifically, to Captain Amnat Sangmanee of the Data Services for Regional Planning Unit, to the Office of Accelerated Rural Development (ARD), and to the Advanced Research Projects Agency (ARPA), for special efforts made to provide me with the most relevant ground data sets.

Translations from Thai to English were done by Mrs. Anong Isarabhakdi. Her good work made possible the inclusion of ARD data and maps in the study.

I owe more personal and longstanding debts of gratitude to those who were most directly and fundamentally involved with this study. Professor Frank W. Young, scholar and social scientist, laid the foundation of concepts and methodology which were applied and demonstrated in this project. As consultant to this study, he contributed substantively and provided encouragement and constructive criticism. To my friend and colleague, Barton Sensenig III, my gratitude and appreciation for developing the Scale I program. The

results of this program are well worth the frustrations he experienced in its development. Finally, a special acknowledgement to Mr. William B. Oliveri, without whom the data processing for this project could not have been completed. He worked beyond the financial resources of the project, staying on to complete the processing of the data sets, drawing the final copy of isopleth maps and sketching reservoir outlines. I express my sincere appreciation for his sustained interest and productivity and hope that the insights, knowledge and skills he gained from the project made the experience worthwhile.

FOREWORD

Frank W. Young *

This report presents two general conclusions:

1) That the concept of relocation of communities within a regional context be applied to reservoir-displaced populations.

2) That there are new ways of analyzing data which, heretofore, have been considered unusable for statistical programming and analysis.

By stressing the concept of relocation of communities within a regional context, the report merely dramatizes the fact that humans live in groups and cannot survive outside of groups, therefore, if they are to move, they must move as social units and not as individuals. Relocation requires the maintenance of communities and provision for their survival. This emphasis is eminently practical. Resettlement programs that give individuals or individual families a certain amount of money and advice on how to get to a new site prove to be extremely costly in the long run. The government typically ends up with an unorganized, undisciplined mass of dependents. However, there is reason to believe that relocation plans that take account of the functioning communities will be cheaper in the long run as well as easier on the individuals. Given half a chance, human communities can adapt to a variety of circumstances. In fact, it is not too much to say that only social organizations, such as communities, can make the best of a typically unpredictable situation such as geographical transfers. If kept intact, they can construct the new houses, roads, bridges, etc. and all the other community artifacts on which some governments spend great sums of money, only to discover that the people cannot or will not use the facilities in the form they have taken. So, relocation instead of resettlement is practical, even in the short run, and much of the analysis presented here works through this basic insight.

This study constructs measures of the degree of institutional complexity in the various village communities of the Pa Mong Reservoir area and then maps them so that the regions and sub-regions show up. It emphasizes the institutional complexity of communities, thus, the different levels of development of these communities. Communities show a complex division of labor that is realized in the form of institutions, that is, stable patterns of belief, activity and artifact. The technique used here, Guttman scaling, converts the presence or absence of institutions into a quantitative measure. It converts a list of dichotomous attributes into a single yardstick for measuring social complexity. From that point forward, standard statistics can be used and correlations with all the other available data, qualitative and quantitative, can be presented.

The theoretical framework used in this study is structural-symbolic theory which claims that the stuff of social life is social symbols, a term that stands for the institutional patterns referred to above. However, when one thinks of the meaning of "symbolic", it is apparent that all the expressions of human activity — sounds, behavior patterns, artifacts — can be vehicles

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for conveying meaning. Thus, if the atoms of society are social symbols, we can find them by paying attention to representative speeches, institutionalized behavior and artifacts. When it comes to measuring a fundamental dimension of symbolic structure, such as institutional complexity, we may do so by noting the different institutionalized establishments in a village, the different ideas expressed in speeches, or the different community-level artifacts that show up on aerial photographs. Any one of the three types of data should give the same result since institutional complexity is reflected in all of these items. It is this theoretical assumption that prompts this study to compare scales of institutional complexity based on census data with aerial photography data. Symbolic complexity should show up equally well on either type of data and the correlations of the various scales suggest that the assumption is true.

Structural-symbolic theory minimizes the use of the conventional sectoral labels, such as economic, religious or technological. These are terms that make sense in a complex society that needs labels to keep everything straight, but they are insignificant in a general theory of social organization that starts with the assumption that social symbols are the building blocks of society. While it is true that scales of institutional complexity can be constructed from attributes which can be categorized as economic, religious or technological, these scales give similar results and tend to merge into one large inter-correlated bundle. Extended experience with these measures makes one lose any strong belief in the conceptual or empirical distinctiveness of the sectoral categories. This interest in "systemic" dimensions, in contrast to the conventional emphasis on sectoral measures, tends to set this particular theory apart from most purely economic-oriented conceptions. The contrast emerges in the discussion of "central place theory" which, fundamentally, is an economic theory.

The two other variables discussed in this report, centrality and solidarity, simply capture other patterns that social symbols typically take. These concepts are linked together by a set of hypotheses. One of the most straightforward of these hypotheses states that the level of institutional complexity of a village is correlated with its centrality, that is, its niche in the hierarchy of communities of which it is a part. This hypothesis is reflected in the hierarchies and central villages presented in the study. The central villages are seen as innovative nodes. New ideas and practices spread from these out through the network of communities to the periphery. The process is not always so automatic, particularly if a constraining government has control of the central villages, but there is a tendency in this direction. Extremely interesting evidence on this point is shown in terms of the spread of corn and kenaff in one section of Thailand in 1968-1969. It is likely, of course, that some of these central villages are more innovative than others and the determination of this tendency is as yet an unsolved problem. Structural-symbolic theory would point to the degree of solidarity, that is, the mobilization of the village in terms of religious, political or other types of frameworks, as a basis for this innovative tendency.

If the reader keeps in mind the underlying themes, the technical details will fall into place. No matter what the assessment of these technical conclusions may be, the general conclusions that relocation of communities is a significant and more functional concept for reservoir-displaced populations involving regional social systems, and that there are new ways of analyzing social, qualitative data which, previously, have been considered unusable for planning and decision making, are inescapable.

Cornell University March 1972

INTRODUCTION

A. Objectives

At the start of the project, the objectives were three-fold:

1. To apply scalogram analysis (the comparison of certain village structural characteristics with a theoretical model so as to depict the structural development levels of villages and inter-village social systems for the area under study) to certain areas in the Pa Mong region.

2. To demonstrate the feasibility of using aerial photography data to derive data for scalogram analysis.

3. To apply the results of the above to relocation planning and costing.

During the course of the study, a fourth objective was added:

4. To estimate the extent of population and settlements displaced by the Pa Mong reservoir at both the 250 and 230 meters above sea level.

B. Scope of the Study

The initial proposal and funding for this project covered primarily the analysis of aerial photography data. Possibilities for comparative analysis were left open, subject to the event that AID/RED in Bangkok could obtain existing ground data and deliver them to the United States for analysis. However, upon the approval of the contract, permission and additional funds were given to the researcher allowing him to stop over in Bangkok for two weeks for the purpose of locating and obtaining during this period any ground data for the Thai side of the Pa Mong region existing in Bangkok.

The data identified and later obtained from the various offices in Bangkok are listed in the following Table A, together with the districts covered. The accompanying Map A clarifies the geographic location and names of these districts.

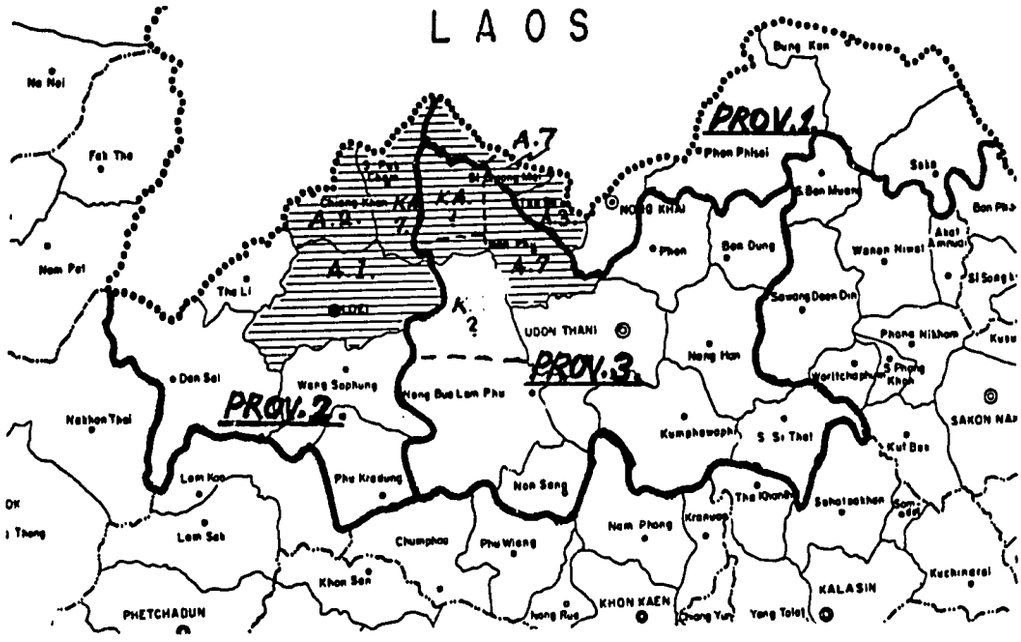
As shown in Table A, a large amount of data from various sources was located and obtained during this two weeks search. This "shot gun" approach was necessary since the quality of the data required for a valid comparison with aerial photography data could not be ascertained right then and there but the objective of obtaining one usable data set still had to be achieved. The amount of ground data which the project had to handle generated several problems and dilemmas.

Some types of data, particularly the 1970 Census data, involved additional costs not provided for in the original contract. Needed funds were added later by AID. Most of the data sets, the 1970 Census data again included here, arrived close to the original project completion data. All these data sets had

MAP A

DISTRICTS IN PA MONG RESERVOIR

FOR WHICH DATA ARE AVAILABLE



THAILAND

Shaded areas denote districts (amphoes) for which data are available:

Province 1: NONG KHAI

A.3	Thabo
A.7	Si Chiang Mai
K.A.2	New K. A. Nam Som Valley

Province 2: LOEI

A.1	Muang
A.2	Chiang Kham
K.A.7	Pak Chom

Province 3: UDON

A.7	Ban Phu
K.A.2	New K. A. Nam Som Valley

TABLE A
DATA COVERAGE

IDENTIFICATION OF DATA SETS AND SPECIFIC DISTRICTS COVERED
(identified by a X)

DATA SETS	DISTRICTS							
	Province 1			Province 2			Province 3	
	A3	A7	KA/NS	A1	A2	KA7	A7	KA/NS
A. Data Fully Processed and Used in Report								
1. 1967 Air Photo	X	-	-	X	-	-	-	-
2. 1970 Thai Census (NSO)	X	-	-	X	-	-	-	-
3. 1969 Village Survey (NSO)	X	X	-	X	X	-	X	-
4. 1968 ARD Village Survey	X	X	X	-	X	X	X	X
5. 1968 ARD Village Maps	X	X	X	-	X	-	X	-
6. 1968 PA Mong Reservoir Maps 1:20,000 scale		THE	TOTAL	RESERVOIR			AREA	
B. Data Fully Processed - Not Used in Report								
7. 1967 USOM USBR	X	X	(and	other	districts)-		X	
C. Data Processed Until Determined Not Usable								
8. 1954, 1961 Aerial Photography	X	X	X	X	X	X	X	X
9. 1960 Census Data (NSO)	X	X	X	X	X	X	X	X
10. 1962 Agricultural Census Data (NSO)	X	X	X	X	X	X	X	X
11. 1969 USBR	X	X	(and	other	Districts)-		X	-
12. 1968 ARPA-SRI Border Security Survey	X	X	X	-	X	X	-	-
13. NSO Provincial Map Overlays	-	X	X	X	X	-	-	-
14. NSO Provincial Map and Data Book	X	X	X	X	X	X	X	X
15. ARD Coop. Survey Data (1966-1969)	X	X	X	-	X	X	X	X

to be processed (documents in Thai translated into English, villages identified and matched, data coded and computer run) in order to determine their quality and comparability. The completion date of the project had to be extended substantially. The extensive computer processing required additional funding which was also provided by AID.

Another objective added during the course of the study expanded its scope further. This objective involved the identification of all settlements located in the reservoir area on new 1:20,000 scale reservoir maps which was done by EARI. An estimation of the potentially displaced population was made, based on available ground and aerial photography data from as many of these villages as possible.

In summary, the scope and content of this report has widened considerably from what was originally proposed and funded.

C. Methodology

This study primarily uses scalogram analysis as a measurement tool ideally fitted to work within the premises of structural-symbolic theory. Scalogram analysis measures social structure which is represented in identifiable "social symbols" systematically recognized and utilized by society.* Structure is easily identified qualitatively, although it always has quantitative aspects in terms of its dimensions such as quantities of consumption or production. Quality and quantity are opposite sides of the same item. There can be no structure without some specific qualities and quantities. Scalogram analysis permits us to concentrate on the measurement of the qualitative side of items which, so far, has been largely unmeasurable.

Qualitative structure has its own laws. A useful analogy may be the difference between molecular structure in chemistry and atomic forces in physics. Parts of qualitative structures, like atoms in molecules, connect in definite, logical ways. There appears to be a fundamental law in structural growth which states that there is a sequence in the accumulation of new parts. It is this systematic order of structural systems and growth which scalogram analysis can measure. Applied geographically, it is the complexity of structure in social units like villages and towns which establishes their relative hierarchy.

A clarifying note is made here: Because this project demonstrates the applicability of scalogram analysis within the parameters of structural-symbolic theory, it may be concluded that the technique used and the theory are fundamentally dependent on each other. This is not the case. Guttman scaling is the scaling technique used in this study. However, Guttman scaling is only a method to systematically re-arrange data according to certain rules to bring out a pattern present in the data. A Guttman scale can be interpreted by other theories or without using any theoretical frame of reference.

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* Frank W. Young, a major proponent of and contributor to structural-symbolic theory, defines social symbols as the institutional patterns or the stable patterns of belief, activity and artifact developed in communities. (Ref., Foreword to this report.)

Following is a list of the research activities conducted in this study:

1) Obtained data for project. (See Table A for different types and sources of data and the areas covered in the study.)

2) Identified on maps all the villages in the data sets to assure that data obtained from different data sets pertained to the same village.

3) Processed qualitative data by the technique of Guttman scaling.

4) Analyzed scales produced by above technique in terms of the relative levels of development of the villages.

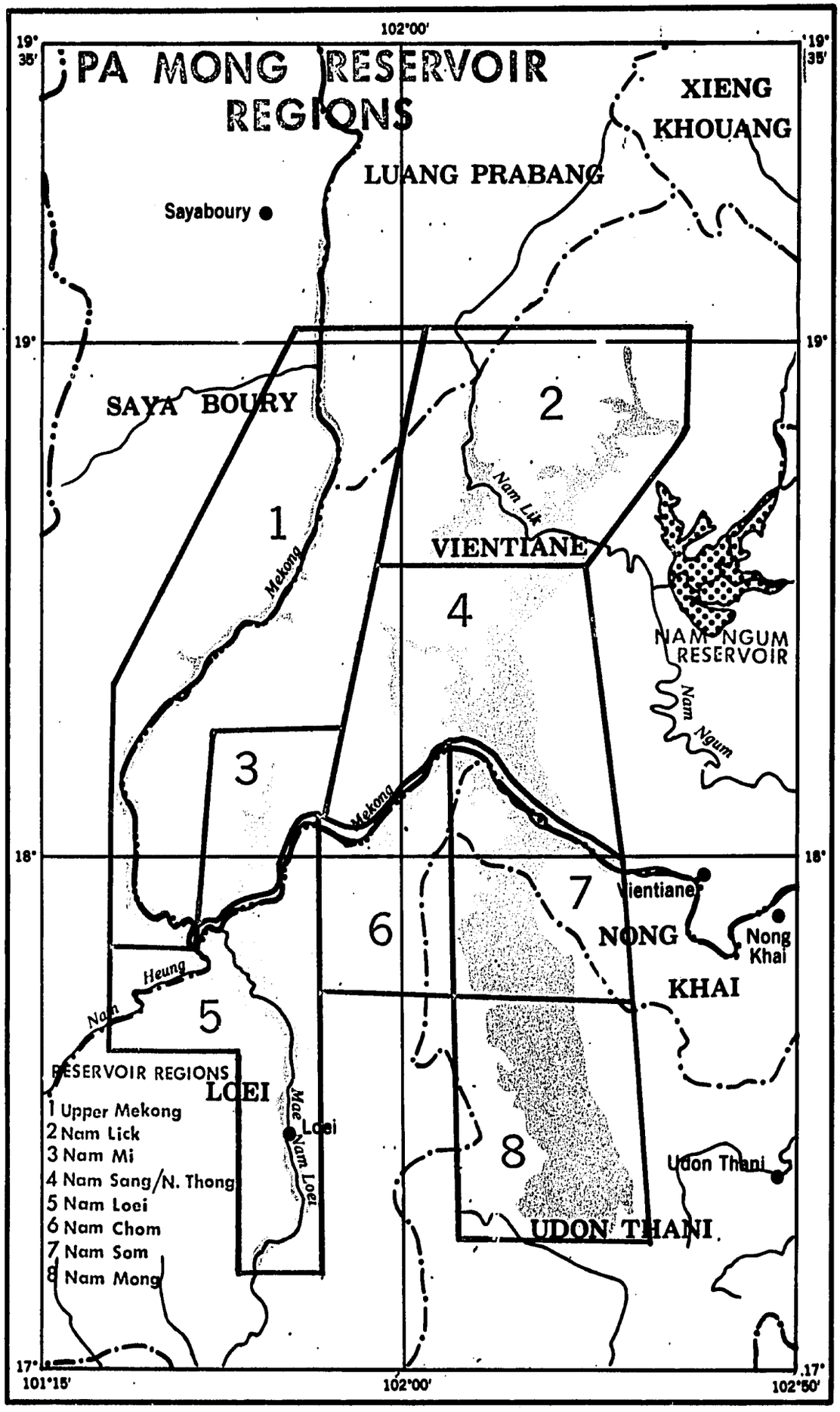
5) Used scale scores to construct isopleth maps which identified central villages and micro-regions and analyzed distance patterns between them.

6) Superimposed the Reservoir outlines of 250 meters level and 230 meters level on the isopleth maps to identify the degree of reservoir intrusion into the micro-regional pattern.

7) Processed quantitative data from different data sets by correlation and factor analyses.

8) Identified the location, elevation and distance from the shoreline of all settlements in the Pa Mong reservoir below the 250 meters and 230 meters, elevations. Population estimates were made based on ground and aerial photography data for many of these villages.

9) Re-estimated relocation costs for three Pa Mong reservoir sizes: Plans 250m and 230m levels and 230m level without Nam Lick and Nam Mong valleys plan 230A. Re-calculated the optimal reservoir size in terms of cost of produced electricity.


PA MONG RESERVOIR REGIONS
102°00'
19° 35'
19°
18°
17°
101°15'
102°50'
XIENG KHOUANG
LUANG PRABANG
Sayaboury
SAYA BOURY
VIENTIANE
NAM NGUM RESERVOIR
Nam Ngum
Nam Lik
Mekong
Heung
Nam
Mae Nam Loei
Loei
LOEI
Vientiane
NONG KHAI
Nong Khai
Udon Thani
UDON THANI
1
2
3
4
5
6
7
8
RESERVOIR REGIONS
1 Upper Mekong
2 Nam Lick
3 Nam Mi
4 Nam Sang/N. Thong
5 Nam Loei
6 Nam Chom
7 Nam Som
8 Nam Mong

SUMMARY

A. Findings and Conclusions

Objective A: Scalogram Analysis as a Tool for Measuring Village Development Levels and for Depicting Inter-Village Systems

1. Scalogram analysis of several data sets, ranging from aerial photography data to village survey data, identified the relative levels of development of all the villages included in the study, in terms of the diversity of structural attributes of each village. (Chapter II - all)

2. Scalogram analysis of different data sets identified consistently the same geographical pattern of micro-regions consisting of groups of villages clustering around central villages.

The Central Village is identified as the most highly developed settlement in a micro-region. Identification of central villages was done by isopleth mapping of village scale scores. The scale score of a village ranks it within a hierarchy based on the diversity of structural attributes. Structural attributes are the qualitative aspects contained in a data set, such as, well, school, temple, dirt road, paved road, water tower, market hall. (Chapter II)

3. Isopleth mapping showed that distances between central villages are, on the average, very uniform in relation to population density per utilized land area. This finding is almost identical with the finding in China on the distance between market towns. It can be concluded that the evolution of central places begins long before economic and commercial market forces exist in a society and that social service and communication functions are causal. The apparently universal existence of micro-regional patterns holds important implications for relocation planning and costing. (Chapter II-A-1)

4. A comparison of scale scores with factor scores shows that both scalogram and factor analysis methods identify the same central villages but that scalogram analysis identifies central place patterns with more sensitivity, using less complicated processes and data which cannot be processed by aggregative statistics. (Chapter II-B-3)

5. More specifically, isopleth maps of scale scores from the NSO village survey data demonstrate the following:

a. the function of central villages as innovation nodes;

b. the effectiveness of scalogram analysis in utilizing the qualitative content of data with doubtful quantitative accuracy. (Chapter II-C-1)

6. Combined with available computer processing technology for scaling and contour mapping, micro-regional development diffusion maps could be produced from the NSO village survey data for at least those regions covered by the current survey system, and kept updated. (Chapter II-C-1)

7. The agricultural data from the Accelerated Rural Development Program survey reveal that the Pa Mong region on the Thai side has a relatively diversified agriculture and, more importantly, that villagers are aware of and desire modernization and commercialization now. (Chapter II-C-2)

8. Non-agricultural needs expressed in the ARD Program survey indicate both an opportunity and potential danger for the Government. People in each village who answered the survey questions and expressed their needs appear to be positively inclined towards the government and willing to cooperate in solving the security problems. They expect government officials to improve their actions and to provide arms and personnel for the better self-protection of the villages. The danger lies in disappointing these expectations and causing a shift in attitudes and actions which could endanger the Pa Mong project. (Chapter II-C-3)

Objective B: The Possibility of Using Aerial Photography to Derive Data for Scalogram Analysis

1. The comparison maps using the scale scores derived from aerial photography and census data show that, in general, the micro-regions and central village locations identified by either data set are almost the same. This visual evidence is further supported by the correlation coefficients and factor analysis results, indicating that for the purposes of scalogram analysis, aerial photography data are a valid and useful alternative to detailed ground data. The major implications are:

a. Aerial photography data can be used to measure structural development levels of micro-regions.

b. This data source is particularly crucial for areas which are remote and have limited access for ground data surveys.

c. This data source is preferable for any region where the collection of data from aerial photos is less expensive than through ground surveys (which is the case when aerial photos have been taken already for other purposes, as was the case in the Pa Mong area). (Chapter II-B-3)

2. The aerial photo scale produced in this study appears consistent with a major premise of structural-symbolic theory, namely, that structural differentiation (or development) is a uni-dimensional process. In applied terms, this means that it is only necessary to measure the increasing complexity of one sector, such as education or transportation or industry, in order to identify the relative development levels of settlements or other units. (Chapter II-B-1)

Objective C: Application of Findings to Relocation Planning and Costing

1. A review of several large scale dam projects indicates that a satisfactory relocation of displaced populations has, so far, never been achieved. (Chapter I-A & B)

2. From the planning viewpoint, a major reason for the above situation can be attributed to the fact that studies identifying the feasibility and costs of relocating populations from reservoir areas have been largely neglected. Three basic causes can be identified:

a. Policymakers in both donor and host country organizations, who decide and define how, when and where the feasibility study for dam projects should be made, did not define requirements for social and human feasibilities and costs.

b. Policymakers in sponsoring countries of people-dislocating projects did not appear to recognize that they also bear some degree of responsibility to insure that studies, adequate by international standards, are carried out on the social feasibility of such projects.

c. Presently at the contractor level, there is inadequate technology and expertise available to design and implement social feasibility studies for dam projects. In fact no experienced contractor seems to exist anywhere in this field. (Chapter I-B)

3. In terms of population, property and benefits displaced, the Pa Mong project, at the 250 meters above sea level, is potentially the largest project ever attempted in the world. Compared with the African large scale hydro-projects, the Pa Mong project is also relatively very expensive in terms of two new indices: a) the number of people displaced per Km.^{3} reservoir volume, and b) the population and/or property cost per generated megawatt of power. (Chapter I-E)

4. In defining costs for Mekong Committee Guidelines for Resettlement, the ultimate fair value of present improvements for relocation without loss is identified as replacement cost. Only if all economic and social benefits presently existing for the population in the reservoir area, which includes their community and micro-regions, are replaced at the new site would no loss occur. The only cost estimation and relocation methods which would satisfy the Mekong Committee guidelines, therefore, are:

a. Costing of all present structures, private and public, should be made at replacement costs and not at either market value or investment minus depreciation of physical structures only in order to avoid substantial losses in tangible benefits by relocation.

b. Community relocation site selection must aim to find new location sites at the shoreline of the shortest possible distance from the old location of the community to obtain reservoir benefits in payment for irreplaceable losses and to avoid loss of regional benefits.

c. The relocation of communities with reference to micro-regional patterns is essential to avoid many social and economic costs.

d. In essence, the level of living of families and communities, by whatever method it can realistically be achieved at the new location, should at least be no lower than it had been at the original location of livelihood. Livelihood or level of living here include all aspects of living, not just the monetary amount of annual income usually computed by economists. Level of living includes also aspects of status, service and benefits received from the community and the region surrounding it. (Chapter I-E)

5. It would be ideal to actually cover all potential costs incurred by the relocated populations through a combination of the above mentioned methods. However, project and/or national realities may prevent achieving this ideal. Nevertheless, assessing total costs should be mandatory for decision makers under any circumstances, so they can base their decisions on all relevant facts. If the reservoir population (the Few) have to pay for the benefit of the nation (the Many), then at least decision makers in donor and host countries alike, if not the whole nation, should know exactly how much the "few" had to contribute for the benefit of the "many". (Chapter I-E)

Objective D: Settlements and Population in the Pa Mong Reservoir Area at 250 meters versus 230 meters above sea level

1. An important dimension of relocation involves the major differences in development and relocation problems among the sub-regions formed by the major branches of the Pa Mong Reservoir. These branches which are situated in the basins of the tributaries to the Mekong River are identified in Map 1. (Page 6)

2. The total length of the shoreline, at the 250 meters level, in the multiple-branched Pa Mong Reservoir is estimated to be between 12,000 and 15,000 kilometers, based on a ratio of length of reservoir to length of shoreline of 1:18. (Chapter III-B-1)

3. Of all the villages to be inundated at either the 250 meters or 230 meters level, over 50 percent of the villages lie within one kilometer and 80 percent within three kilometers from the shoreline. Of the remaining 20 percent, the largest distance from a village to the shoreline is approximately nine kilometers.

The implications are: a) since the average utilized land area of a village extends to approximately three kilometers from that village, many villages will have some of their village land area left outside of the reservoir; b) communities will prefer to creep up to an elevation above the shoreline and remain within their traditional village area. This preference will be stronger the more colonizable lands are available above the reservoir and within the larger village area; c) every dry season, many villages will have a large portion of their former cultivated land become available during the drawdown period which lowers the normal reservoir level about ten meters. To utilize these lands, a location on the shoreline is essential. (Chapter III-A-4)

4. For 1968-1970, the maximum number of people to be relocated at the 250 meters level was estimated to be 220,000 or approximately 55,000 less than the Bureau of Reclamation Report base figure. This estimate was based on settlement counts on 1:20,000 scale maps (provided just prior to the completion of the Bureau's analysis), house counts on aerial photos and various data sets. At an average annual rate of 3.0%, this population would grow to 397,000 by 1990, the estimated latest date for inundation. (Chapter III-A-3)

5. Highly accurate population estimates can be made from house counts taken from aerial photos. The correlation coefficient between the number of dwellings and the census population per village is .98. More specifically, the census figure of 1,540 for the average number of people per village divided by the aerial photography figure of 164 for the average number of dwellings per village, results in a figure of 6.4 people per dwelling unit. This figure is comparable with the census figures of 6.4 people/family in the Thabo District and 6.1 people/family in the Loei District. (Chapter II-B-1)

6. The population estimates in Table 12-A are subject to change by the following three factors:

a. Fifty-four villages at the 250 meters level and fifty-six at the 230 meters level reservoir will be only partially flooded, with half of these villages being less than 50 percent inundated. This means that fewer people will lose their dwelling but may still lose some of their land and part of their livelihood. A net reduction of relocation costs may result.

b. Numerous villagers located in villages above the respective reservoir levels and not included in the settlement count in Table 12-A will lose some or all of their land, causing a net increase in relocation costs.

c. If the crest elevation of the reservoir cannot be reduced to a maximum of approximately half a meter above normal (250 or 230 meters), the annual flooding of the shore areas will make it necessary to relocate a larger number of people than presented in Table 12-A. The two factors -- 1) crest elevation flooding and 2) land inundated belonging to villages remaining above the reservoir level -- may require the relocation of roughly 25-30 percent additional population, bringing the total affected population at the 250 meters level to 500,000 by 1990. (Chapter III-A-3)

7. The significant population relocation differences occur between the 250 and 230 meters reservoir levels. The quantitative difference can be seen on Table 12-A where the number of settlements at the 230 meters level is 63 percent of the 250 meters level and the numbers of families and population are 58 percent and 61 percent, respectively. (Chapter III-A-3, Table 12A)

8. The relocation problem at the 240 level can be considered to equal that of the 250 level, especially in the crucial Loei Valley.

9. The Nam Mong Valley is naturally excluded from the reservoir at the 230 meters level by the saddle elevation of 235 meters. The exclusion of Nam Lick Valley requires only a 3.4 kilometers dike of, at the most, 15 meters height at the lowest saddle elevation of about 220 meters. (Chapter III-A-3)

10. Excluding these two valleys, the total population to be relocated at the 230 level is reduced to 40 percent of the maximum 250 level, while the number of settlements is reduced to 43 percent and the number of families to 38 percent. (Chapter III-A-3)

11. The qualitative aspect of the reduction of the reservoir is even more significant than the quantitative aspect because the Loei Valley which will not be flooded at the 230 meters level, is a relatively highly developed, intensively utilized area and in terms of improvement values stands above any of the more remote sub-regions of the Pa Mong Reservoir. The Loei land values alone are over twenty times as high as those of the remote regions mostly affected at the 230 meters level. This is demonstrated by the figures presented in the cadastral survey done by an agency of the Thai Government. According to this survey, the average land value in the Loei Valley is $610 per hectare; the highest given for a sub-district is $2,400 per hectare. For non-agricultural land, the average value is $3,450 per hectare and the highest is given as $10,000 per hectare. For comparison, in the remote Nam Mong and Nam Som valleys, agricultural land is valued at $91 per hectare and non-agricultural land at $132 per hectare, at the maximum. (Chapter IV-B-1 and Supplement)

12. Based on the above findings, the costs of Pa Mong Reservoir displacement of populations and improvements appear to be substantially underestimated in the Bureau of Reclamation Stage I Report. A cursory re-calculation of the optimal reservoir level calculations of the USBR with new cost estimates indicates the 230 meters level reservoir, without the Nam Mong and Nam Lick Valleys, may produce the lowest cost per unit power. The power cost at this level appears to be the only one clearly competitive with the thermal alternative. (Supplement)

NOTE: It must be pointed out that at the 55th session of the Mekong Committee in January 1972, the Thai and Lao representatives declared that the flooding of the Loei Valley and the Vang Vieng plain could not be allowed. These areas will remain unflooded at the 230 m level.

B. Recommendations

1. The large scale displacement of population and property which is part of hydro-power projects requires a basic shift in emphasis from the concept of resettlement of individuals or families to the concept of relocation of settlement units and village systems. The implementation of this concept preserves viable social structures of regional systems instead of destroying them, and uses these structures to the advantage of both the displaced population and the Government. For relocation planning:

a) the primary unit should be the settlement or village;

b) the position of each settlement or village in the micro-regional system and its relationship to the central village should be incorporated into the relocation scheme;

c) the micro-regional pattern within and without the reservoir area should be adjusted around the intruding reservoir instead of being amputated and segmented by removing the displaced population and settlements from the region. (Chapter I-D)

2. These recommendations do not preclude the fact that individual families should be given the choice and the means (through double or tripple compensation payments) to migrate out of their communities and relocate themselves. However, it is estimated that, at best, only 20 percent of the total population will be able and willing to make that choice. The advantage of raising this percentage by special promotion and assistance of out-migration from the Pa Mong area is questionable. It appears that the potential benefits and resources of the Pa Mong reservoir and electric power will support a greater population in the Pa Mong area than at present. The net result will be a population deficit which will cause in-migration from areas outside the Pa Mong area. Only migration within the Pa Mong area should be promoted as opportunities such as dam construction or the growth of towns like Loei and Vang Vieng warrant. (Chapter I-D)

3. Relocation of displaced settlements should, as much as possible, be at the nearest shoreline in order to facilitate self-relocation and to utilize the many advantages the shoreline offers, namely:

a) The 15,000 kilometers shoreline should provide ample relocation sites,

b) The reservoir will open up many still unoccupied valleys and smaller areas of cultivable land,

c) Gradual self-relocation of settlements will be possible and enhanced by the benefits available from the reservoir such as transportation and water for irrigation, consumption and recreation which can be traded against loss of benefits which are irreplaceable,

d) The loss of regional benefits, both social and physical, would be minimized, if not avoided,

e) Drawdown agriculture and fishing, i.e., the utilization of cultivable land exposed during dry season reservoir drawdown, requires settlement location at the shoreline,

f) The orderly occupation and utilization of the shoreline and cultivable land above and below it can be fitted into a general Pa Mong Area Development Plan. (Chapter IV)

4. Implementation of a relocation plan should utilize the functional interest and capabilities of the three major parties involved, namely, the settlements, the Pa Mong Authority and the Host Governments. As much as possible and to the utmost of their respective capabilities,

a) the settlements should be given the means to select their own relocation sites, sufficient time to plan and implement the move gradually (over a period of five to ten years) and technical and material assistance required for this task;

b) the Pa Mong Authority should be given the responsibility and the means to assist communities in their self-relocation and should be in charge of any relocation, replacement and development activities which are outside the scope of individual communities, such as road construction, land development, irrigation works and other necessary utilities to be provided the communities.

The Project Authority should sub-contract individual tasks to local contractors located in the communities and towns in and around the reservoir. It should exert effort to generate such contractors and help develop existing ones through training for the needed skills and occupations. Thus, the Project Authority will not only construct physical structures but, at relatively small additional costs, also will construct social structures and develop human resources which, in the long run, may turn out to be more beneficial than the physical dam and its power plant.

c) the direct involvement of the government bureaucracy in physical and social construction affairs should be kept to a minimum. The interests of the host governments are best served when they assume the responsibility of insuring that the Project Authority and the settlements carry out their respective responsibilities and duties and do their best in the interest of the whole country. The main function of the host government should be to assure the accountability of the other two parties involved, over which it has authority and power. However, government, because of its bureaucratic nature, is the most unsuitable agent, among the three parties, for detailed implementation of construction plans, whether physical or social. (Chapter IV-A-4)

C. Further Investigations and Research Needed

1. The importance of the reservoir shoreline at any reservoir level for relocation and development planning has become overwhelmingly clear during the course of this study. The following research will be required:

a) Inventory of Land Development Potentials.

The following needs to be identified above the shoreline:

(i) all land areas with less than 5 percent slope;

(ii) the soil qualities of these lands before and after development, their suitability for cultivation, and crop type;

(iii) the costs of each area for developing it for cultivation;

(iv) the determination of all other ecological factors along the new shore based on present ecological conditions and how these will change based on experiences with other man-made lakes in a similar climate.

b) Identification of 'draw down' land areas and their use potential

The following needs to be identified below the shoreline:

(i) all the land area between maximum average and the minimum average reservoir level such as between the 240 and 250m contours and/or between the 220 and 230m contours;

(ii) all cultivatable land in the areas identified in (i);

(iii) the exposure time zones of cultivatable lands in (i) on large scale maps to facilitate determination of how long the growing season is for each individual field;

(iv) the determination of "fenced-in fish cultivation areas" and suitable trees along their lower boundary to serve as fence posts;

(v) the determination of rapid growth crops and fish species and their cultivation techniques potentially suited for cultivation in the drawdown area, first by surveying present experiences along the Mekong and other areas in the tropical world and eventually by testing promising material in suitable field research stations along the Mekong such as at Tha Bo or Si Chiang Mai.

c) Research should be done on the factors of the distance pattern of central villages to determine the pattern most likely to develop along the reservoir shoreline. The identification of most favored CV locations caused by the factors identified will be required for relocation planning.

2. A socio-structural and total improvements and population inventory should be made of the total Pa Mong Region (above and within the reservoir area as well as the irrigation area). This inventory should use aerial photography and all available ground data. Specifically the following will be required:

(i) an aerial photo survey, qualitative and quantitative, of all settlements affected directly or indirectly by the Pa Mong project;

(ii) the 1970 Census data should be analyzed on a village basis for the same settlements as in (i);

(iii) the NSO Village Survey data should be analyzed for all years available for the same settlements as in (i);

(iv) the UTM coordinates of all settlements must be established for all data sets to make more comprehensive analysis possible by combining different data sets;

(v) the replacement and market values of all lands and improvements in relation to the development gradient (structural complexity profile) should be established by carefully designed ground surveys on these data. Sample areas must cut across the development gradient and not be randomly selected;

(vi) structural development maps must be produced as part of the above analyzes;

(vii) a combined scalogram analysis of socio-structural and qualitative ecological data should be done to determine their relationship, interdependence or casualties.

3. A rapid land titling project by aerial photography should be started as soon as possible covering all of the Pa Mong Area above and below the shoreline as well as the irrigation areas. Only modern computerized techniques with aerial photography will accomplish this essential and tremendous task in time, if the Pa Mong project is to be constructed in the near future. The same aerial photography can be used for this, as well as other research needed. The necessary correlated ground survey to identify owners can be expanded to collect land value, property value and socio-structural data at the same time and more inconspicuously then if done separately.

4. Development-Value-Replacement cost maps should be drawn after research 1 to 3 above is completed. These maps will be basic to relocation and basin development planning.

5. Research 1 to 3 above should also be done on any potential "resettlement" areas outside the Pa Mong Region.

6. The patterns and processes of agricultural development and CV's as innovation nodes should be researched in other areas of Thailand for which good NSO village survey data are available to:

(i) clarify and validate the tentative results of this study;

(ii) prepare the modification and extension of the present NSO village survey forms;

(iii) develop an annual permanent rapid method social accounting system fitted for automated data processing and production.

7. a) The present functioning of settlement leadership in terms of its potential strength and weaknesses for relocation should be studied.

b) The present functioning official organizations involved in relocation should be studied to identify their strong and weak points both in Thailand and in other parts of the world with relevant experience.

8. The potential of job creation by the Pa Mong Project both agricultural and nonagricultural, in the exploitation of new sites and resources should be studied to determine:

(i) how much out migration in the course of relocation should be encouraged or discouraged;

(ii) essential long range preparatory programs in human resource development (training and institutions);

(iii) necessary capital investments as part of the Pa Mong basin development plan.

CHAPTER I

SOCIAL PROBLEMS OF RESERVOIR PROJECTS

A. Past Approaches to Resettlement and Costs

A review of literature on large scale hydro-electric projects reveals that there has been little or no social feasibility studies done for these projects. Neither had there been satisfactory relocation of populations displaced by the reservoirs.* In this aspect, even the extensively pre-studied and planned resettlement project at the Volta reservoir suffered severely in implementation. Over 60 percent of the resettled population, approximately 40,000, chose to leave the elaborate resettlement scheme within the first two years. High costs were added to reverse the trend. Other reservoir projects incurred additional costs caused by ensuing social unrest. In social and human terms, the Pa Mong Reservoir will be the biggest project ever attempted. Yet, too little has been done, so far, to at least identify the dimensions of the social problems, let alone develop new concepts and techniques essential for satisfactory solutions.

The concept of resettlement itself has been a major misleading factor. Resettlement is generally thought of as moving an X number of people. A certain number of people displaced by water in the reservoir have to be moved in the most efficient way possible. Occasionally, resettlement has also been seen as an opportunity to "develop" the population. The greatest weaknesses of most resettlement projects so far executed have been: 1) the idea that given amounts of uniform persons or families have to be moved from one place to another, and 2) the displaced persons must be made to accept "progress". Social structure is rarely, if at all, recognized. The community, the environment, property have entered the picture only as correlative or additional aspects or problems.

An analogy to this concept of resettlement would be the concept of bricks being the most important parts of a building. This would be like stating that to preserve a historical building from inundation, one only has to break it down into its individual bricks and use these bricks for constructing more modern and efficient buildings. A brick is a brick whether it is part of Angkor Wat or a town shop, but the two structures are quite distinct and different in value and service terms. The significant difference is the total structure, not the individual brick involved. The value of an individual brick outside a structure is insignificant. The value of an individual who is placed outside a social structure which permits him to be productive according to his ability, is negative. His survival depends on either social welfare or crime — and here is where the brick analogy ends. Because people are not uniform bricks. They are building blocks of social structures giving shape and influencing these structures as much as they are shaped and influenced by them. To alter structure requires alteration of the people and this is a complicated process about which we know little for us to be very successful.

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* See quotations and references later in this chapter.

In most cases in the past, reservoir resettlement projects have taken the affected population as very much like a number of bricks to be restructured (resettled) at the new site according to some blueprint drawn in the minds and offices of men far removed from the reservoir area. Each "brick" was seen and treated equally at the new site. Equality was often stressed by distributing new homes and field sites through random selection by drawing lots. This type of settlement projects have recognized only two areas of individuality, i.e., differences between the individual families to be resettled, namely, (1) the amount of compensation each received which more or less reflected previous value of possessions in the old residence, and (2) differences in motivation and ability to "make good" by fitting into the resettlement scheme.

Some examples of past resettlement projects: (underlining added)

"In 1959 the Government started the program for the transmigration of 5,000 inhabitants of the lake region to new settlements. The rescuing of animals in the inundated area was organized by the Foundation "Thali oe de Gwamba" with the help of the International Society for the Protection of Animals, Boston. John Walsh of this Society and cooperators rescued about 9,700 animals in the period from August 1964 to December 1965. Hunting was forbidden in the lake region until 1969....

As to the social, economic and ecological implications of the Brokopondo Lake it may be concluded that for the Surinamese people as a whole it has been beneficial, although quite a number of bush-negroes had to be moved to other settlements, which caused some social unrest....pp. 35-37. "

(From: P. Leentvaar, LAKE BROKOPONDO, 1971 Symposium paper.)

While here the humane treatment of animals appears more important then the annoyance from the resentful human population displaced by a "beneficial" lake, the next excerpt shows another attitude: the displaced population can be forced into new shapes for its own benefits as defined by an ambitious blueprint which, however well intentioned, is based more on a technocratic type of agricultural engineering than social reality.

"The purpose of the project is to resettle 80,000 farm people forced to move as a result of the flooding of the Volta River Basin following the construction of the Hydro-electric works. The farmers are to be resettled in 52 agriculture areas around the newly created lake and these areas have been initially cleared, parcelled and prepared for planting, with the town site of each being laid out and prepared for occupancy. The Government is also providing seeds, animal breeding stocks, fertilizers, the infra-structure required, and other production amenities, including 10,000 rudimentary housing units to house the settlers. In its turn the WFP is providing US $1,437,760 worth of food to carry the settlers over the resettlement period (six months) and to meet expenses incurred in land clearing and drainage, building roads and houses.

To prevent the settlers from reverting back to shifting cultivation, the farm units are to be operated co-operatively with cultivation being partly mechanized under the direction of the Extension Division of the Ministry of Agriculture. The executing agency for the overall resettlement project is the Volta River Authority, an autonomous government institution."

(From: U.N. Food and Agriculture Organization, Rural Institutions and Services Division, Agrarian Research and Intelligence Service VOLTA RIVER RESETTLEMENT PROJECT IN GHANA in Information on Land Reform, Land Settlement and Co-operatives (Rome) July, 1964. p. 57.

The initial results of the above program presented candidly below are not surprising. The analysis and corrective action taken however are most encouraging. The wider goals and implications expressed in the national context apply especially to Thailand and Laos as well. From the report,

"THE VOLTA LAKE IN RELATION TO THE HUMAN POPULATION AND SOME ISSUES IN ECONOMICS AND MANAGEMENT" (1970-71 Symposium paper):

"Naturally, this was an ambitious programme which was to encounter practical difficulties in implementation. For the entire programme to succeed, systematic planning, marketing organization, and other things were required. But the manpower resources, the skills and the experience needed to carry out this programme successfully were not available in adequate quantities with the result that initial progress was very poor.

Still a great deal of care was taken about grouping of villages as units. Villages from the same area were put together unless they asked not to. An attempt was made to settle villages in wards in such a way that adjacent wards would be mutually friendly and the communities would remain under their own traditional leaders so as to reduce sources of social tension in the earlier days of the relocation....

The fact that acquisition arrangements had not been worked out before the move posed two immediate problems for the settlers: they had to begin long and tedious negotiations for farming land - and they had to clear the land themselves. Furthermore they had very little working capital, farming equipment, etc., and none was provided for them. Predictably, farming was off to a poor start under these conditions....

The effect was an out-migration of settlers in search of new opportunities elsewhere. In 1968, it was found that 60 percent of the original settlers had moved out (Taylor 1970). The trend has only recently been reversed by a positive and more effective approach to land acquisition and distribution. Under the new approach, 438,000 acres are being acquired around the 52 settlements....

"I have tried in this paper to examine the Volta Lake as one of the major instruments for transforming the economy of Ghana. In so doing, I have considered certain specific industries. It would seem appropriate to assess Ghana's record in exploiting the developmental opportunities.

In our case, the Volta Lake has created a new set of production possibilities. But the account above has shown that we have not been able to exploit the new opportunities open to us.

Consider, for example, resettlement, which, as we have said above, could be viewed as a major exercise in rural development. The essence of the programme was to provide the people with improved living conditions and the necessary incentives for productive effort. But our failure to complete the land acquisition arrangements and the necessary land clearing prior to relocation, and the lack of extension and other supporting services, must mean that the people could not even operate at their old production possibilities level; and we have mentioned the initial outmigration which resulted from this. On the contrary, development was clearly hampered by the tension of displacement and unrealized expectations...

The account above suggests some possible explanations: our inexperience, defective planning and implementation and lack of enterprise. This is the challenge that we face."

Experiences in resettlement with smaller dam projects in Thailand have been mentioned by J. Ingersoll and described in detail by M.L. Thomas and E.L. Block in their reports to the Agency for International Development.* They need not be repeated here. It must be pointed out, however, that past experience in and policies for resettlement in Thailand and Laos are of only marginal relevance to the resettlement of reservoir displaced village systems or their parts. Both Thai and Lao resettlement programs in the past did not intend to deal with the government-induced large scale transfer or alteration of relatively sophisticated regional structures. Resettlement policies, programs and implementing agencies in Thailand were created under the social welfare concept for the purpose of settling landless poor from urban areas on virgin lands. In Laos, huge resettlement efforts had to be exerted during the last two decades for war refugees in quantities which at times involved up to 25 percent of the total population of the country. Policies and agencies were designed to meet emergency welfare needs. The policies and practices for settling the landless poor in Thailand or the uprooted refugees in Laos were and are the most relevant and functional for the problems on hand. However, these policies and practices are not relevant for the distinctly different problems of reservoir-displaced populations.

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*Ingersoll, Jasper. The Social Feasibility of Pa Mong Irrigation. A Report to the US Bureau of Reclamation, US Department of the Interior, and the US Agency for International Development, US Department of State, July 1969.

Thomas, M. Ladd and E.L. Block. Land Resettlement in Northeast Attendant Upon the Projected Pa Mong Dam. SEADAG Research Grant #69007e, June 1970.

B. Relocation is a Part of Project Feasibility

A thorough analysis of resettlement experience in large-scale dam projects in Africa was made in the book "Dams in Africa", chapter 3, by Brokensha and Scudder. In it Scudder has the following to say:

> "The logical corrective here is to broaden the feasibility studies, which are apt to stretch over a number of years prior to site selection. To date, the scope of these has been much too narrow... Though expansion of the usual geological, economic and engineering surveys will increase costs, these are slight in terms of the cost in both human and financial terms of a prolonged period of famine relief. They are even smaller when measured against the benefits that could accrue from a well-planned, well-timed and well-implemented program of a river and lake basin development." p. 22.

In the same book David Lilienthal, the former chairman of the TVA, is quoted as saying,

> "The TVA could not close the gates of the dam, pay off the landowners and townspeople, and call it a day. That would not do because the resources of the region - human energies included - were to be seen as a whole...What at first seemed a calamity was turned into an opportunity and a community sense of direction has resulted that continues to bear fruit." p. 23.

The faults to be corrected by the above suggestions originate, it appears, with the feasibility studies of either large or small-scale projects. But neglect to cover adequately the feasibility aspects of population relocation from the reservoir area can be traced to three causes which are preliminary to a feasibility study: the first, the most important one, lies at the policy level with those who make the decision and define how, when, and where a dam project is to be researched for its feasibility. It is at this level that feasibility studies have initially been perceived too narrowly. As long as the specifications for a feasibility study are not inclusive of all project aspects and, especially, do not include a very definite demand for social and human feasibilities and costs, the ability of the contracting agent generally will not and perhaps often cannot include these aspects in the feasibility determination.

The second cause of neglect lies again at the policy making level in the lack of complete assumption of responsibility for people-dislocating-projects by all the sponsors of such projects. In practice such responsibility can not be divided. Whether in crime or good deed any knowing participant shares either the guilt or the credit. Such common sense principle should and does at least morally apply especially to the decision makers in the donor countries of the developed world who make such large projects possible in the first place. If they assume responsibility to have the required technical standards and resources applied to study engineering feasibility then they must in all honesty and conscience apply the same to the often more complex social feasibility aspects of such projects.

The third cause of neglect lies at the level of feasibility determining agent, private or public, the contractor who organizes and employs the necessary expertise and resources to determine the feasibility of a project for the contracting policy and decision makers. It seems that here too often a neglect is simply the result of global ignorance because of the lack of expertise and technology in social engineering.

It appears that all three causes affected the Pa Mong feasibility study resulting in the omission of substantial relocation costs and benefits in the cost-benefit calculation. Therefore, it would be erroneous to accept the USBR cost-benefit ratio as anything but suggestive of the benefit of building the dam. In terms of people and property dislocation costs, Pa Mong poses serious consequences which are yet to be incorporated into a comprehensive cost-benefit analysis. (A cursory attempt has been made in the supplement to this report.)

Table 1 below shows this aspect quite clearly. Pa Mong is compared with the four major dam projects in Africa which have all been more or less criticized as inadequate in coverage of human and social problems. The cost per relocated person is set so low in the Pa Mong project that it becomes suspected alone from this comparison. In the Supplement to this report, reasons for these low figures and a conservative adjustment will be presented.

C. Reservoir Power Efficiency and Costs in Terms of People

It is important to compare Pa Mong with the African dams on other aspects. Table 1 is an attempt to present and compare dam projects in terms of human costs per power benefits instead of simply financial costs and benefits. The human costs are primarily caused by the reservoir, while the primary benefit to be derived from a dam project usually is electric power. The efficiency of a dam project in term of power generated per cubic volume reservoir capacity represents a fairly good index of efficiency of a hydroelectric project in term of benefits versus the potential human cost resulting from reservoir displacement. The Pa Mong reservoir appears to be fairly power efficient at the proposed 250m level but surprisingly even more so at the 230m level. The USBR report finds the 250m level most economical in terms of power cost. The importance of this index is made clear by two other indexes, one in terms of number of people displaced per unit volume of reservoir capacity (cubic kilometers) and two in terms of number of people displaced per megawatt power generated. These indices highlight the social costs of engineering projects for which too often the only criteria are financial efficiency which result in 'the bigger the better' conclusions.

The size of reservoirs has a direct bearing on the number of people displaced, but there can be large differences depending on the density and level of development of the population in the reservoir area. At once the major problem of the Pa Mong Project becomes apparent: the Pa Mong Project is relatively expensive in terms of population cost per generated megawatt of power. The importance of reservoir power efficiency becomes clear. Volta Lake which has a rather low cost in terms of people per reservoir capacity has, because of the very inefficient use of reservoir volume for power

TABLE 1. RESERVOIR POWER EFFICIENCY AND POPULATION COSTS OF SOME MAJOR DAM PROJECTS

Lake name & Country	Cubic Kilometer Reservoir Volume (Km^3)	Max.Instal. Power Potential (mw) megawatt	Reservoir Power Efficiency mw/km^3	Number People Displaced (000)	Number People $/km^3$	Number* People /mw	Approx.** Resettl. Costs $/pers.	Approx. Reservoir Draw Down	Plans and/or Research for Draw-Down Agriculture
	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Lake Brokopondo, Surinam	12	180	15	5	417	28	?	?	no
2. Lake Nasser, UAR	157	2,100	13	100	640	48	700	7 m	yes
3. Lake Kainji, Nigeria	13	1,940	149	43	3,270	22	195	10 m	yes
4. Lake Kariba, former Rhodesia	157	1,500	10	50	321	33	140	5 m	no
5. Volta Lake, Ghana	148	854	6	80	540	90	480	5 m	yes
6. a. Proposed PA MONG at 250 m.	98	4,800	49	275	2,800	57	69	10 m	not to date
b. Proposed PA MONG at 230 m.	40	3,200	80	168	4,200	53	30	10 m	"
c. Same as 6 b minus N. Lick and N. Mong Valleys	40***	3,200	80	111	2,800	29	45	10 m (?)	"

* This index was suggested by Professor J. W. Mellor of Cornell University.

** Adequate resettlement costs range from $420 to $840 per person according to Brokenshaw and Skudder in "Dams in Africa" (see sources below) Colonization and Settlement costs in Malaysia were about $9,000 per family or if divided by 6 people per family, $1,500 per person ("State Aided Rural Land Colonization in Malaysia: An Appraisal of the F. L. S. A. Program" by K. Vikkramatileke, 1965).

***The reduction in volume from 6b. to 6c. is from 40.4 Km^3 to 40.1 Km^3.

Sources: See following page.

SOURCES TO TABLE 1

1. Lake Brokopondo

   Abstract of Papers: International Symposium on Man-Made Lakes Scientific Committee on Water Research, International Council of Scientific Unions; Knoxville, Tennessee, May 3-7, 1971. p. 35.

2. Lake Nasser

   a). P.C. RAHEJA, Project Manager "Lake Nasser: A Case Study" UNSF-FAO Lake Nasser Development Center Project, Aswan, Mimographed paper.

   b). W. M. Warren & N. Rubin "Dams in Africa: An Interdisciplinary Study of Man-Made Lakes in Africa", Frank Cass & Co., London, 1968. pp. 20-31.

3. Lake Kainji from
   a). Same as (1) p. 134.
   b). Salah EL-DIN EL-Zanka, Project Manager "KAINJI Lake: A Case History" UNSF/FAO Kainji Lake Research Project. December 1970. Mimeographed paper.

4. Lake Kariba
   Leonard S. Joeris "Lake Kariba. The UNDP program and North Slope." Central fisheries Research Institute, Chilanga, Zambia, 1971. Mimeograph paper to symposium under (1.) above.

5. Volta Lake

   a). E.A.K. Kalitsi "The Volta Lake in Relation to the Human Population and some Issues in Economics and Management". Volta River Authority, Accra, Ghana 1971. Mimeographed paper to symposium under (1) above.
   b). "Volta - The Study of Ghana's Volta River Project." Special publication by Volta River Authority; Appendix. Date unknown.

6a & b Pa Mong

   U.S. Bureau of Reclamation:
   "Optimization Study and Interest Rate Sensitivity Analysis. Supplement to PA MONG Stage One Feasibility Report"
   U.S. Department of Interior, 1970. Tables 1 and 13.

   The population displaced at the 250 m level is the number used by the B.R. The 230 m reservoir level displaced population was taken to be 61% of the population displaced at the 250 m. level reservoir, the ratio identified by this project. The B.R. may have based the $5 million for resettlement on a different population figure, though none could be found in the report or appendices. The numbers used here are 275,000 at 250 m and 167,500 at 230 m.

generation, a very high "people displacement cost" per generated power. On the other hand, the "people displacement cost" per reservoir volume of Lake Kainji is very high, but because of the exceedingly high efficiency in power production the "people displacement cost" per generated unit of power is very low.

A potentially large benefit of reservoirs missing in the cost benefit study of the Bureau of Reclamation is the utilization of cultivated lands exposed during the draw down period of the reservoir. These lands are presently the property of the population to be displaced. Their loss has been taken to be absolute but they may be available for 3-4 months each year. Usage during reservoir operations would be an important benefit to the displaced population if relocation permits it. However, relocation which incorporates utilization of drawn down lands could also be an important cost item in the cost benefit analysis. These aspects are illuminated in more detail later in this report.

D. The Concepts of Resettlement Versus Relocation

The emphasis in the title for this report on concepts of "Relocation of Settlements" from reservoir areas instead of Resettlement of Populations was intentional. As described above the mere resettlement of numbers of individuals has not been satisfactory in practice. Reasons for this failure become clearer when reviewed from the point of view of structural-symbolic theory. Resettlement has the connotation of settling down some foot loose and floating individuals. (In some of the worst resettlement projects in the past in already flooding reservoirs this may literally have been the case.) However, in this study we intend to demonstrate that the unit to be relocated is not the individual person nor his family so much as it is his community, and the group of communities within the microregional system which make up the social structure within which he exists. Community settlements as units cannot be resettled, they have to be relocated. Relocating a settlement implies that community structure never ceases. To resettle settlements implies that they be altered if not destroyed first in the process. While beneficial alterations are often desirable and relocation presents a unique opportunity for their implementation, the technology for achieving satisfactory results is still too much in its infancy for substantial attempts.

A primary objective of this study is to demonstrate that people are integral parts of a social structure which is manifested in the pattern and level of sophistication of a community and of groups of communities in micro-regions. Groups of communities cluster around and in definite relation to centers, be they towns or simply the highest developed village in a group. Such centers are dispensing services and act as innovation nodes in the region. The innovation nodes are crucial to microregional systems since they distribute existing and new technology down through the hierarchy of their satellite villages. While much of this has been descriptively part of central place theory for a long time, structural-symbolic theory provides a more fundamental model for the process. A more detailed explanation has been presented in section II-A-3 on social structural theory, while sections II-B and C give several empirical demonstrations.

The actual application of the theory in the Pa Mong reservoir and irrigation areas will be demonstrated in the following sections of this report, but a brief outline of the concepts is in order at this point. Each individual in the social structure belongs to a family and it is the family unit within the community which occupies a certain position within the hierarchy of families in that community. The relative positions of families within communities can be taken as their level of development. The same applies to the relative position of communities in a region. Development levels can be measured by the degree of differentiation of sophistication which for families includes everything personally relevant to their living: their education, their income, their training, their properties, their communication with other individuals, their communication with institutions and places outside their community.

The development level of communities is measured in terms of their institutional complexity relative to each other and to their microregional center. Again this can be measured in terms of the quality of the technological or institutional channels, and their mastery over the surrounding environment. Since individual families cannot have higher levels of development than their village as a whole, the level of development of the community sets the upper limits for all individual families within. Therefore one can, for costing purposes of relocation, measure the average relative costs of the relocation of individuals much better by measuring the costs of relocating settlements with defined levels of development (values of improvements and services).

Since one of the prime determinants of the level of development of a community is its relationship to the other communities and to its central village and town in the region, relocation strategy, has to take careful cognizance of this relationship when planning relocation sites for communities. Neither should the new location of a community disturb the interregional relationship of those villages remaining outside the reservoir. Otherwise considerable stress and possible waste of resources (loss) occurs within the regional system of communities. Measures to minimize regional stress often imply additional costs which must be identified for a realistic cost-benefit analysis.

E. Defining Costs by Mekong Committee Guidelines for Resettlement

In 1968 the United Nations Mekong Committee formulated a set of guidelines for resettlement in the Mekong Basin Development Plan. In essence, these guidelines direct that the population displaced due to dam projects incur no loss and have equal rights to the benefits of the project affecting them. Abstracts of three other sets of guidelines are presented in Appendix A; they show that these basic guidelines reflect a growing international consensus.

Basically, these guidelines appeal to common sense and moral fairness worldwide. Projects to which these guidelines apply are always done for the benefit of the people. But loss equals cost: any loss caused by a

project is a cost to that project and many "beneficial" projects cause substantial losses to displaced populations. Invariably the displaced people are of the same country as the people to receive the benefits. It would appear to be both illogical and unfair that a number of people should receive the benefits while another portion of the same people in the same country should have to pay for these benefits through their own losses without receiving benefits. This, however, is presently implied in the Stage I Report of the Bureau of Reclamation.

The social injustice involved in such action violates one's political sense as well. Any people, but especially when in large numbers, who suffer social injustice will generate and apply political power to those responsible either through the existing political system, if they have such channels, or violently against such a system if they have no other means for redress of grievance. The costs of such conflict always far exceed the "savings" which caused it.

While the above criteria are primarily subjective, the guidelines also have an economic aspect which can be quantified and therefore can be highly objective in its analysis and results. Most of the losses which potentially can incur to the displaced population can be quantified in monetary terms. All of the "improvements" made by or for the local population can be assessed in terms of public and private investments, be they in land, roads, or public and private buildings and utilities. The crucial points here are the method and parameters of cost evaluation for such improvements.

The easiest method would appear to be the cost of investment minus depreciation. However, such information generally is not available in regions such as the Pa Mong. Even if such an evaluation were possible, it would still result in a cost to the displaced population. No loss, would mean same benefits of all the improvements presently owned or available at the new location. Invariably this means replacement, which will be more expensive than the initial investment of the improvement in the present location. The net result for the relocated population of computing cost at initial investment minus depreciation would be improvements of lower utility value than previously possessed. A net loss would occur.

A second method would be to evaluate improvements at present market value. However, this market value exists at undisturbed conditions of demand for the improvements. The large-scale disturbance by inundation and relocation would increase the demand for the continuation of improvements to such a degree that market value would soon equal the replacement cost value; then surpass it because the inefficiencies created by a rapid and large-scale rise in demand for all kinds of improvements are taxing resources beyond their capacity to replace improvements rapidly enough. In either case, the ultimate fair value of present improvements for relocation is the replacement cost. If all improvements presently existing for the population in the reservoir area are replaced at the new site no loss in terms of man made improvements would occur. The only cost estimation method which would

satisfy the Mekong Committee guidelines, therefore, is replacement cost and neither the market value of improvements nor the investment cost minus depreciation of improvements.

There are, in addition to the assessable costs in monetary terms of improvements, cost which derive from the loss of services and satisfactions provided by the community, the system of neighboring communities, the nearest town and the natural environment surrounding each community. These services range from the proximity and benefits obtained from one's friends and relatives to those coming from the community and communication with the outside world through the nearest central town or central village. They also include the natural environment in terms of forests, rivers and streams, rainfall, temperature, and the controlled hazards to the health of the population to which it has more or less adjusted itself in the present location over a long period of time, often centuries. While such losses cannot be compensated in monetary terms, they may be replacable, or such loss can be avoided all together by relocation as communities and by careful selection of relocation sites. Generally this will be made easier the closer the new location site is to the original location of the settlement site.

To summarize two basic principals derived from the above for fair relocation costing and strategy: (1) costing of all improvements should be made at replacement cost and not at either market value or investment minus depreciation. (2) This is cheapest at community relocation and community relocation site selection closest to the old location of the community.

However, some losses can be traded against benefits wherever they cannot be avoided, or the affected population selects to trade certain benefits against some losses. In theory at least the above guidelines only demand that no net loss occurs to the affected population. Certain benefits will accrue automatically from the project itself. The reservoir will provide water, transportation, recreation and fishing to many villages who formally had very little of either in their remote valleys. The people relocated to obtain these benefits may easily feel a fair trade-off has been made against losses difficult to replace such as loss of religious sites, adequate large areas of paddy land which were easily cultivated with familiarity and other advantages only present at the old location. Other costs they may have to take and trade against benefits would be the more difficult working of upland fields or small, narrowly terraced paddy fields, the efforts and risk involved in learning new agricultural techniques for working the new type of fields and crops, the effort and risk involved in learning to live near and with a large body of water fluctuating severely between the seasons.

While it will be difficult to assess exactly the value for traded benefits and losses to relocated populations, one basic criteria can always be applied: the level of living, by whatever method it can realistically be achieved at the new location, should at least be no lower for the individual family than it had been at the original location of its livelihood. Livelihood or level of living here include all aspects of living, not just the monetary amount of annual income usually computed by economists. Level of living includes also the aspects mentioned above of status, service and satisfaction received from the community and the region surrounding it.

There are furthermore potentially high costs which can accrue to the population remaining above reservoir from removal of settlements from the region. As shown later, micro-regions are hierarchical settlement systems which in narrow river basins usually have their centers i.e. the highest developed and most populous settlements at the mouth and bottom of the basin. Most often inundation affects these most highly developed portions of micro-regions first. Since these centers are essential to the functioning of the micro-regions at their present level, relocation outside the region removes a definite number of services and benefits from those settlements remaining in the basin above the reservoir. This loss will only be offset when some of the remaining or new communities have developed the capacities (at same cost) to provide the previously available services.

F. Conclusion

This chapter does not aim to show how faulty or excessively expensive large scale hydro-projects are if one realistically considers social and human costs. On the contrary, it intends to show that these problems and costs exist whether they are recognized or not. Moreover, many costs can be paid for by benefits from the reservoir while others can be avoided by relocation policies and strategies designed for this purpose. Even where this is not possible and the displaced population has to bear certain costs, it seems imperative that decision makers and the nation concerned are fully aware of the contributions which have been made to generate the benefits of the hydro-project. For both moral and practical reasons, giving credit where it is due should replace the insult added to loss which results from the social stigma attached to "welfare cases". The loss of dignity and status which is unavoidable when a productive and self-reliant population is turned into welfare dependents should be the most easily avoidable cost. This can be done by separating policies and implementation for the relocation of reservoir-displaced people from those policies and actions applicable only for a genuine welfare population.

CHAPTER II

PA MONG SOCIAL DIMENSION

Sub-Regions in the Pa Mong Reservoir Area:

1. The Mekong and tributary Basins: Reservoir Sub-Regions.

When trying to identify dimensions of the relocation problems in the Pa Mong Reservoir it was necessary to divide the reservoir into its natural parts. The major, long branches of the Pa Mong Reservoir can be seen as sub-regions of the whole reservoir area; they are primarily situated in basins of tributaries to the Mekong River in the reservoir. The settlements in these basins form rather distinct, homogeneous village systems or sub-regions. The regions, each numbered and named for the river forming the basin have been identified on Map 1, Pa Mong Reservoir Regions. (See Summary) For brevity, the regions will often be referred to by their number instead of their name. Major differences in relocation problems occur between these sub-regions which makes them an important dimension of resettlement.

The differences are related to several factors: the width of the reservoir, the extent of colonizable lands above the reservoir, the road-access system and most importantly, the number of villages and their levels of development both in and outside of the reservoir which intrudes into the village clusters (micro-regions).

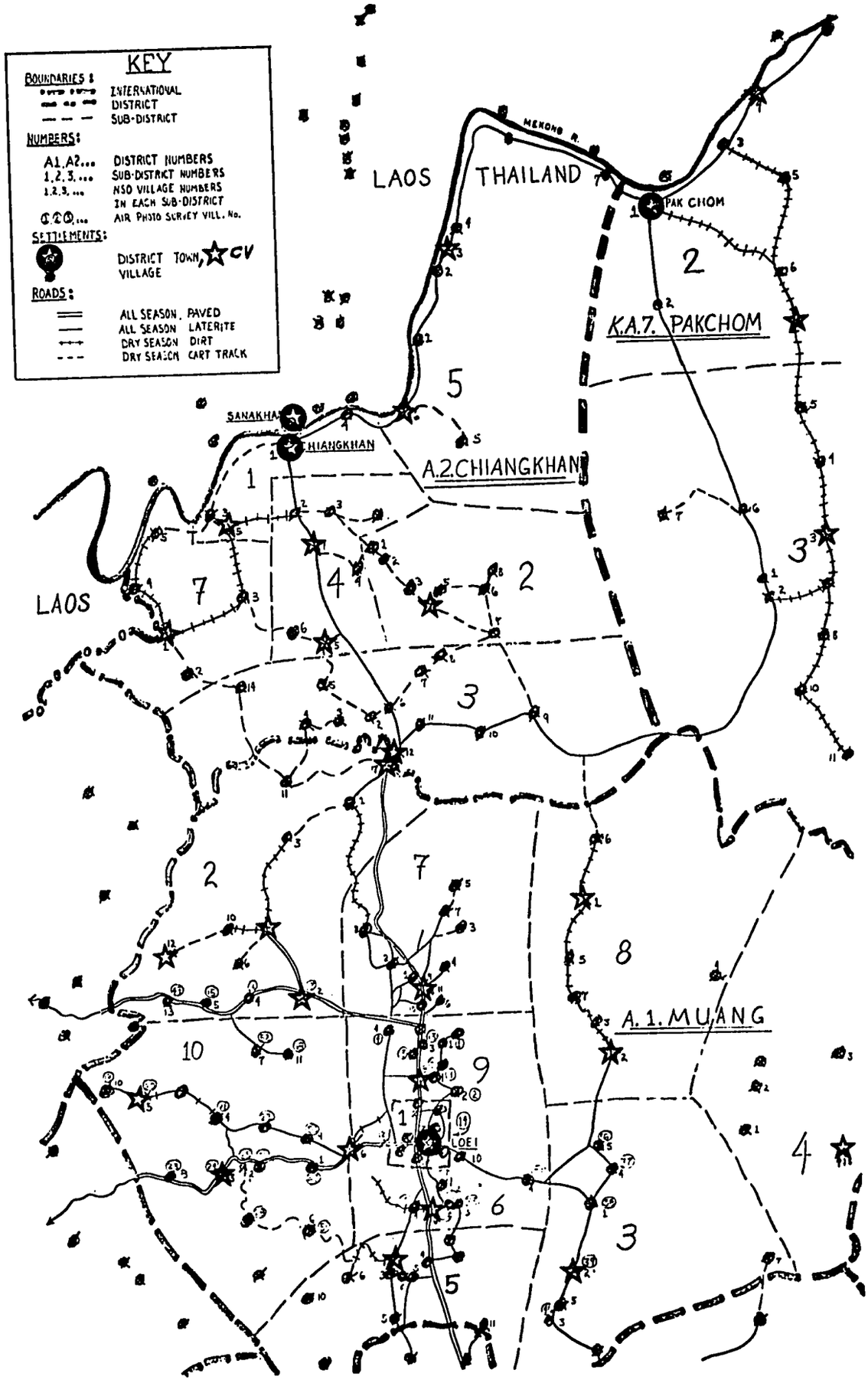
2. Distribution and Access of Villages in the Pa Mong Sub-Regions

A most simple but crucial requirement for the analysis of micro regions and their disturbance by reservoir incursions is the exact identification of settlement locations. This requires map analysis and correlation of the findings against ground data. In the Pa Mong sub-regions this turned out to be no easy task because of the substantial amount of ground data received from Thailand. The basic map used in this task was the 1:50,000 scale topographic map reduced by 50 percent to an operating scale of 1:100,000. These maps are excellent to work with since they have a kilometer square UTM grid and sufficient contour lines and other information. They are, however, limited in providing only the larger or more important cultural and geographic features. The more remote areas, such as regions 3, 4, 6, 7 and 8, have many villages which are not identified on these maps; where villages are identified, the names are sometimes outdated. Unfortunately the only correlation between village map and ground data identification is by their name. In these remote regions of Thailand and Laos, the prevailing custom is to change the village name for reasons such as a major disease, crop failure due to drought, pests and other causes. As it turned out even different sets of ground data such as those from the Accelerated Rural Development Program (ARD), the National Statistic Office (NSO) 1970 Census, or the NSO Annual Village Survey data contain villages with different names and even different numbers in each set.

Proper matching turned out to be a major exercise in detective work and patience. The potential user of different data from the area is warned about the time requirements for the task. Many village data were matched by a process of deduction, others by mountain or stream names also contained in village names. However, there are indications on the isopleth maps that several village data still are not matched with their correct geographic location.

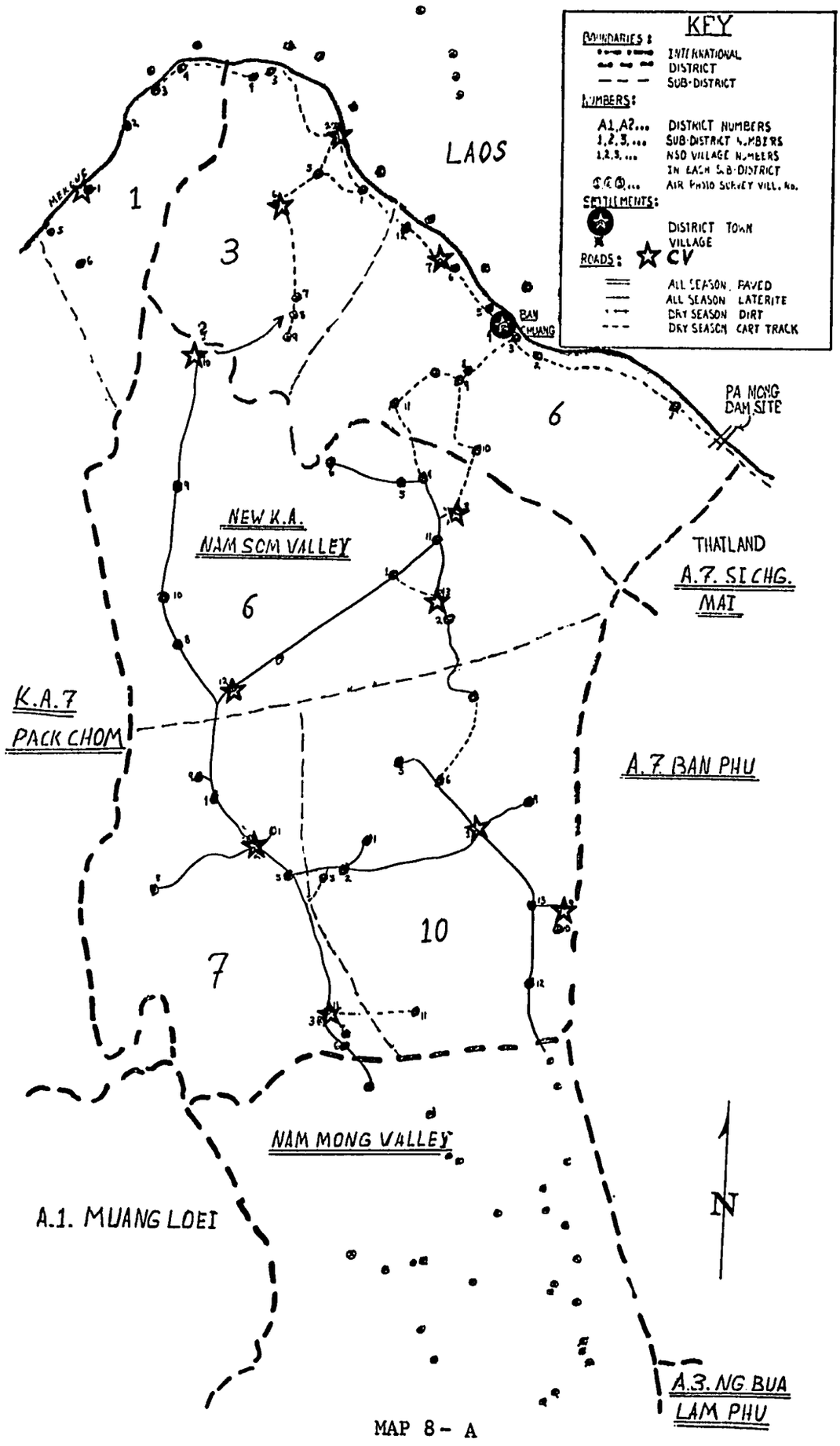
The most useful data came from the Office of Accelerated Rural Development (ARD) which sent along with its ground survey data a set of district (Amphoe) and sub-district (Tambon) maps. These maps show the types of roads which reach each village as well as all public utility structures ranging from a school to ground water wells present in each village. The road information especially reflects the latest results of the ARD program up to 1968-69. Since this information is much more current than available on most other maps, it was reproduced on Maps 2-A, 8-A and 13-A.

Central Village (CV) locations are identified on these maps by a star symbol. These villages signify the center of micro-regions which consist of groups of villages surrounding the most diversified village, the central village, in the group. The Central Village is not so much central geographically as it is crucially central in the sub-regional communication system. The methodology and theories involved in the identification of Central Villages and their micro-regions are presented in the following sections of this chapter.



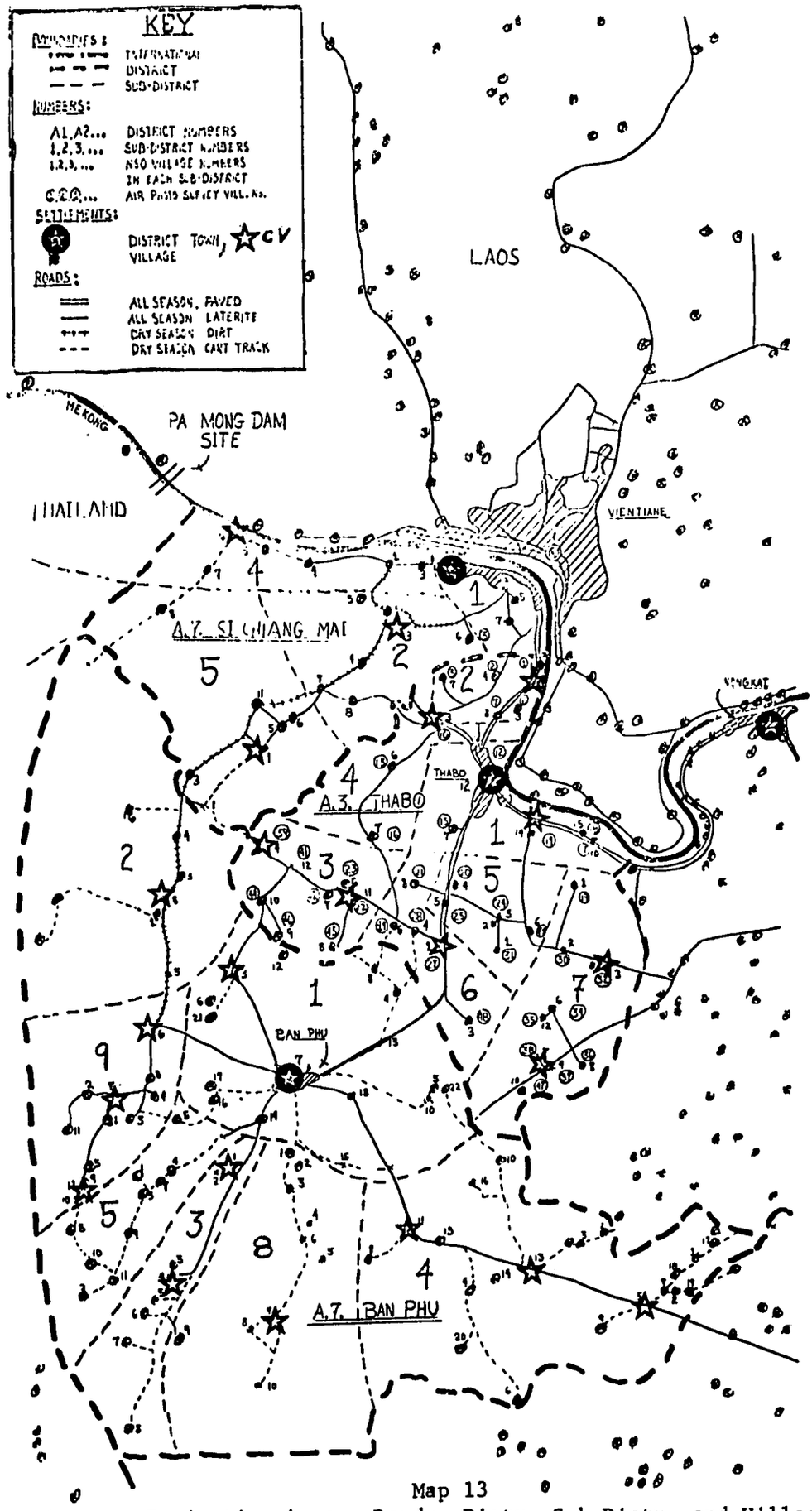
MAP 2-A

Regions 5 and 6: Roads, Distr., Sub-Distr. and Village Numbers.



MAP 8 - A

Region 7: Roads, Distr., Sub-Distr. and Village Numbers.



Map 13
Region I. Irrigation Area: Roads, Distr. Sub-Distr. and Village Numbers

Scalogram Analysis and Micro-Regional Structures

1. The Identification of Central Villages (CV) and their Micro-Regions by Scalogram Analysis

Scalogram analysis is used in this study to measure the relative levels of development of the villages and depict the pattern of micro-regions with their respective central villages and satellite villages on isopleth maps.

The technique used to process the data is known as Guttman scaling. The following text, with Tables 2-a to 2-e, describes the sequence of data processing and outputs used in this study. A computer program for Guttman scaling and the technique itself are further described in Appendix C.

Guttman scaling produces an array of cases in a hierarchical order showing the accumulated items for each case. In this study, the cases are villages and the items are the structural attributes of these villages. The diversity of structural attributes of a village is measured by its scale score. For instance, in Scale 1, Village 42 has a scale score of 16 while Village 1 has a scale score of 2. This means that Village 1 has two items or structural attributes, namely wells and dirt streets, while Village 42 has these two items, plus others, like temple, school, rice mill, market building, power station building, etc. Assuming that the more diversified structural attributes a village has, the more developed it is, the relative levels of development of villages can then be depicted by the array of scale scores.*

Data from the maps of the Accelerated Rural Development (ARD) Program in Thailand were used in the first approximation of relative levels of development of villages. The presence of public structure items (school, well, temple, etc.) in each village was identified in the maps. The items were coded per village for computer processing.

The data were then processed into a Guttman scale. The scaling technique converts the dichotomous presence or absence of items into a quantitative measure. Once quantified, standard statistics can be used and correlations with all other available data can be presented.

Table 2-a lists the twenty-three items coded from the maps of the ARD Program. Each item included has been identified from at least one village in the entire area studied. The list is reproduced from the computer printout. The computer program transforms item quantities per case of more than one into binary data of "1" (presence) or "0" (absence) and lists this in the form of a binary input matrix (Table 2-b). In the matrix, as in all the

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* Later in the study, the scale scores from the aerial photography data and other data sets were correlated to demonstrate the feasibility of using aerial photo data for scalogram analysis.

other printouts by the computer, the cases (villages) and items (structural attributes) are identified by number. Villages and attributes are spelled out in the tables of output statistics only. The computerized Guttman scaling technique produces a scale as presented in Scale 1 below.

To arrive at Scale 1, the scaling process rearranges alternately the binary data of cases (presented vertically) and items (presented horizontally) at the same time that it maximizes a separation of "1's" and "0's" into opposite corners of the matrix. Zeros interspersed among the "1's". and "1's" interspersed among the "0's" are identified as scale deviations. The primary aim of the scaling process is to reduce such deviations by removing a few items at a time which contain the largest number of deviations and reordering cases and items each time this process occurs, until an acceptable scale is produced.

The acceptability of a scale is determined by the coefficient of scalability which is based on the amount of deviations present within a scale. The coefficient measures the percent perfection of a scale. A 100 percent or perfect scale is one without any deviations, that is, without any "0's" among the "1's" and vice versa. Such a scale would have a coefficient of 1.00. The generally acceptable limit of scale imperfection is 35 percent. This means that a 65 percent perfect scale or a scalability coefficient of .65 has to be attained for a scale to be acceptable.

Only items (attributes) are removed to improve a scale. Items which do not fit into the systematic accumulation, i.e., do not scale sufficiently, are removed by placing them on top of the scale above the dotted scale line (as illustrated in Scale 1). The removed items may form what is called a "shadow scale" which contains unacceptable amounts of deviation but which, nevertheless, contrast the "1's" and "0's" roughly in the same parts of the matrix as the actual scale does below. Such a shadow scale is not present in the ARD map scale (Scale 1) for Province 2, but it is very large and distinct in the air photo and census scales shown later in the text, in Sections II, D, 1 and 2. Shadow scales are significant in time-change analysis. There are indications from a limited number of time series scales that such items, over time, fill in their zero deviations and scale at a later period.

The computer program used in this study was set towards achieving a coefficient of .65, the lowest limit of an acceptable scale set by statistical convention. Once enough least scaling items had been removed to reach this scalability coefficient, the processing stopped and the scale was completed.

On the scale printout, the dividing line between "1's" and "0's" is the scale line. For each case, the number of items below the scale line represent the scale score for that village. The scale line progresses in step-wise manner from left to right. Some steps have more than one item.

Table 2a

```
SCALE 1A  BASIC FORTRAN IV 4/2/71 150X110

          JOB 0022 ARD MAP DATA, FROM PROV. 2.  23 ITEMS, 042 CASES, AUG. 30,71

          SET  23  42 222 215 .60

          ITEM 9120 WELLS DIRT                    68 0    1    9
          ITEM 9150 WELLS WOOD                    68 0    1    9
          ITEM 9170 WELLS CONCRETE                68 0    1    9
          ITEM 9200 WELLS PUMP                    68 0    1    9
          ITEM 9220 WELLS WATER WORKS             68 0    1    9
          ITEM 9270 RDS.SEASONAL CART TRACK       68 0    1    9
          ITEM 9300 RDS.SEASONAL DIRT             68 0    1    9
          ITEM 9320 STREETS DIRT                  68 0    1    9
          ITEM 9350 STREETS PAVED                 68 0    1    9
          ITEM 9370 RDS.ALL WEATHER LATERITE      68 0    1    9
          ITEM 9400 RDS.ALL WEATHER ASPHALT       68 0    1    9
          ITEM 9420 BLDGS. TEMPLES                68 0    1    9
          ITEM 9450 BLDGS. SCHOOLS                68 0    1    9
          ITEM 9470 BLDGS. RICE MILLS             68 0    1    9
          ITEM 9500 BLDGS. CLINICS                68 0    1    9
          ITEM 9520 BLDGS. MARKETS                68 0    1    9
          ITEM 9550 BLDGS. STORES SHOPS           68 0    1    9
          ITEM 9570 BLDGS. POWER STATION          68 0    1    9
          ITEM 9600 BLDGS. CHURCH MISSION         68 0    1    9
          ITEM 9620 BLDGS. POLICE STATION         68 0    1    9
          ITEM 9650 BLDGS. TOBACCO BARN           68 0    1    9
          ITEM 9670 BLDGS. AMPHOE OFFICE          68 0    1    9
          ITEM 9700 BLDGS. UNIDENTIFIED           68 0    1    9

          CASE 0112 2
          CASE 0312 2
          CASE 0412 2
          CASE 0512 2
          CASE 0122 2
```

Table 2b

0022 ARD MAP DATA. FROM PROV. 2. 23 ITEMS, 042 CASES, AUG. 30,71

INPUT MATRIX

		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
CASES		1	3	4	5	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	0	1	3	4	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	CASES	
		1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5	7	7	7	7	7		
I ID....		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	....ID	I
T .																																													. T
E .		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		. E
M .		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4		. M
S .	RANK	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	RANK	. S
9120	23	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	23	9120
9150	22	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	9150
9170	21	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	1	1	21	9170
9200	20	0	0	1	1	0	1	0	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	1	0	1	1	0	1	1	1	1	0	1	0	0	1	0	1	1	0	0	0	20	9200
9220	19	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	19	9220
9270	18	0	0	0	0	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	18	9270
9300	17	0	0	0	0	0	1	1	0	1	1	1	0	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1	1	0	1	0	0	0	0	1	0	0	1	1	1	0	0	17	9300
9320	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	16	9320
9350	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	9350
9370	14	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	0	1	1	0	0	0	0	0	14	9370
9400	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	9400
9420	12	1	1	1	3	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	12	9420
9450	11	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	11	9450
9470	10	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	1	1	1	0	1	0	0	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	0	10	9470
9500	9	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	9	9500
9520	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	9520
9550	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	9	1	1	0	1	1	0	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	7	9550
9570	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	9570
9600	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	9600
9620	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9620
9650	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9650
9670	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	9670
9700	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9700
I .	RANK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	RANK	. I
T .		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4		. T
E .		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2		. E
M .																																													. M
S ID....		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	....ID	S
		1	3	4	5	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	0	1	3	4	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5		
CASES		1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	5	7	7	7	7	7	CASES	
		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		

Table 2c

0022 ARD MAP DATA, FROM PROV. 2. 23 ITEMS, 042 CASES, AUG. 30,71 SUMMARY

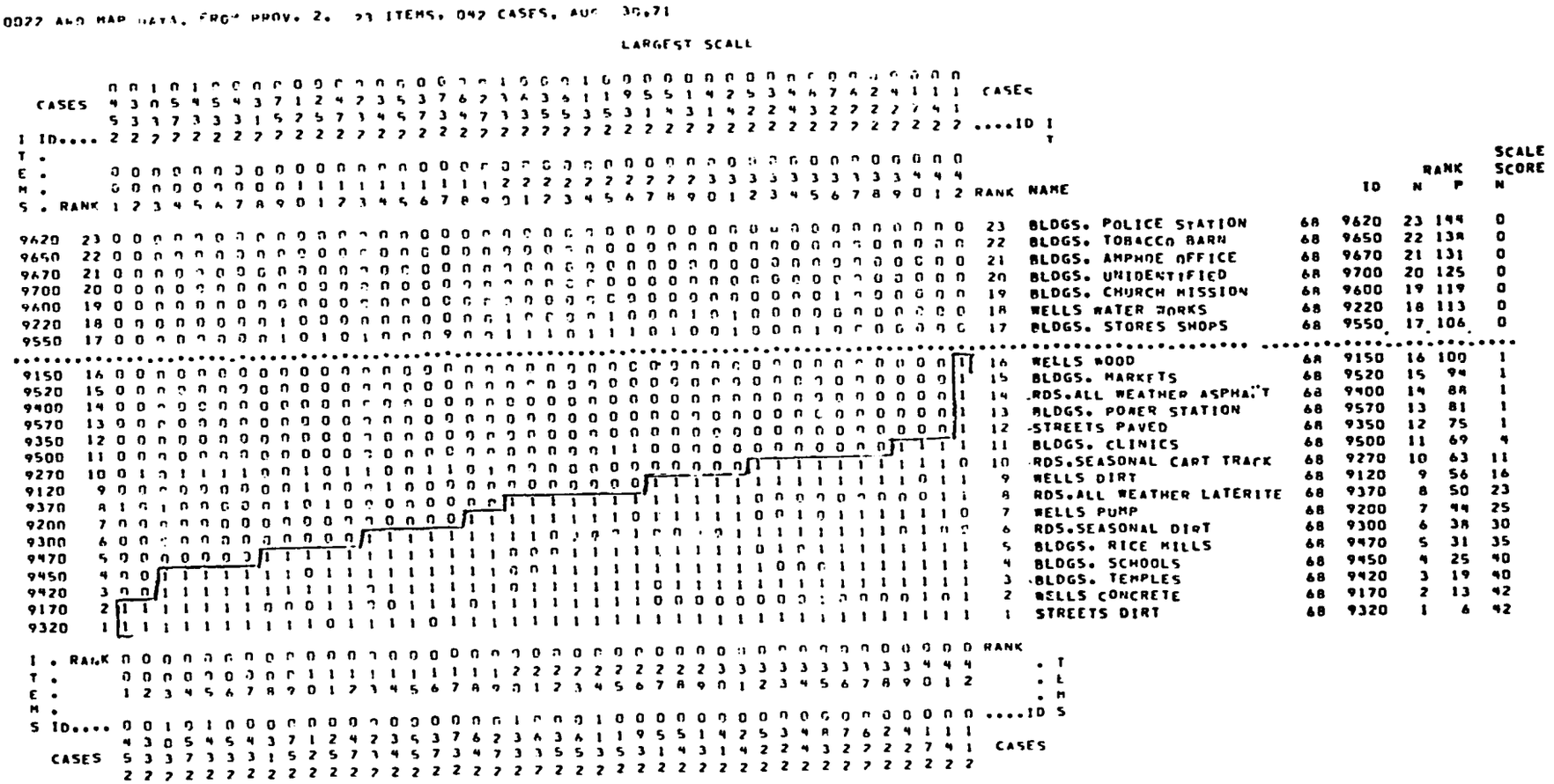
TRY	ITEMS	SCALABILITY	DISPERSION	ITEM DROPPED		REASON
1	23	.632	.250			
2	23	.643	.266			
3	23	.650	.258			
BEST	23	.650	.258			
				9220 WELLS WATER WORKS	68	MORE DEVIATIONS THAN SCALE SCORE
				9550 BLDGS. STORES SHOPS	68	MORE DEVIATIONS THAN SCALE SCORE
				9600 BLDGS. CHURCH MISSION	68	MORE DEVIATIONS THAN SCALE SCORE
				9620 BLDGS. POLICE STATION	68	ZERO SCALE SCORE
				9650 BLDGS. TOBACCO BARN	68	ZERO SCALE SCORE
				9670 BLDGS. AMPHOE OFFICE	68	ZERO SCALE SCORE
				9700 BLDGS. UNIDENTIFIED	68	ZERO SCALE SCORE
1	16	.642	.272			
2	16	.671	.276			
3	16	.652	.282			
BEST	16	.671	.276			

TOTAL CYCLES = 13

Scale 1

0022 AND MAP DATA, FROM PROV. 2. 23 ITEMS, 042 CASES, AUG 30,71

LARGEST SCALE



RANK	ID	NAME		ID	RANK N	RANK P	SCALE SCORE N
23	9620	BLDGS. POLICE STATION	68	9620	23	144	0
22	9650	BLDGS. TOBACCO BARN	68	9650	22	138	0
21	9670	BLDGS. AMPHOE OFFICE	68	9670	21	131	0
20	9700	BLDGS. UNIDENTIFIED	68	9700	20	125	0
19	9600	BLDGS. CHURCH MISSION	68	9600	19	119	0
18	9220	WELLS WATER WORKS	68	9220	18	113	0
17	9550	BLDGS. STORES SHOPS	68	9550	17	106	0
16	9150	WELLS WOOD	68	9150	16	100	1
15	9520	BLDGS. MARKETS	68	9520	15	94	1
14	9400	RDS.ALL WEATHER ASPHALT	68	9400	14	88	1
13	9570	BLDGS. POWER STATION	68	9570	13	81	1
12	9350	STREETS PAVED	68	9350	12	75	1
11	9500	BLDGS. CLINICS	68	9500	11	69	4
10	9270	RDS.SEASONAL CART TRACK	68	9270	10	63	11
9	9120	WELLS DIRT	68	9120	9	56	16
8	9370	RDS.ALL WEATHER LATERITE	68	9370	8	50	23
7	9200	WELLS PUMP	68	9200	7	44	25
6	9300	RDS.SEASONAL DIRT	68	9300	6	38	30
5	9470	BLDGS. RICE MILLS	68	9470	5	31	35
4	9450	BLDGS. SCHOOLS	68	9450	4	25	40
3	9420	BLDGS. TEMPLES	68	9420	3	19	40
2	9170	WELLS CONCRETE	68	9170	2	13	42
1	9320	STREETS DIRT	68	9320	1	6	42

This causes the step score per village to be different (smaller) than the scale score. Whether scale scores and step scores of a case are used depends on the size of the scale. For map plotting of isopleth contours, the scale scores can be used directly if the scale is small; from a large scale, even the scale steps have to be condensed into contour intervals. (See brackets in Table 2-d.)

Scale scores are printed by the computer program in two tables: 1) the Item Statistics Table containing the scores and other data per attribute, and 2) the Case Statistics Table containing the scores and other data per village. These statistics outputs are reproduced in Table 2-d. The Item Statistics Table is in the same order as the scale so that it can be placed next to the scale and the items identified. On Scale 1, only part of the Items Statistics Table has been added next to the scale.

Other outputs from the scale are presented in Table 2-e which contains general statistics about the scale as a whole, such as its scalability coefficient and its dispersion coefficient. The dispersion coefficient measures the distance of deviations from the scale line, or the dispersion of deviations in the scale. The final statistic, the deviation range, is related to the dispersion coefficient. It identifies the cumulative percent deviation on either side of the scale line (1 or 0 deviations) within each range step removed from the scale line. The percent deviation within a certain range from the scale line is important for the analysis of development change based on structural-symbolic theory.

The determination of the "development levels" of the villages led to further analysis. Central villages in the area were identified by plotting the scale score of each village on a map, taking the scale score as the village "height" of development, and drawing cumulative isopleth lines around villages of equal scale score "height" within utilized land areas. (See Maps 3, 9 and 17). The high points representing villages with higher scores relative to their neighboring villages are identified as Central Villages (CV). Since only a limited number of contours are necessary to achieve this purpose, usually six to eight, scales with many items and steps are condensed into six or eight contour intervals, as indicated by the brackets on the Item Statistics Tables accompanying the isopleth maps (Table 2-f).

Most of the isopleth maps in this study were interpolated and drawn manually by non-professionals after brief instruction and practice. Their satisfactory performance indicate the simplicity of the method. Computer programs and equipment for contour interpolation and plotting have been available since the 1960's. (See Appendix F.) However, facilities were not available until the very end of this project, therefore, only a few sample maps could be drawn by computer. These maps are included to show the capability of a fully automated production of Structural Development maps on a large scale. (See Maps 4-A. B and C and 11 in Section III-D-3.)

In summary, the technique of Guttman scaling, by systematically rearranging structural attributes so that it brings out the structural complexity of villages, furnishes quantitative data which depicts the relative levels of development of villages and presents the pattern of micro-regions with their respective Central Village and satellite villages. The

Table 2d

ITEM STATISTICS

Content Levels

	NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	NINES N	NINES P	DEVIATIONS ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
	BLDGS. POLICE STATION	6A	9620	23	144	0	0	11	110	0	107	42	168	0	0	0	195	0	100	0	122	0	0	100	0
	BLDGS. TOBACCO BARN	6A	9650	22	138	0	0	11	110	0	107	42	158	0	0	0	195	0	100	0	122	0	0	100	0
	BLDGS. AMPHOE OFFICE	6A	9670	21	131	0	0	11	110	0	107	42	148	0	0	0	195	0	100	0	122	0	0	100	0
	BLDGS. UNIDENTIFIED	6A	9700	20	125	0	0	11	110	0	107	42	137	0	0	0	195	0	100	0	122	0	0	100	0
	BLDGS. CHURCH MISSION	6A	9600	19	119	0	0	11	110	1	107	41	127	0	0	1	195	0	100	1	122	1	1	0	15
	WELLS WATER WORKS	6A	9220	18	113	0	0	11	110	5	106	37	116	0	0	5	189	0	100	5	121	5	3	0	49
	BLDGS. STORES SHOPS	6A	9550	17	106	0	0	11	110	12	104	29	107	1	0	12	163	0	100	12	115	12	8	0	56
	WELLS WOOD	6A	9150	16	100	1	2	10	100	1	100	41	100	0	0	0	100	0	100	0	100	1	1	100	0
	BLDGS. MARKETS	6A	9520	15	94	1	2	10	100	1	100	41	90	0	0	0	100	0	100	0	100	1	1	100	0
10	RDS.ALL WEATHER ASPHALT	6A	9400	14	88	1	2	10	100	1	99	41	80	0	0	0	100	0	100	0	100	1	1	100	0
	BLDGS. POWER STATION	6A	9570	13	81	1	2	10	100	1	99	41	69	0	0	0	100	0	100	0	100	1	1	100	0
	STREETS PAVED	6A	9350	12	75	1	2	10	100	1	99	41	59	0	0	0	100	0	100	0	100	1	1	100	0
9	BLDGS. CLINICS	6A	9500	11	69	4	10	9	90	6	98	36	49	0	0	2	100	0	100	2	100	4	4	67	11
8	RDS.SEASONAL CART TRACK	6A	9270	10	63	11	26	8	80	21	96	21	40	0	0	11	89	1	100	12	98	21	14	43	37
7	WELLS DIRT	6A	9120	9	56	16	38	7	70	17	88	25	35	0	0	2	32	1	98	3	83	17	11	82	7
6	RDS.ALL WEATHER LATERITE	6A	9370	8	50	23	55	6	60	18	82	24	29	0	0	4	21	9	97	13	79	18	12	28	34
5	WELLS PUMP	6A	9200	7	44	25	60	5	50	20	75	22	23	0	0	0	0	5	82	5	63	20	13	75	12
4	RDS.SEASONAL DIRT	6A	9300	6	39	30	71	4	40	19	68	23	17	0	0	0	0	11	74	11	57	19	13	42	31
3	BLDGS. RICE MILLS	6A	9470	5	31	35	83	3	30	33	61	12	11	0	0	0	0	5	56	5	43	12	8	58	21
2	BLDGS. SCHOOLS	6A	9450	4	25	40	95	2	20	34	50	8	8	0	0	0	0	6	48	6	37	8	5	25	45
	BLDGS. TEMPLES	6A	9420	3	19	40	95	2	20	37	37	5	6	0	0	0	0	3	39	3	30	5	3	40	26
1	WELLS CONCRETE	6A	9170	2	13	42	100	1	10	23	23	19	5	0	0	0	0	19	34	19	26	19	13	0	80
	STREETS DIRT	6A	9320	1	6	42	100	1	10	40	15	2	0	0	0	0	0	2	3	2	2	2	1	0	31

CASE STATISTICS

ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	NINES N	NINES P	DEVIATIONS ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
452	1	2	2	13	1	10	3	1	20	5	0	0	1	5	0	0	1	1	3	1	67	12
332	2	5	2	13	1	10	3	2	20	10	0	0	1	11	0	0	1	2	3	1	67	17
1032	3	7	4	25	2	20	5	4	18	14	0	0	1	16	0	0	1	4	5	2	80	5
572	4	10	4	25	2	20	5	6	18	19	0	0	1	21	0	0	1	5	5	2	80	8
1432	5	12	4	25	2	20	5	8	18	23	0	0	1	26	0	0	1	6	5	2	80	8
532	6	14	4	25	2	20	5	10	18	28	0	0	1	32	0	0	1	7	5	2	80	8
432	7	17	4	25	2	20	5	11	18	32	0	0	1	37	0	0	1	9	5	2	80	8
312	8	19	5	31	3	30	4	13	19	37	0	0	0	37	1	2	1	10	4	2	75	6
752	9	21	5	31	3	30	7	16	16	41	0	0	1	42	1	3	2	12	7	3	71	6
122	10	24	5	31	3	30	5	17	18	46	0	0	2	53	2	6	4	17	5	2	20	17
252	11	26	5	31	3	30	6	20	17	50	0	0	1	58	1	8	2	20	6	2	67	8
472	12	29	5	31	3	30	6	22	17	54	0	0	1	63	0	8	1	21	6	2	83	5
232	13	31	6	38	4	40	6	24	17	58	0	0	1	68	2	11	3	25	6	2	50	13
342	14	33	6	38	4	40	6	26	17	62	0	0	1	74	1	13	2	27	6	2	67	8
552	15	34	6	38	4	40	6	29	17	67	0	0	0	74	0	13	0	27	6	2	100	0
372	16	38	6	38	4	40	6	31	17	71	0	0	1	79	1	15	2	30	6	2	67	11
732	17	40	6	38	4	40	7	33	15	75	1	0	1	84	0	15	1	31	7	3	86	4
642	18	43	7	44	5	50	6	36	17	79	0	0	0	84	1	16	1	32	6	2	83	7
272	19	49	7	44	5	50	8	39	15	83	0	0	1	89	0	16	1	33	8	3	87	2
1332	20	48	8	50	6	60	7	41	16	87	0	0	0	89	3	21	3	37	7	3	57	14
632	21	50	8	50	6	60	7	44	16	91	0	0	0	89	2	24	2	40	7	3	71	8
352	22	52	8	50	6	60	7	46	16	95	0	0	0	89	2	27	2	42	7	3	71	6
652	23	55	8	50	6	60	7	49	16	99	0	0	0	89	1	29	1	43	7	3	86	2
1132	24	57	8	50	6	60	8	52	15	102	0	0	0	89	1	31	1	44	8	3	87	2
152	25	60	8	50	6	60	10	56	13	105	0	0	1	95	1	32	2	47	10	4	80	4
932	26	62	8	50	6	60	9	59	14	109	0	0	1	100	1	34	2	49	9	4	78	3
512	27	64	9	56	7	70	6	61	17	113	0	0	0	100	3	39	3	53	6	2	50	21
542	28	67	9	56	7	70	8	64	15	117	0	0	0	100	2	42	2	56	8	3	75	11
132	29	69	9	56	7	70	8	67	15	121	0	0	0	100	2	45	2	58	8	3	75	11
412	30	71	9	56	7	70	7	70	16	125	0	0	0	100	2	48	2	60	7	3	71	12
242	31	74	9	56	7	70	10	73	13	128	0	0	0	100	1	50	1	62	10	4	90	7
522	32	76	10	63	8	80	6	76	17	132	0	0	0	100	4	56	4	67	6	2	33	24
322	33	79	10	63	8	80	6	78	17	136	0	0	0	100	4	63	4	72	6	2	33	25
442	34	81	10	63	8	80	6	80	17	141	0	0	0	100	4	69	4	77	6	2	33	28
832	35	83	10	63	8	80	8	83	15	144	0	0	0	100	3	74	3	80	8	3	62	12
722	36	86	10	63	8	80	9	86	14	148	0	0	0	100	2	77	2	83	9	4	78	10
622	37	88	10	63	8	80	8	89	15	151	0	0	0	100	2	81	2	85	8	3	75	11
222	38	90	10	63	8	80	8	92	15	155	0	0	0	100	2	84	2	88	8	3	75	11
422	39	93	11	69	9	90	8	95	15	159	0	0	0	100	3	89	3	91	8	3	62	18
172	40	95	11	69	9	90	9	99	14	162	0	0	0	100	2	92	2	94	9	4	78	5
142	41	98	11	69	9	90	9	102	14	166	0	0	0	100	2	95	2	96	9	4	78	14
112	42	100	16	100	10	100	13	107	10	168	0	0	0	100	3	100	3	100	10	4	70	24

Table 2e

0022 ARD HAP DATA, FROM PROV. 2. 23 ITEMS, 042 CASES, AUG. 30,71

SCALE STATISTICS

ITEMS = 16

CASES = 42

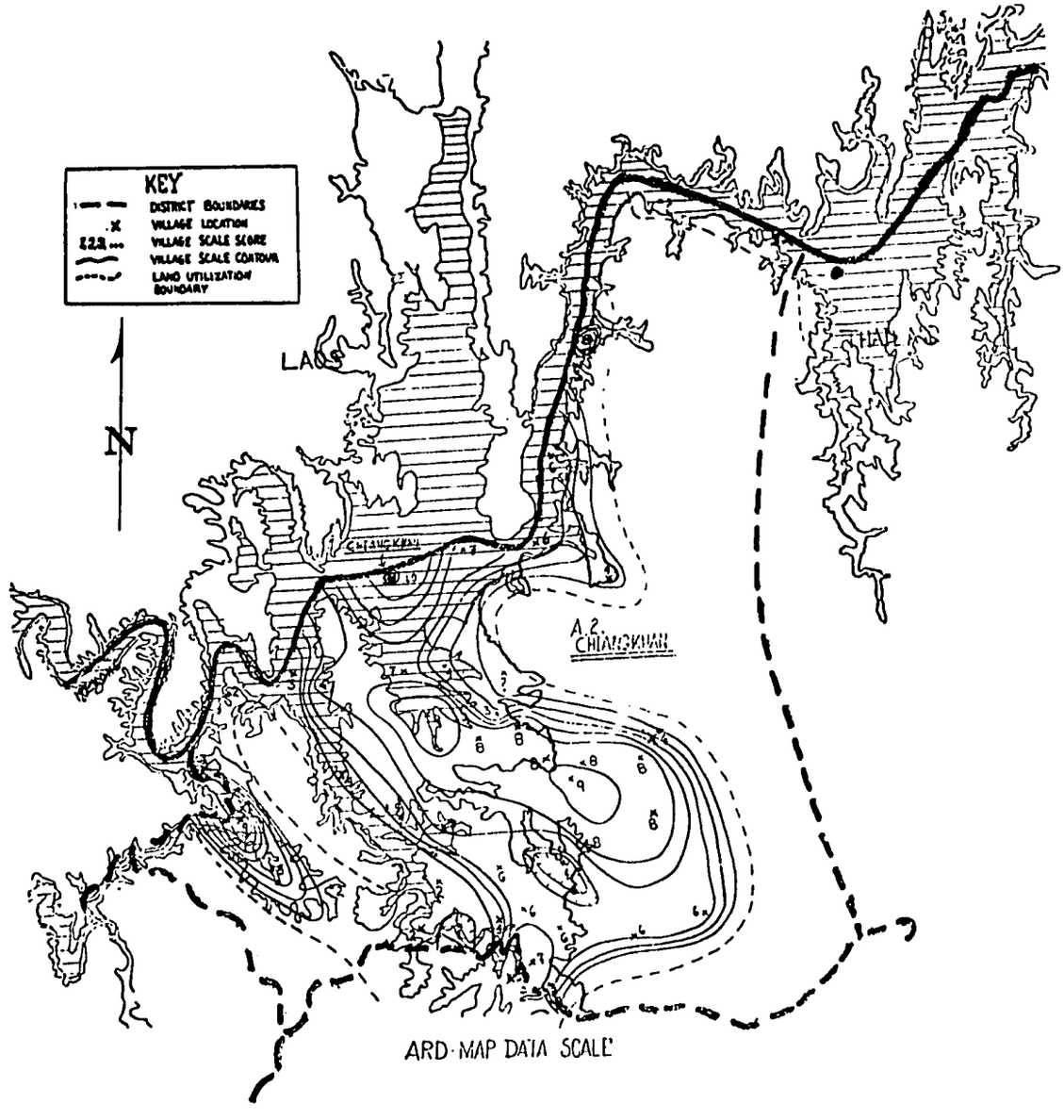
SCALABILITY = 671

DISPERSION = 276

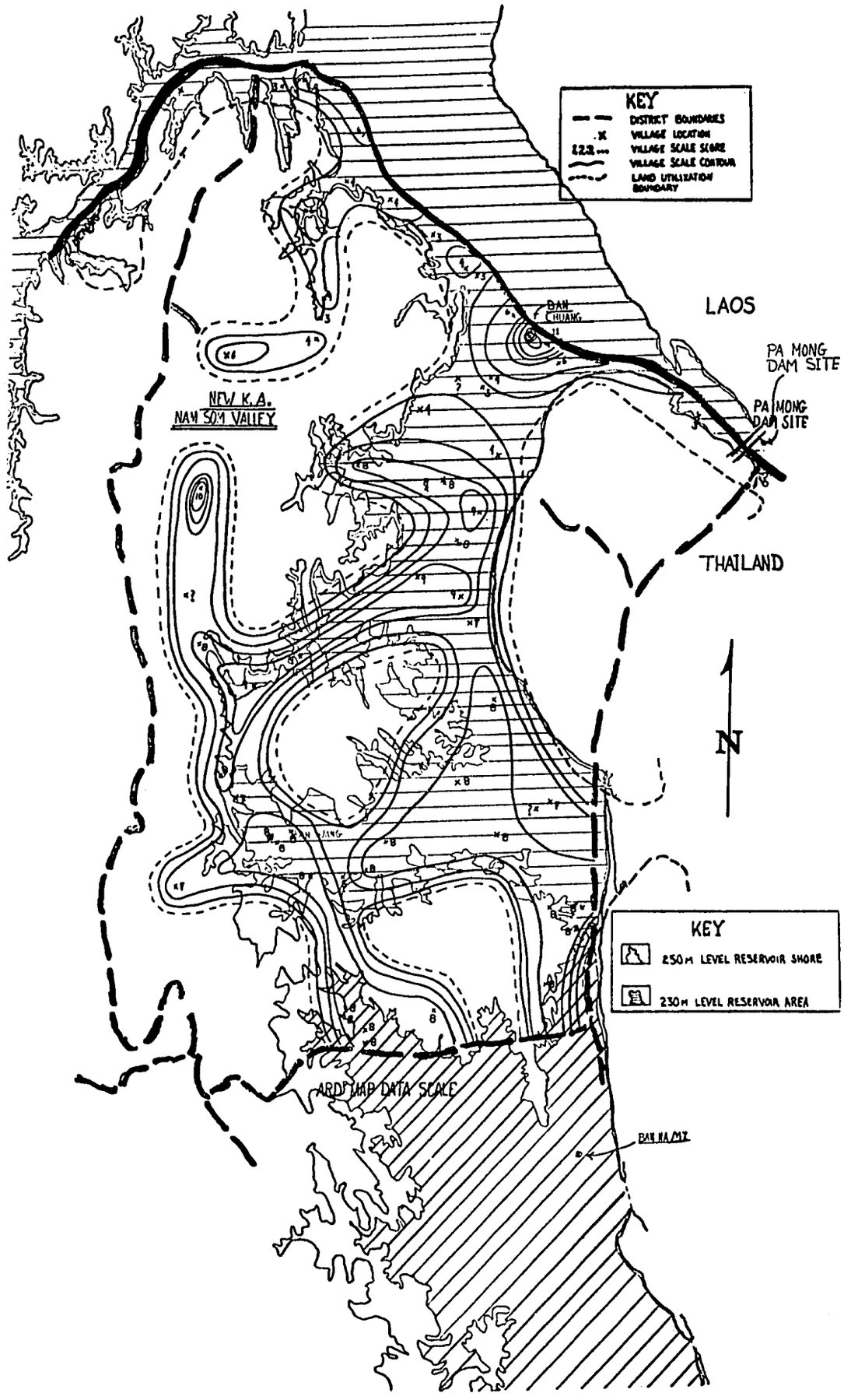
		N	P			
DEVIATIONS				NON-MODALS		
ZEROS	=	62	77	ITEMS	=	152
ONES	=	19	23	CASES	=	256
TOTAL	=	81	100	MIN	=	152
SCALE SCORE				SCALE STEPS		
CELLS IN	=	313	47	TOTAL	=	10
CELLS OUT	=	359	53	STEPS/ITEM	=	63
TOTAL	=	672	100	STEPS/CASE	=	24
FREQUENCIES						
ONES	=	270	40			
ZEROS	=	402	60			
NO DATA	=	0	0			
TOTAL	=	672	100			

0022 ARD HAP DATA, FROM PROV. 2. 23 ITEMS, 042 CASES, AUG. 30,71

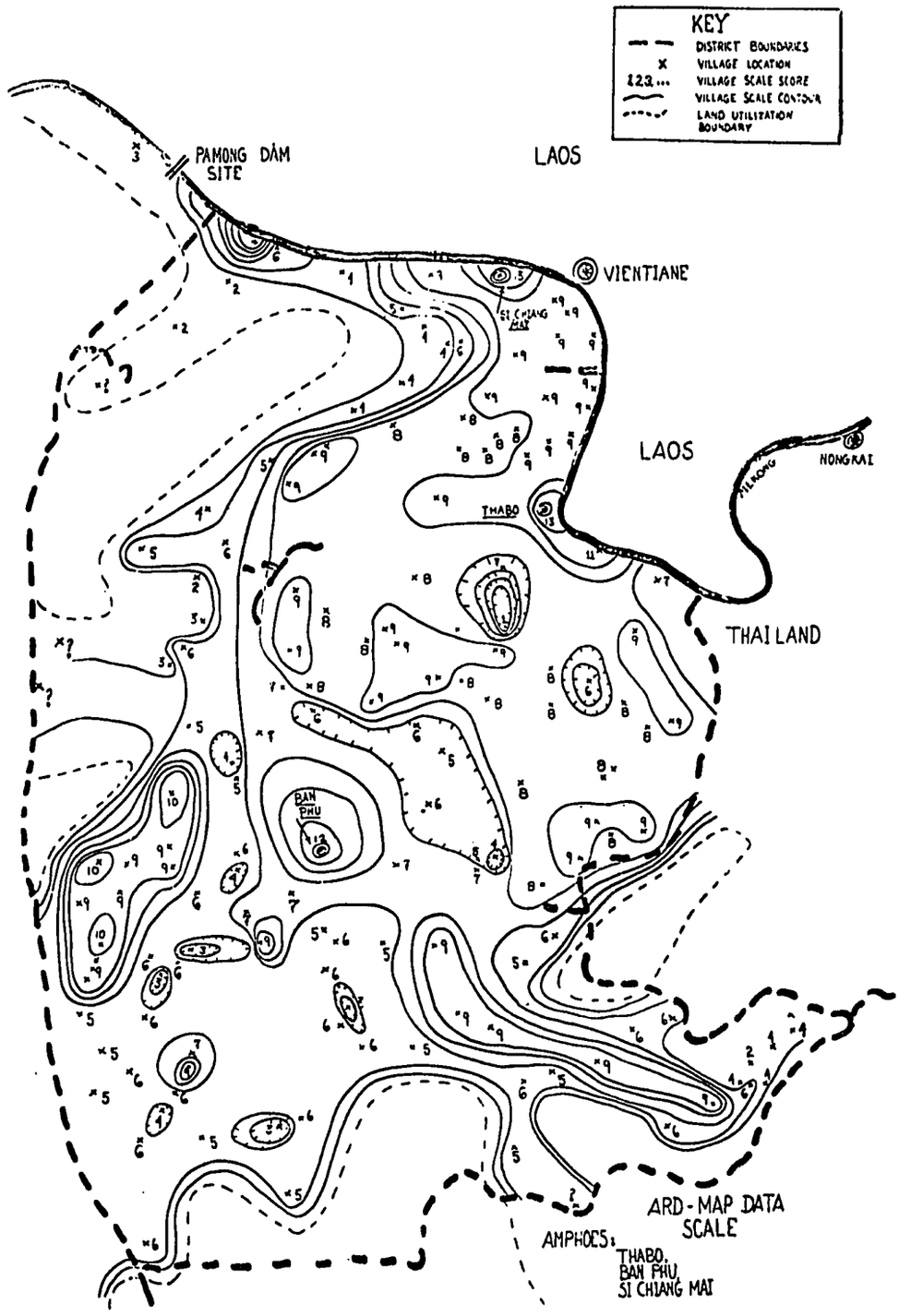
	DEVIATIONS IN RANGE					
	ONES		ZEROS		TOTAL	
RANGE	N	P	N	P	N	P
1	0	0	0	0	0	0
2	4	21	6	10	10	12
3	9	47	30	48	39	48
4	14	74	38	61	52	64
5	18	95	45	73	63	78
6	19	100	49	79	68	84
7	19	100	56	90	75	93
8	19	100	61	98	80	99
9	19	100	62	100	81	100



MAP 3
Region 5 District 2 only: ARD Map Data Scale Contours
(for Scale content see Item Statistics Table)



MAP 9
Region 7: ARD Map Data Scale Contours
(for scale content see Item Statistics Table)



Map 17

Irrigation Region I-A: ARD Map Data Scale Contours
(for Scale content see Item Statistic Table)

Table 2f

0011 ARD DATA, MAP, FOR 125 CASES IN PROV.1. 23 ITEMS, AUG 30, 71 LARGEST SCALE

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQ. ONES P	FREQ. ZEROS N	FREQ. ZEROS P	FREQ. NINES N	FREQ. NINES P	DEVIATIONS ONES N	DEV. ONES P	DEV. ZEROS N	DEV. ZEROS P	DEV. TOTAL N	DEV. TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
BLDGS.	68	9700	23	177	0	0	16	123	0	115	125	238	0	100	0	546	0	103	0	193	0	0	100	0
BLDGS. TOBACCO BARN	68	9650	22	169	0	0	16	123	3	115	122	223	0	100	3	546	0	103	3	193	3	1	0	57
RDS.ALL WEATHER ASPHALT	68	9400	21	162	0	0	16	123	6	115	119	209	0	100	6	535	0	103	6	191	6	2	0	48
STREETS PAVED	68	9350	20	154	0	0	16	123	6	114	119	193	0	100	6	512	0	103	6	186	6	2	0	48
WELLS WATER WORKS	68	9220	19	146	0	0	16	123	6	114	119	178	0	100	6	489	0	103	6	181	6	2	0	47
BLDGS. CHURCH MISSION	68	9600	18	138	0	0	16	123	9	113	116	164	0	100	9	465	0	103	9	177	9	3	0	70
WELLS PUMP	68	9200	17	131	0	0	16	123	19	112	105	150	0	100	19	431	0	103	19	170	19	6	0	58
BLDGS. CLINICS	68	9500	16	123	2	2	15	115	14	109	111	137	0	100	12	359	0	103	12	155	14	4	14	39
RDS.SEASONAL CART TRACK	68	9270	15	115	5	4	14	108	21	109	104	123	0	100	18	312	2	103	20	145	21	6	5	71
RDS.SEASONAL DIRT	68	9300	14	108	5	4	14	108	41	105	84	110	0	100	37	242	1	101	38	130	41	12	7	66
BLDGS. POWER STATION	68	9570	13	100	0	0	13	100	1	100	124	100	0	100	1	100	0	100	1	100	1	0	0	12
BLDGS. AMPHOE OFFICE	68	9670	12	92	2	2	12	92	3	100	122	85	0	100	1	96	0	100	1	98	3	1	67	10
BLDGS. MARKETS	68	9520	11	85	3	2	11	85	5	100	120	70	0	100	2	92	0	100	2	98	5	2	60	21
BLDGS. POLICE STATION	68	9620	10	77	5	4	10	77	7	99	118	55	0	100	3	85	1	100	4	97	7	2	43	27
WELLS CONCRETE	68	9170	9	69	44	35	9	69	54	96	71	41	0	100	10	73	0	99	10	94	54	16	91	10
WELLS WOOD	68	9150	8	62	73	58	8	62	63	91	61	32	1	100	3	35	12	99	15	86	61	18	75	13
RDS.ALL WEATHER LATERITE	68	9370	7	54	85	68	7	54	66	84	59	25	0	50	1	23	20	97	21	74	59	18	64	15
BLDGS. RICE MILLS	68	9470	6	46	96	77	6	46	92	75	33	17	0	50	2	19	6	68	8	58	33	10	76	10
BLDGS. STORES SHOPS	68	9550	5	38	98	78	5	38	93	64	32	13	0	50	3	12	8	62	11	52	32	10	66	14
BLDGS. SCHOOLS	68	9450	4	31	113	90	4	31	80	52	45	9	0	50	0	0	32	54	33	43	45	14	27	40
BLDGS. TEMPLES	68	9420	3	23	119	95	3	23	114	43	11	4	0	50	0	0	5	22	5	17	11	3	55	21
WELLS DIRT	68	9120	2	15	122	96	2	15	104	28	20	2	1	50	0	0	17	17	17	13	20	6	15	53
STREETS DIRT	68	9320	1	8	125	100	1	8	125	15	0	0	0	0	0	0	0	0	0	0	0	0	100	0

Center Intervals

0033 ARD MAP DATA, MAIN SCALE, FOR PROV. 3, 023 ITEMS, 126 CASES. AUG 30,71 LARGEST SCALE

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQ. ONES P	FREQ. ZEROS N	FREQ. ZEROS P	FREQ. NINES N	FREQ. NINES P	DEVIATIONS ONES N	DEV. ONES P	DEV. ZEROS N	DEV. ZEROS P	DEV. TOTAL N	DEV. TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
RDS.ALL WEATHER ASPHALT	68	9400	23	230	0	0	10	111	0	106	126	423	0	0	0	281	0	100	0	141	0	0	100	0
STREETS PAVED	68	9350	22	220	0	0	10	111	0	106	126	397	0	0	0	281	0	100	0	141	0	0	100	0
WELLS WATER WORKS	68	9220	21	210	0	0	10	111	0	106	126	372	0	0	0	281	0	100	0	141	0	0	100	0
BLDGS. POWER STATION	68	9570	20	200	0	0	10	111	0	106	126	346	0	0	0	281	0	100	0	141	0	0	100	0
BLDGS. TOBACCO BARN	68	9650	19	190	0	0	10	111	0	106	126	320	0	0	0	281	0	100	0	141	0	0	100	0
BLDGS. AMPHOE OFFICE	68	9670	18	180	0	0	10	111	1	106	125	295	0	0	1	281	0	100	1	141	1	0	0	46
BLDGS. CHURCH MISSION	68	9600	17	170	0	0	10	111	2	106	124	270	0	0	2	277	0	100	2	140	2	1	0	69
BLDGS. POLICE STATION	68	9520	16	160	0	0	10	111	2	106	124	244	0	0	2	269	0	100	2	138	2	1	0	49
BLDGS.	68	9700	15	150	0	0	10	111	2	105	124	219	0	0	2	262	0	100	2	136	2	1	0	20
BLDGS. CLINICS	68	9500	14	140	0	0	10	111	5	105	121	194	0	0	5	254	0	100	5	134	5	2	0	27
WELLS PUMP	68	9200	13	130	0	0	10	111	5	105	121	170	0	0	5	235	0	100	5	130	5	2	0	25
WELLS CONCRETE	68	9170	12	120	0	0	10	111	12	104	114	145	0	0	12	215	0	100	12	126	12	4	0	66
RDS.SEASONAL DIRT	68	9300	11	110	0	0	10	111	18	102	108	122	0	0	18	169	0	100	18	116	18	6	0	75
BLDGS. MARKETS	68	9520	10	100	5	4	9	100	10	100	116	100	0	0	5	100	0	100	5	100	10	3	50	36
BLDGS. STORES SHOPS	68	9550	9	90	26	21	8	89	33	99	93	76	0	0	8	91	1	100	9	96	33	11	73	11
WELLS WOOD	68	9150	8	80	51	40	7	78	43	94	83	59	0	0	2	50	10	99	12	88	43	15	72	11
RDS.ALL WEATHER LATERITE	68	9370	7	70	63	50	6	67	64	89	62	41	0	0	4	42	3	88	7	78	62	22	89	5
BLDGS. RICE MILLS	68	9470	6	60	88	70	5	56	89	90	37	28	0	0	5	27	4	84	9	72	37	13	76	8
BLDGS. SCHOOLS	68	9450	5	50	105	83	4	44	106	69	20	21	0	0	2	8	1	80	3	64	20	7	85	4
WELLS DIRT	68	9120	4	40	117	93	3	33	99	55	27	17	0	0	0	0	18	79	18	61	27	9	33	20
BLDGS. TEMPLES	68	9420	3	30	124	98	2	22	122	42	4	11	0	0	0	0	2	59	2	46	4	1	50	17
RDS.SEASONAL CART TRACK	68	9270	2	20	126	100	1	11	75	26	51	10	0	0	0	0	51	57	51	44	51	18	0	94
STREETS DIRT	68	9320	1	10	126	100	1	11	126	16	0	0	0	0	0	0	0	0	0	0	0	0	100	0

pattern identified and measured by the scale is the systematic accumulation of diversity of attributes. Isopleth contours facilitate the visualization of the pattern in geographic space, by which the relative high points or the Central Villages of micro-regions are identified. These statistical patterns require interpretation before they can be meaningfully used in planning and implementation tasks. Since interpretations which lack a guiding theoretical framework can become haphazard and inconsistent from one analyst to the next, the next sections explore theories by which central place systems as identified by scales may be explained. The reader who is not interested in theory may omit the next sections and continue with Section II-B.

2. Central Villages Interpreted by Central Place Theory

Interpretations of patterns made within the framework of a theory have to be consistent with it. On the other hand, the discovery of new patterns with new tools may often require alterations of a theory if the explanation of the new pattern is to be made consistent with the theory. Central Villages are a new level of central places which occurs at concentrations of population and societal levels of development where market towns do not yet exist or are still very sparse. The existence of central villages in any systematic order could not be recognized in Central Place Theory because its basic causal variables are economic and commercial quantities clearly are not present at this level of subsistence rural society. However, some aspects of the theory such as the distance patterns of certain places and their relationship to topography, transportation and population density appear to be applicable even at this level of Central Place formation.

Central Place Theory was developed in Germany in 1933 by Walter Christaller, but the model has been applied to central market evolution in China by G. William Skinner. His model is especially relevant to the Thai-Lao areas analyzed in this study. For this reason a brief description of the model has been abstracted from Skinner's paper and is presented in Appendix D. The interested reader is urged to at least skim this Appendix since it does present an excellent overall description of the evolution of a socio-geographic pattern of society. Briefly, the model describes the growth of market central places from their initial appearance in occasional village clusters in sparsely settled areas to a hierarchical system of minor, standard, intermediary and central market towns in densely settled areas in China. Skinner investigated the large amount of excellent records on market towns in China from local town gazeteers and other documents covering a period of several centuries. He was thus able to trace the evolution of market town-village systems throughout the ups and downs of a substantial period of Chinese history. In the model, the evolution of market systems and their intensification is correlated to a transportation function, the productivity of soils within a market area and the population density in that area.

The most striking phenomenon in the evolution of market town systems is the uniform pattern of distances between market towns. The spacing, according to Skinner is related to population density and transportation efficiency determined by topography. Thus two models of spacing occur: one in mountainous regions and one in flat fertile plains. Since this process has taken place in a traditional agrarian society in Asia, very similar to that present in Thailand and Laos, the relationship of population density and central village distance within the Pa Mong Study area was investigated and compared to Skinner's work. Tables 3A and 3B present the results of this comparison. The degree of correlation is surprising. The tables indicate that the forces which create central places exist before markets come into being. Since the spacing of central villages is so very much the same as that of market towns in China, the same population density-transportation mode function (in these areas primarily walking on foot) must be important at this level of development as well.

One major difference exists between the measurements of the two central place systems. In China, population density was based on the total land area of a market area hexagon. For the central villages of Thailand and Laos, population density was based on the Utilized Land Area (ULA). The ULA estimated on maps is based on aerial photography which shows that generally the utilized land area of villages on the average does not extend beyond 3 kilometers from a village.

On the above mentioned 1:100,000 scale maps a boundary was drawn about 3 kilometers from contiguous village areas (as a broken line on the isopleth maps) which encloses the ULA. The remaining land area outside the ULA boundary line was judged not significantly utilized. Significant is taken to mean a utilization of the land which generates additional population such as experienced by shifting agricultural practices while occasional hunting does not significantly increase population.

Initially, only contiguous unutilized areas of at least 50 square kilometers were measured, but later it was necessary to include those areas which were only 10 square kilometers or more in size to achieve the close correlation with the China pattern. The total unutilized land area was subtracted from the total land area of the district and the population density was computed for the remaining utilized land area. Some utilized land areas make only very narrow strips along which villages are strung like beads. Invariably these are long and rather narrow valleys with some flat bottom land which provide enough resources for initiating permanent settlements. Here shifting agriculture is necessary in the surrounding hills which, depending upon the amount of flat bottom land turned into paddy, may constitute up to 90 percent of the total land area cultivated by a village.

TABLE 3A

The Effect of Population Density on Average Distances between:

A. Central Villages with Utilized Land Area (ULA/CV) in the Pa Mong Area and
B. Market Towns with Total Land Area (TLA/MT) in China

Pa Mong Subregion No. and District	No. People per Km^2 ULA in Pa Mong or per TLA in China (A & B)	At same Pop. Dens.Aver.Dist. between MTs in China (B)	Approximate Average Dist. betw. CVs in Pa Mong Area (A)	ULA as % of TLA in Pa Mong Area (A)	CV popul. as % of MT popula. in China (A/B)	Aver. ULA/ ** CV as % of TLA/MT in China (A/B)
	1.	2.	3.	4.	5.	6.
Reservoir Area						
2 Vang Vieng	27 *	(13.5 *)	12.4 *	35	44	45
6 Pak Chom	34	(12.2)	12.2	36	50	50
7 Nam Som Valley	37	(12.0)	11.5	42	44	42
5 Muang Loei	86	(9.5)	9.2	54	69	69
5 Chiang Khan	87	(9.4)	9.3	58	70	70
Irrigation Area						
I. Ban Phu	96	(9.1)	9.4	57	70	65
I. Si Chg. Mai & Tabo	128	(8.4)	8.2	87	80	86
Total Area	76	(9.8)	9.6	50	65	64

Source: same as Table

*Col. 1 gives the same population densities for Pa Mong per ULA and for China per TLA. Col. 2 gives the average distances between Market Towns in China at that population density and Col. 3 gives the average distances between Central Villages at the same population density per ULA.

**The close correlation between columns 4, 5 and 6 indicates that the effective causal variable for central place formation is population density per Utilized Land Area (ULA) even in sparsely settled areas whether in China or the Pa Mong Region.

TABLE 3B

Basic Data for Table 3A

Pa Mong Region and District	A. Pa Mong Area: Approximate Total Land Area (Km^2 TLA) 1/	Approximate Utilized Land Area (Km^2 ULA) 2/	Number People 3/	No. Central Vill. 4/ (CVs)	No. Market Town (MTs)	Average Populat. per CV AREA	Average Km^2 ULA per CV	B. China 5/ at same popul./Km^2 TLA: Populat. Per MT Area	Average Km^2 TLA per MT
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Reserv. Area:									
2 Vang Vieng	1,430	490	10,000	7	1	1,400	71	3,160	158
6 Pak Chom	900	320	10,861	5	2	2,200	64	4,368	129
7 N. Som Vall*	1,560	650	24,115	12	2	2,000	53	4,585	125
5 Chg. Khan	840	490	42,367	9	1	4,700	54	6,675	77
Irriga. Area:									
I. B. Phn*	970	550	57,550	12	1	4,800	46	6,890	71
I. Si Chng. Mai* & Thabo	700	615	78,446	13	2	6,000	47	7,510	59
All Districts	8,080	4,070	301,932	76	6	4,150	54	6,360	84

*Nam Som Valley was made a New King Amphoe made up of Subdistricts from Ban Phu and Si Chiang Mai. These two districts are now smaller then previously.

Sources:
1. The approximate Total Land Area (TLA) was measured on 1:50,000 scale maps within the district boundaries indicated.
2. The Approximate Utilized Land Area (ULA) was estimated on 1:50,000 scale maps to be all lands up to about 3 km. from villages, modified by either favorable flat terrain very steep mountains or next village proximity.
3. For population estimates see table 12A.
4. Central Villages (CVs) are identified by isopleth contours based on scale scores. See Isopleth maps.
5. G. William Skinner "Marketing and Social Structure in Rural China" Part II, Table I, in Journal of Asian Studies. Vol. 24. p. 34. Reproduced in Appendix D .

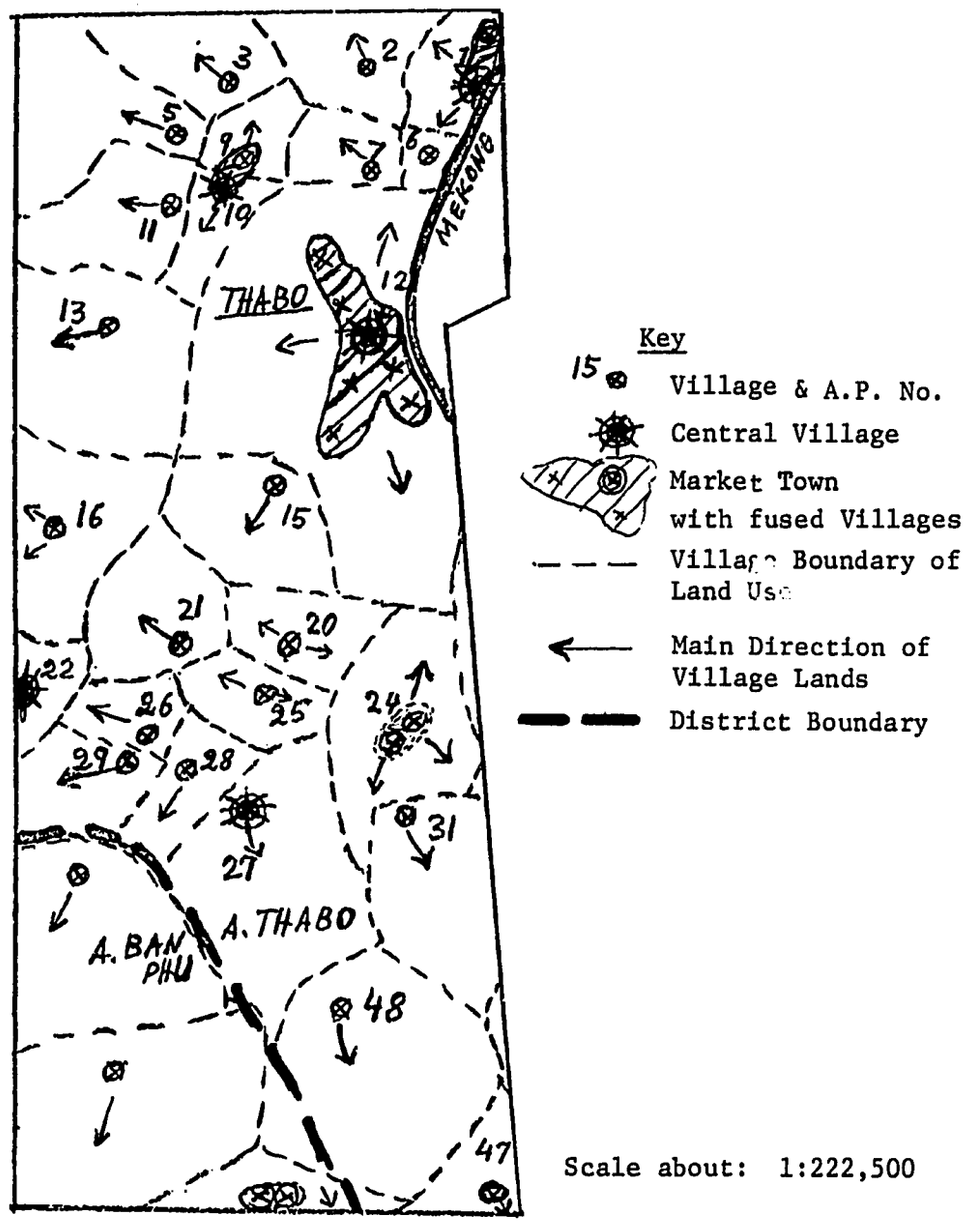
The conclusion must be drawn that some forces exist within village clusters that cause some of the villages to become more differentiated and sophisticated than their neighbors. Since the location of these villages is in a pattern closely following that of market towns in China and since walking is the most general form of travel and transportation in both areas, a maximum walking distance to central places must be a major cause determining the distances between central villages.

Another probable cause is suggested by Map 12, the colonization drift from central villages. The map covers only a small area of the Tha Bo district, most of which is in the flat fertile plains along the Mekong in the Stage One Pa Mong irrigation area. Colonization in this flat area appears to be following Skinner's Model B. The colonization drift is identified on Map 12 by the phenomenon that most villages have their land area concentrated toward one side away from central villages. It appears that central villages were first settled in the area and the surrounding villages are second or even third generation settlements from the central villages. New settlements it seems, do not jump to the center of their new village area but merely develop near the boundary of the already cultivated land belonging to their mother village. They colonize land in the direction it is available, namely away from the central village.

Other factors related to the suggestion that central villages are first settlements are that they may merely have a longer time period available, in which they can accumulate wealth and the fact that they also have first access to the resources coming from district and provincial governments. This conclusion is reinforced by the following indications: most central villages are also the seat of the subdistrict chief; the first public health clinics provided by the provincial government appear to be placed usually in or near central village locations; the first school in a subdistrict appears in a central village. Furthermore the temple and monastery in central villages is more elaborate and larger than in other villages because religious and public celebrations in these regions are usually combined and take place in central villages. Another function of central villages is that of innovation nodes. This most important aspect of central villages will be specially discussed and presented later in this report. (Section II-C-1.)

For reservoir population relocation the importance of the Skinner model of central place evolution is suggested by the fact that central markets grow in response to the needs and support of their satellite villages as soon as population density creates the economies of scale which makes viable the creation and maintenance of "market-service giving structures". Central villages similarly have such a service function. In the case of reservoir intrusion into such a spatial social system one important consideration is the removal of central villages and the loss of services to the remaining villages unless the relocation of these central places takes cognizance of interdependencies in this spatial pattern and adjusts the micro regions around the reservoir intrusion instead of letting them become amputated.

Map 12



Colonization Drift from Central Villages

No. 1, 10-9, 12, 22, 27.

Stage I. Irrigation Area in Thailand

Skinner's model and research in China is but one example from a rapidly growing body of pure research which is accumulating on central place theory. The theory has gained great influence in the geography disciplines in the United States during the last decade. Here the direction has been primarily toward mathematical model building which has grown highly sophisticated and for the applied field, sorry to say, very complicated as well. It has also encountered some very fundamental methodological problems in geography as pointed out by Peter Gould*.

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* "Thus it is almost true to say that the entire body of parametric statistics built during the last seventy years is founded upon the fundamental assumption that variables entering analyses are distributed in a normal fashion. For most geographic variables the assumption does not hold by the most charitable stretch of the imagination, and since the fifties a succession of monographs and papers have appeared in which variables have been transformed to achieve normality of distribution...

Too often we end up relating the value of one variable to the log of another, with the square root of the third, the arc sin of a fourth, and the log of a log of a fifth. Everything is normal, statistically significant at the one percent level -- except that we have not the faintest idea what it means. In the same breath we complain that theory is slow in developing, but is it any wonder after such nonsense? To produce model changes simply to fulfill the computationally simplifying assumptions of inferential statistics seems to be going forward in such a posterior fashion that we shall soon disappear up our own Klein bottles...

Situations often occur in geographic research where samples need not be taken. Very often whole populations can be investigated, yet the results of inferential tests of significance are still conscientiously reported. But having investigated a whole population, to what are we now inferring our results?...

In entering the world of inferentialism, and using probabilistic tests of significance, we assume that each of our observations is quite independent of the others...

Now it is doubtful if one could find an assumption that was more at variance with the research aims of the geographer. Why we should expect independence in spatial observations that are of the slightest intellectural interest or conceptual importance in geographic research I cannot imagine. All our efforts to understand spatial pattern, structure, and process have indicated that it is precisely the lack of independence -- the interdependence -- of spatial phenomena that allows us to substitute pattern, and therefore predictability and order, for chaos and apparent lack of interdependence of things in time and space. The drive towards the structuring of systems of events and the relationships that bind them together, and the construction and use of process models simply emphasizes that virtually all phenomena of interest to the geographer are never independent in the fundamental dimensions of his enquiry."

Peter Gould: "Is Statistix Inferens The Geographical Name for a Wild Goose?", Economic Geography, Supplement, June 1970, pp. 442-444

The most extensively used mathematical methods, testing central place data have been regression analyses and factor analysis. The theory depends almost entirely on transportation efficiency in relation to market and demand and other economic quantitative variables. Social variables are recognized only descriptively but they are neither measured nor satisfactorily explained in the theorical framework. Outside these limitations the body of emperical research is very impressive and applications in regional planning are growing rapidly.*

The most serious limitations of central place theory for application in traditional agrarian society has been its over reliance on economic quantitative variables.** In societies at the pre-market stage of development i.e. at the agricultural subsistence level of development, such economic variables are either clearly missing or are so intermeshed and hidden behind social and religious variables that they are extremely difficult to identify, let alone be measured. Only lately has the relatively new field of economic anthropology begun to identify the social covers under which economic variables can be shown to exist even in primitive society. (See Paul Bohannan and George Dalton in "Markets in Africa" 1965.) Invariably the economic variables are operative under the cloak of religious or tribal customs. Consequently it is very difficult to measure them quantitatively; quantitative aspects either can not be identified or data on them can not be collected. As a result the extension of central place theory into pre-commercial society has so far been difficult if not impossible. Most of the developing world however is precisely at this state of societal evolution and spatially useful theories are urgently needed for development planning.

To summarize briefly the important points of this section:

a. We have shown that central villages and their micro-regions have very much the same geographic distance patterns as do market towns in China.

b. In terms of developmental levels of society therefore, central places and systems exist before the market function is operating because central place evolution during the strictly subsistence level of rural development in Thailand and Laos has not been depended on or caused by market variables.

   Very few economic factors can even be conceived to exist since very little trading seems to exist between villages and reciprocal obligation between relatives in times of need seem to constitute the only exchange of produce between villages in remote areas.

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* Perhaps the best review and summarization of central place theory in this vein has been presented by the dean of American central place geographers, Brian J.L. Berry in 1965 in two corollary publications "Geography of Market Centers and Retail Distribution", and "Central Place Studies: a Bibliography of Theory and Application".

** Brian Berry used binary, qualitative data on commercial diversity in one of his early applications of factor analysis to the measurement of market place hiearchies even though he was aware of the possible applicability of Guttman scaling according to a reference he made to a 1962 Cornell Extention Bulletin.

c. Factors contributing to the spacing of central villages must be sought mostly in social needs of communication(such as those for social, religious or political gatherings); these are dependent on the transportation mode which is the distance that a person is reasonably willing to travel on foot for these purposes. Other factors may be contained in the colonization process which simply gives the central village area more time to develop and accumulate structural resources. These resources become expressed in physical structures and in terms of interdependent occupations and technology.

d. Politically, CVs almost automatically grow into a leadership role by having first and special access to political and administrative structures outside their village clusters.

e. Finally we show that scalogram methodology identifies central places with more sensitivity than quantitative methods have so far been able to do. A primary reason for this may be sought in the lack of quantitative data at these levels of development in rural society; however scalogram methodology also can analyze available data in much simpler ways than sophisticated quantitative methods such as factor analysis -- especially if the quantitative margin of error is large, rendering them useless for this purpose.

We have briefly shown the relative strength of central place theory in identifying patterns of central places and the process and variables causing them. But we also have identified its short-comings in handling pre-commercial stages of development and of the accompanying absence of quantitative and prevalence of qualitative data. It remains now to see how scalogram analysis overcomes these problems and what theoretical formulation can not only assist in the interpretation of the identified patterns but also answer some questions on why and how central places and central place patterns develop and change.

3. The Interpretation of Central Village Systems by Structural-Symbolic Theory

There are some important differences between Central Place Theory and Structural-Symbolic Theory applied geographically, but there is also considerable overlap. We have shown that central villages (CVs) evolve before the variables identified as causal for market towns are operative in a geographic area and we suggested that causes for the development of CVs must be mostly social in nature. However, three factors remain the same as in the central place theory, namely topography, population density and transportation efficiency. The most significant aspect which is similarly important in the identification of market towns as well as central villages is the greater diversity and complexity of these central places relative to their neighboring communities. Structural-symbolic theory makes this general phenomenon of growing diversity and complexity the elemental variable in the evolution of society as a whole. In doing so the theory becomes all inclusive of the products of human knowledge, not just the special parts of economic, commercial, and technological knowledge contained in the causal variables of central place theory.

A very brief outline of structural-symbolic theory may suffice here.* The theory is a model of societal evolution which tries to explain the cumulative pattern of qualitative diversity in society as a whole as it evolves by the interaction of three abstract variables from pre-historic times to the present. Structural-symbolic theory appears to be the most abstract and all inclusive theory of development that has so far been formulated which can be verified emperically most simply and clearly by scalogram analysis but also by other methods.

The basic element in the theory is human knowledge and the utility producing structure which processes this knowledge into some kind of use for all or parts of a society. The diversification or the growth of knowledge follows an identifiable process of differentiation which is the first of the three variables operating in the model. Knowledge processing i.e. utility producing structure forms distinct systems of communication channels for distributing processed knowledge whether in physical forms such as products and materials, or in the form of energy such as gas, oil and electricity, or in the form of ideas such as news, books, laws or public opinion.

The second variable is the relative access social units such as villages have to the communication systems which may be seen as the relative centrality of units in the distribution system. The distribution of communication channels in geographic space is strongly effected by efficiencies created by topography and population density. These two influences thus remain the same as in central place theory. But structural theory is much more all-inclusive in the abstract of what the communication system is transporting and distributing, namely: all processed human knowledge at all levels of societal structure and development.

The third variable attempts to explain the greater social effort, stronger civic spirit and better quality leadership occuring in some places but not others but which generally results in higher levels of development marking a central place. This variable is dependent on an imbalance between variables one and two, caused by the recognition of new knowledge but lack of access to processed utility thereof. According to the theory new knowledge without its utility produces stress until the utility is realized. Because utility is produced by knowledge processing structures, access to such structures must be achieved. As a result, new knowledge generates a solidarity of effort in a social unit to derive the utility of new knowledge by either constructing the necessary knowledge processing structure or gaining access to the distribution of an already existing processing structure.

The development of central places can be seen as the product of the three variable interacting in the structural-symbolic model. The growth of central villages which are the embryos of later market towns can be hypothesized as follows: as geographic areas are being settled, communication channels always follow from the original settlements and also grow between the new settlements within an area. The development of these communication channels depends heavily on the transportation mode influenced by topography and population density. The interaction of these factors favor certain locations more than others which results in the relatively uniform distance

*For a more detailed explication see special bibliography.Abook is shortly to be published by the Youngs.

between such locations. Villages at these nodes of communication will be favored in receiving the utilities of knowledge processing structures from the mother communities; they will also receive first any new knowledge (differentiation) coming into new village clusters (micro-regions) by virtue of their strategic location in the communication network. They will therefore not only differentiate first but they must also develop a higher degree of solidarity to obtain access to the utility producing structures for the new knowledge. This is why central villages are the first to have a school, first to have a clinic, first to have knowledge of and access to new plant varieties, new crops and crop inputs i.e. why they are also innovation nodes. Furthermore, social solidarity or the effort to make knowledge useful is itself producing special structures which give a certain permanence to a solidarity movement. A stronger civic spirit is a more or less permanent attribute of central communities especially if constantly stimulated by new knowledge flowing to them. In addition such solidarity structures need continuing reasons for their own maintenance; they thus must seek new knowledge to be processed as an end in itself.

This model may sound more deterministic to many people than they would like to accept. The solidarity variable, though dependent on the other two, still provides a certain amount of freedom of choice to the human element. At the individual level especially, freedom of choice is further increased under certain circumstances which determine the availability of new knowledge to those individuals who have special communication channels through friends and relatives to knowledge outside the immediate region. Such persons, differentiated beyond the structural capability of their community, can and do move to those places where their individual solidarity effort gains the access to the aspired utility structures. Most migrations from rural to urban areas or from one country to another can be explained in this context.

If seen as part of the structural process, it should be clear that out-migration can involve, at best, only a marginal part of the population. Otherwise, it becomes wholescale, disorganized flight from a disintegrating local structure, i.e., the breaking up of society itself.

4. Advantages and Limitations of Scalogram Analysis

a. The major advantages of scalogram analysis as demonstrated in this study are:

(1) It can systematically process and measure qualitative data which previously permitted only intuitive analysis. Such data are largely contained and processed in case studies or descriptive evaluation reports. Conclusions on sequence and interdependence had to be deduced in the narrative by subjective logic. Consistent objective mass-processing of such data was impossible. Through scalogram analysis even large amounts of qualitative data can now be processed by computer.

(2) It also focuses on the existing qualitative priorities and needs of development for a particular country, region or village out of a long list of problems and constraints by identifying the general sequence of accumulation. Focusing on such priorities prevents overlooking essential investments for the development of requisite or lagging structures as identified in the scale. The development process through policy formation, program planning and execution can thus be greatly accelerated and be made more efficient.

(3) It can use rapid survey methods whereby highly relevant information on major structural attributes can be obtained from key informants of analysis units, be they villages, provinces or countries. At the local level village survey data and aerial photography are used to provide this qualitative information, at the country level country experts or county studies can be used.

(4) Time series of data which provide extremely important information on the development process are more easily obtained for and processed by scalogram analysis than for quantitative methods. For the local level, aerial photography is the most ideal source of time series data on developmental change. At the country level periodic country evaluation reports such as those compiled by the World Bank are valuable sources.

(5) It can process quantitative data having a high margin of error by only using their qualitative content for which the error margin does not apply. For instance, to illustrate, a village chief, as a key informant, may not be sure how many pupils, wells, families boiling drinking water, pigs, cows or fertilizer users there are in his village but he will know for certain if there are any or none, which is all the information needed for scalogram analysis. Similarly a country expert may not be able to quantify the insufficiencies and resulting costs of a country's transportation system, government service, technical professionals, health service or education system but quite often he will be aware of a consensus on these matters whether among experts or the country's population. A key informant is anyone who can express the social consensus on a qualitative situation and the scale can process this qualitative information.

(6) The concepts and methods of scalogram analysis are simple. They do not require intensive mathematical training for either computation or interpretation. The data are mostly self descriptive; the interpretation merely requires a common sense level of preparation and effort. Small scales of up to 20 by 30 matrix size can easily be constructed manually. Field personnel, such as extension agents in Less Developed Countries (LDCs) with only a high school education, can be trained to do it. Development Institutions, whether national or international, can easily built it into their development survey and evaluation system, especially since a computer program handling a matrix of several hundred cases and items has now been developed.

(7) It can objectively process so called sensitive qualitative information. The scale can process information on government efficiency, minority problems and their solutions, local political systems and their performance, political stability and its degree, etc. Such information can easily be fitted into general development scales for strictly "in house use" when such rated attributes create emotional responses. Yet these attributes are extremely important in the analysis of development as a whole as well as for identifying development problems of specific regions.

(8) It can serve as a substitute to quantitative analysis when for reasons of lack of quantitative data or speed and simplicity, quantitative analysis is not possible or desirable. Ideally however, scalogram analysis is complimentary to quantitative analysis and vice versa in measuring development. The strength of quantitative analysis, given quantitatively reliable data, lies in the measurement of efficiency and correlations between variables while it does poorly in identifying sequence and multiple interdependencies of development variables. The strength and weakness of scalogram analysis are almost exactly the opposite.

(9) It presents in a highly simplified manner extremely complex inter-relationships and sequences of development. It integrates in an abstract though theoretically comprehensible form (structural-symbolic theory) the inter-relationships between social development, political development and economic development. Scalogram analysis may contribute considerably towards increased productive cooperation among the various disciplines and specialties involved in development planning and execution and overcome the present considerable theoretical overlap among various disciplines. As such scalogram analysis and the proposed theory of structural growth may finally contribute a platform on which a generally acceptable development theory can be formulated and validated through actual measurement.

b. <u>Scalogram analysis has certain distinct limitations:</u>

(1) Qualitative ratings often contain a certain amount of subjective judgment by the rater. Insufficient knowledge of general conditions also often require conjecture and estimates on the actual conditions of attributes mentioned in the scale. The scalogram technique has a built-in check against severe misinformation entered into the scale in the form of excessive deviations. However, these limitations must be recognized. The quality of key informants, or raters, or narrative sources must always be considered in using rated qualitative information. Cross checking with quantitative variables can be used to validate rated information.

(2) Qualitative indicators have problems of exact parameter definition. To maintain a common definition of some indicators among different raters may be difficult. This problem however, is not insoluble and simply requires careful initial work before rating takes place. Such definitions will have to be spelled out in more detail. Indicators should be tested on their uniformity in definition on a number of raters in a seminar environment.

(3) Scalogram analysis does not measure efficiency. Only quantitative data can do this in an exact sense. But structural qualities, especially over the long run, imply efficiency or their presence could not continue.

(4) Scalogram analysis also has limitations in processing quantitative data. Only ranges of highly correlated variables can be fitted into scales. At points where quantitative data are highly accurate and are easily available, quantitative methodologies become more useful for specific purposes such as input-output, efficiency and cost-benefit determinations but a correlory scalogram analysis may provide special insights into the causes of either efficiencies or inefficiencies.

B. Comparison of Aerial Photo and Census Data by Scalogram Analysis

1. The Structural Sophistication of Settlements: 1967 Aerial Photography Data

According to theory and borne out again by the data analyzed in this project, differentiation or the orderly growth of variation and complexity is an unidimentional process in societal development. In practice this means that different data sets on different categories of knowledge processing structure should merely be alternatives in measuring the spatial distribution of this structure. We are now prepared to see why qualitative information from aerial photography is usable to measure social structure in settlements and micro-regions.

Most of the items contained in the Map Scale (Scale 1) above can also be identified on good aerial photography. But aerial photography contains much more information on residential construction (levels of living), agricultural technology and community patterns and cohesiveness. To demonstrate this, five photographs selected from the Tha Bo and Loei districts are presented and the major qualitative items identified. The villages on photographs 1 through 5 range from the district town of Tha Bo and the provincial capital of Loei to the small and remote settlements among the hills some 30 kilometers west of Loei. (The items are listed on Table 4.) The difference in qualitative levels between these extremes are readily recognized but one can also identify the relatively minor differences between the small mountain villages. Scalogram analysis makes these differences measureable objectively and consistently if the data collection, i.e., the survey of villages on aerial photographs is done by sufficiently qualified personnel.

While the quality of the photography in scale and resolution is a major factor determining recognizable details, a minimum of training in the basic concepts and standards for the selection of qualitative data from aerial photography for scalogram analysis is essential. The only technical equipment needed are magnifying glasses and stereoscopes. For the collection of data to be consistent between different investigators requires the testing of survey items and the proper comprehension of their interpretation by each investigator. Initially data collection requires constant checking and communication between all the surveyors involved.

Table 4

Reference Key to Numbers on Air Photos 1-4*

A. Institutional Building

1. Temple Compound
2. School Compund
3. New Dwellings
4. Shops
5. Market Hall
6. District Office
7. Provincial Office
8. Prison
9. Army Compound
10. Factory (jute, cotton mill, distillery, etc.)
11. Temporary Housing in Mekong Flood Plain
12. Chinese School
13. Mission School
14. Hospital
15. Police Station
16. Lumber Yard

B. Land Use

21. Primary Forest
22. Secondary Forest
23. Paddy Fields
24. New Paddy Fields
25. Rice Threshing Areas
26. Shifting Cultiv. Fields, new
27. Shifting Cultiv. Fields, old
28. Permanent Upland Cultivation
29. Vegetable Gardens at Edge of Settlemen
30. Commercial Vegetable Gardens
31. Plantation
32. Fruit and/or Shade Trees among Dwellings
33. Irrigation Reservoir and Canals
34. Fish Pond, Managed
35. Terraced Vegetable Gardens on River Bank
36. Tobacco or Watermelon Fields on Flood Plain

C. Access Modes

41. Paved Street or Road
42. All Weather Dirt (Laterite) Road
43. Dry Season Dirt Road
44. Cart Track
45. Foot Trail

*The clarity of the photos has been significantly reduced by the printing process. The original photography shows many details clearly even without magnifying and stereoscoping equipment.

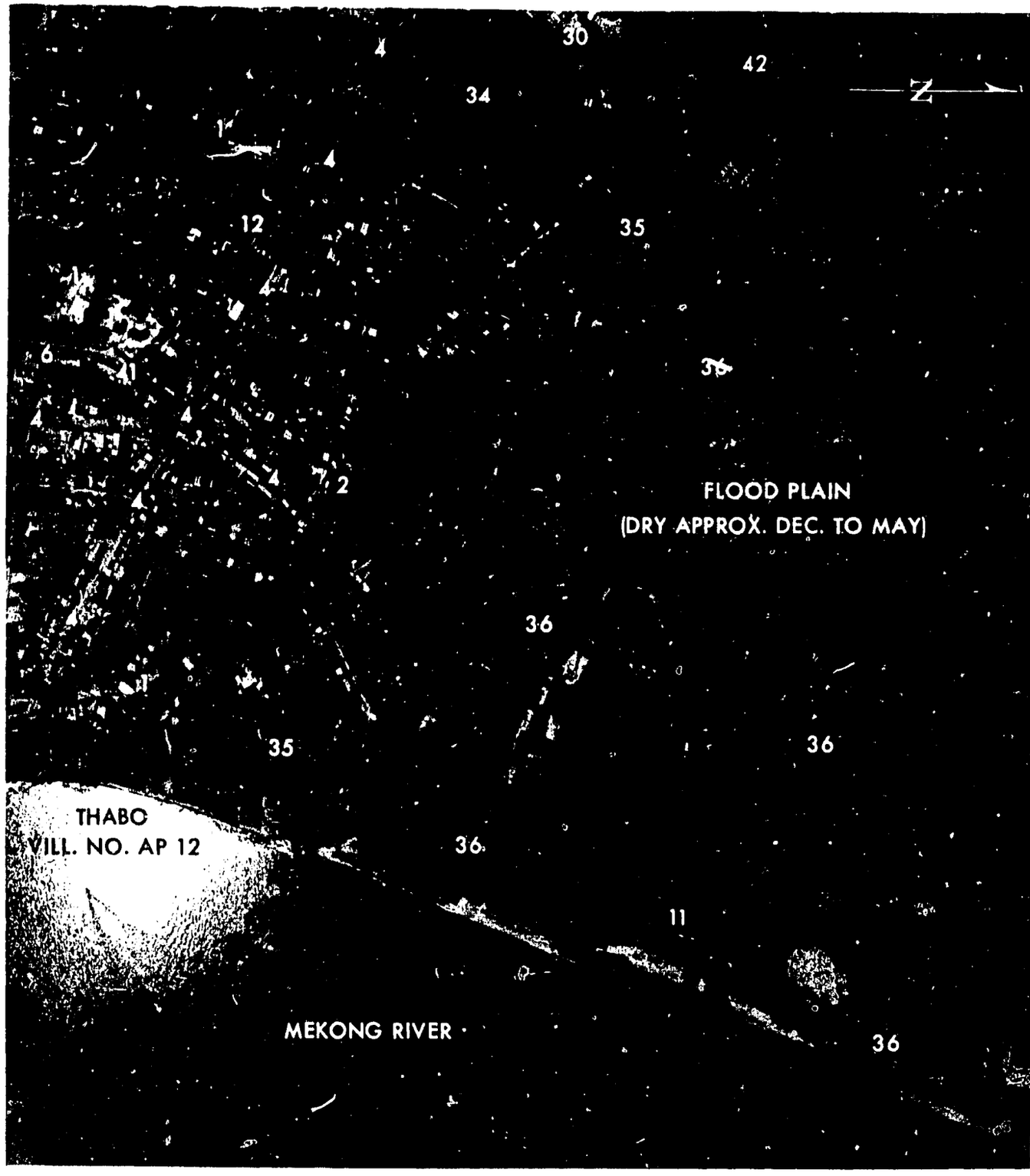


PHOTO NO. 1 THABO TOWN AND FLOOD PLAIN CULTIVATION SCALE 1:7,000

Town Pattern Grid — Organic

PHOTO NO. 2

BAN PHON TAN, THABO DISTRICT

Village Pattern Grid — Organic

SCALE 1:7,000

PHOTO NO. 3 LOEI TOWN SCALE 1:25,000

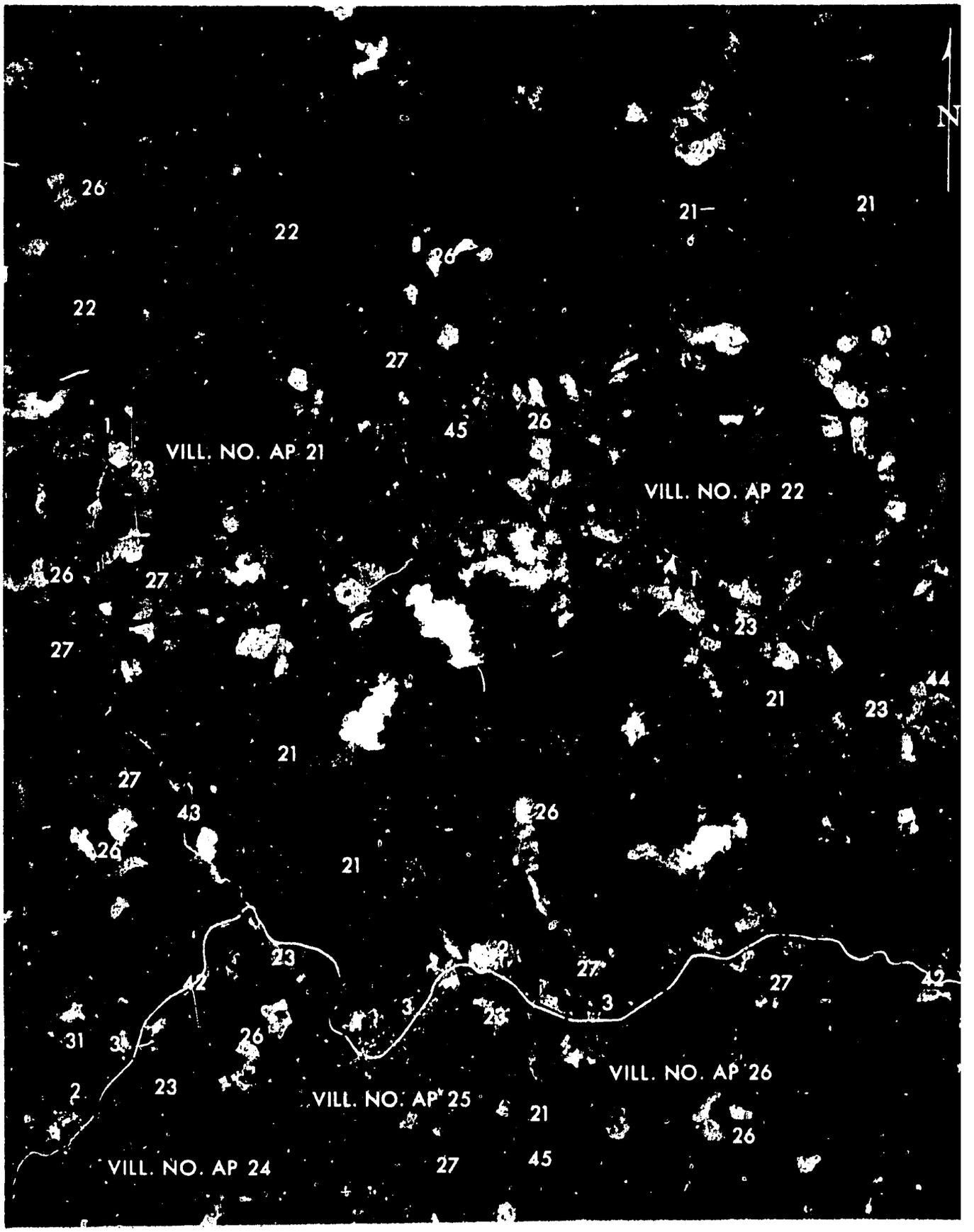


PHOTO NO. 4 DRISTRICT 1: LOEI SUB-DISTRICT 10: SIEO

This study being a test demonstration, time and personnel limitations restricted the number of villages which could be surveyed. Only the Tha Bo district in the irrigation area and the central part of the Muang Loei district (some 45 to 50 villages in each district) were surveyed on 1967 photography. The initial hope that time series of data could be obtained from the several time frames of aerial photography taken between 1956-1968 was disappointing. The Loei sample area was surveyed on both the 1954 and 1967 photography and the collected data were processed, but the 1954 photography is of so much poor quality that a significant comparative analysis could not be made without much additional work, not possible within the limitations of this study. For demonstration purposes, however, the sample areas selected on the 1967 photography are sufficient to prove the point that data from aerial photography are valid alternatives to ground data in measuring the structural differentiation of settlements in remote regions.

In addition, the project's terms of reference permitted only the collection of a minimal amount of agricultural data from the photography. Only enough agricultural information was identified to show that growth of agricultural technology is an integral part of the overall societal structure of a region. Much more detailed agricultural information can be detected, especially on the high quality photography at the 1:7,000 scale from the irrigation area. To obtain that information systematically requires very time-consuming and careful identification work with high magnification equipment. Most of all, it requires photography taken during the growing season, ideally in color, and more specialized knowledge on the aerial photo interpretation of plant life and agricultural practices then was available to this study. From more detailed information highly informative agricultural subscales could be constructed.

The Items Statistic Tables 5a and b on the Loei Aerial Photo (AP) Scale (Scale 2) show the 142 qualitative attributes of villages in the Pa Mong region which were collected from the aerial photography. Of these items 95 scale, most of the rest forms a distinct shadow scale. The items represent any discernible detail of qualitative variation between and in village patterns, agriculture, dwellings, institutions and access. Some redundancy is present in this scale but it was not removed since it demonstrates the large amount of information that can be identified on aerial photography. Scale 2 shows how the many details of village complexity are accumulated in a fairly orderly sequence. At the same time the villages are ordered into a hierarchy of increasing complexity and diversity. Though the same in principle as Scale 1 this large scale demonstrates these aspects in much more detail. Another point of importance is that the AP Scale (Scale 2) identifies the same CVs as the Map Scale (Scale 1) and scales from other data sets presented in the sections below.

At the same time the AP Scale verifies a major premise of structural-symbolic theory, namely that structural differentiation (development) is a unidimensional process. Economic development concepts would generally conceive of agriculture, residential living levels, access to transportation and public and private service institutions as belonging to different sectors, and therefore as more or less distinct and only correlated development categories. The interspersing of all these categories in the scale shows that they diversify together and grow in complexity in the same villages, i.e.,

Table 5a

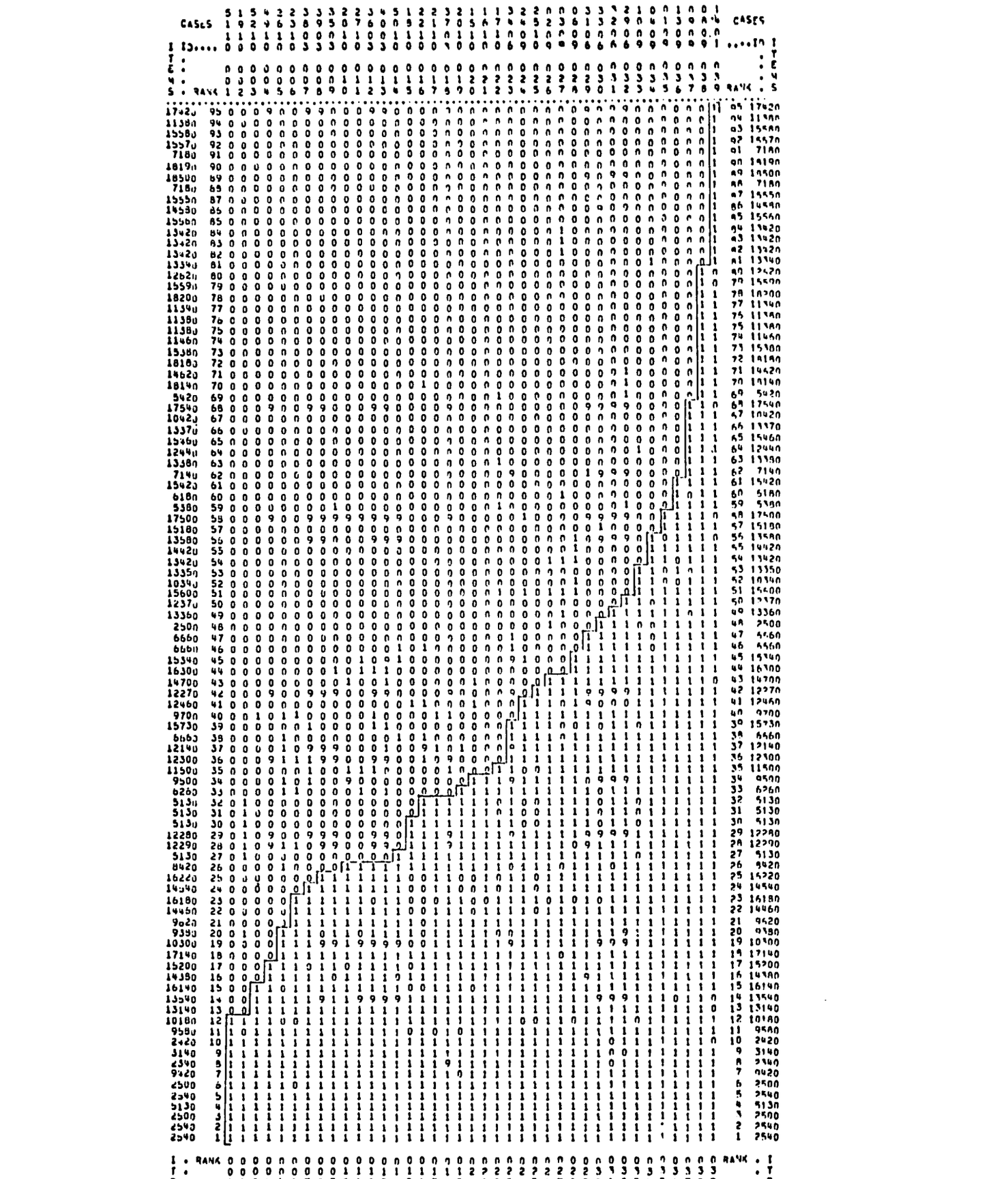
ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	MINES N	MINES P	DEVIATIONS ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ANTL ITY	DIS PER SION
MARKET HALL	67	17420	95	100	1	3	30	100	1	100	29	100	10	100	0	100	0	100	0	100	1	0	100	0
IR.DAM MAT.CONCRETE	67	11380	94	99	1	3	30	100	1	100	35	99	0	92	0	100	0	100	0	100	1	0	100	0
INST.FORMAL POND	67	15580	93	98	1	3	30	100	1	100	39	97	0	92	0	100	0	100	0	100	1	0	100	0
INST.WELLS	67	15570	92	97	1	3	30	100	1	100	39	95	0	92	0	100	0	100	0	100	1	0	100	0
AIR-FIELD FOR LARGE AIRCR.	67	7180	91	96	1	3	30	100	1	100	39	93	0	92	0	100	0	100	0	100	1	0	100	0
LOW HILL	67	18190	90	95	1	3	30	100	1	100	38	92	0	92	0	100	0	100	0	100	1	0	100	0
POWER STATION	67	18500	89	94	1	3	30	100	1	100	35	90	3	92	0	100	0	100	0	100	1	0	100	0
AIR-FIELD ATL.FOR STOL	67	7180	88	93	1	3	30	100	1	100	39	89	0	89	0	100	0	100	0	100	1	0	100	0
INST.BILLB.TREE	67	15550	87	92	1	3	30	100	1	99	39	87	0	89	0	100	0	100	0	100	1	0	100	0
INST.RECREAT.FACILITY	67	14580	86	91	1	3	30	100	1	99	35	85	2	89	0	100	0	100	0	100	1	0	100	0
INST.FOUNTAIN	67	15560	85	89	1	3	30	100	1	99	39	83	0	88	0	100	0	100	0	100	1	0	100	0
INST.COMPLX.BLDG.J	67	13420	84	88	1	3	30	100	2	99	37	81	0	88	1	100	0	100	1	100	2	0	50	15
INST.COMPLX.BLDG.H	67	13420	83	87	1	3	30	100	2	99	37	80	0	88	1	99	0	100	1	100	2	0	50	15
INST.COMPLX.BLDG.I	67	13420	82	86	1	3	30	100	2	99	37	79	0	88	1	99	0	100	1	99	2	0	50	15
INST.BLDG.PAT.--	67	13340	81	85	1	3	30	100	2	99	37	76	0	88	1	97	0	100	1	99	2	0	50	5
FISH TRAPS-BOONS	67	12620	80	84	2	5	29	97	1	99	39	75	0	88	0	96	1	100	1	98	1	0	0	3
INST.AREA WTH VEGT-TREEPLT	67	15590	79	83	2	5	29	97	1	99	39	73	0	88	0	96	1	99	1	99	1	0	0	3
RICE MILL	67	18200	78	82	2	5	29	97	2	99	37	71	0	88	0	96	0	98	0	97	2	0	100	0
IRRIG.DAM	67	11340	77	81	2	5	29	97	2	98	37	69	0	88	0	96	0	98	0	97	2	0	100	0
IR.DAM MAT.STICKS	67	11380	76	80	2	5	29	97	2	98	37	68	0	88	0	96	0	98	0	97	2	0	100	0
IR.DAM MAT.DIRT	67	11380	75	79	2	5	29	97	2	98	37	66	0	88	0	96	0	98	0	97	2	0	100	0
DOUBLE CROPPING	67	11460	74	78	2	5	29	97	2	98	37	64	0	88	0	96	0	98	0	97	2	0	100	0
INST.MONUMENT	67	15380	73	77	2	5	29	97	2	98	37	62	0	88	0	96	0	98	0	97	2	0	100	0
COTTON MILL	67	18180	72	76	2	5	29	97	2	98	37	61	0	88	0	96	0	98	0	97	2	0	100	0
INST.PRODUCT.FACILITY	67	14620	71	75	2	5	29	97	3	98	36	59	0	88	1	96	0	98	1	97	3	1	67	5
FACTORY	67	18140	70	74	2	5	29	97	4	97	35	57	0	88	2	94	0	98	2	97	4	1	50	18
INDUSTRIAL-RESID SUBCOMMUN	67	5420	69	73	2	5	29	97	4	97	35	56	0	88	2	92	0	98	2	96	4	1	50	14
MERCHANT BLOCKS	67	17540	68	72	3	8	28	93	2	97	27	54	10	88	0	90	1	90	1	95	2	0	50	3
WATER TOWERS-TANKS	67	10420	67	71	3	8	28	93	3	97	36	53	0	80	0	90	0	97	0	94	3	1	100	0
INST.BLDG.PAT.(-)	67	13370	66	69	3	8	28	93	3	96	36	51	0	80	0	90	0	97	0	94	3	1	100	0
INST.ORNAM.GARDEN	67	15460	65	68	3	8	28	93	3	96	35	50	0	80	0	90	0	97	0	94	3	1	100	0
MANGO PLANTAT.	67	12440	64	67	3	8	28	93	4	96	35	48	0	80	1	90	0	97	1	94	4	1	75	2
INST.BLDG.PAT.(=)	67	13380	63	66	3	8	28	93	4	95	35	46	0	80	1	89	0	97	1	94	4	1	75	10
DUGOUT BOATS	67	7140	62	65	3	8	26	93	4	95	31	45	4	80	1	88	0	97	1	93	4	1	75	5
INST.INSIGNIA SYMB.	67	15420	61	64	4	10	27	90	4	95	35	43	0	76	0	87	0	97	0	93	4	1	100	0
ALL WEATH.PAVED ROAD	67	6180	60	63	4	10	27	90	4	95	35	42	0	76	1	87	1	97	2	93	4	1	50	6
COMMERCIAL-RESID SUBCOMMUN	67	5380	59	62	4	10	27	90	7	95	32	40	0	76	3	85	0	94	3	92	7	1	57	17
MERCHANT STORES	67	17500	58	61	5	13	26	87	5	94	28	39	14	76	1	82	1	94	2	90	5	1	60	8
INST.ACCESS TO WATER BODY	67	15180	57	60	5	13	26	87	6	94	33	38	0	65	1	81	0	96	1	89	6	1	83	2
INST.BLDG.BRICK	67	13580	56	59	6	15	25	83	5	93	26	36	8	65	1	80	2	96	3	89	5	1	40	6
INST.ROOF SHED-LEAN-TO	67	14420	55	58	6	15	25	83	7	93	32	35	0	59	1	79	0	94	1	87	7	1	86	2
INST.COMPLX.BLDG.T	67	13420	54	57	6	15	25	83	8	92	31	33	0	58	3	78	1	94	4	87	8	1	50	7
INST.BLDG.PAT.()	67	13350	53	56	7	18	24	80	5	92	34	32	0	58	0	74	2	93	2	85	5	1	60	3
CONCRETE SLAB ROOF-DWEL.	67	10340	52	55	7	18	24	80	6	92	33	30	0	58	1	74	2	91	3	84	6	1	50	4
INST.AREA WTH TREES ONLY	67	15600	51	54	7	18	24	80	12	91	27	29	0	58	5	73	0	89	5	82	12	2	58	8
COMMERC.VEGET.AREAS	67	12370	50	53	8	21	23	77	7	90	32	28	0	58	0	67	1	89	1	80	7	1	86	1
INST.BLDG.PAT.(-)	67	13360	49	52	9	23	22	73	9	90	30	26	0	58	1	67	1	80	2	78	8	2	78	3
NO FORES.WITHIN NEXT VIL.	67	2500	48	51	10	26	21	70	9	89	30	25	0	58	1	56	2	89	3	78	9	2	67	3
AT.SMALL NAVIG.RIVER	67	6660	47	49	11	28	20	67	11	89	28	23	0	58	1	65	1	86	2	77	11	2	82	3
ATL.NONNAV.RIVER ALL SEAS.	67	6650	46	48	11	28	20	67	13	88	26	22	0	58	3	64	1	85	4	76	13	2	69	0
INST.FLAG POLE	67	15340	45	47	12	31	19	63	15	87	22	21	2	58	3	61	0	84	3	74	15	3	80	7
TEMP.BUDA CHAPEL	67	16300	44	46	12	31	19	63	16	86	23	20	0	57	4	57	0	84	4	73	16	3	75	13
INST.ENTRANCE STRUCTURE	67	14700	43	45	14	36	18	60	16	85	23	19	0	57	3	53	1	84	4	70	16	3	75	9
CITRUS IN DWEL.YRD	67	12270	42	44	15	38	17	57	11	84	16	18	12	57	0	49	0	83	0	69	11	2	100	0
BANANA PLANTAT.	67	12460	41	43	16	41	16	53	14	83	24	17	1	47	3	49	4	83	7	69	14	2	50	10
MULTIPLE ROOFED DWEL.S	67	9700	40	42	16	41	16	53	22	82	17	16	0	46	6	46	0	80	6	65	17	3	65	15
INST.APART-NEAR VIL.	67	15730	39	41	17	44	15	50	16	80	23	15	0	46	3	39	4	80	7	62	16	3	55	12
ATL.NONNAV.RIVER DRY SEAS.	67	6660	38	40	17	44	15	50	19	79	20	14	0	46	3	36	1	76	4	50	19	3	79	6
GARDENS ATL.NEAR HOUSES	67	12140	37	39	17	44	15	50	20	78	14	13	5	46	4	33	0	75	4	57	14	2	71	8
BANANA IN DWEL.YRD	67	12300	36	38	17	44	15	50	21	76	12	12	6	42	4	28	0	75	4	55	12	2	57	14
RICE THRESH.AREAS	67	11500	35	37	18	46	14	47	21	75	19	12	0	37	5	24	2	75	7	53	18	3	61	10
HEDGED DWEL.LOTS	67	9500	34	36	20	51	13	43	17	73	17	11	5	37	2	18	1	74	3	49	17	3	82	7
ALL WEATH.DIRT ROAD	67	6260	33	35	21	54	12	40	24	72	15	10	0	33	4	16	1	73	5	49	15	3	67	10
VIL.PAT.SEMI CIRCLE	67	5130	32	34	24	62	11	37	20	70	19	10	0	33	1	11	5	72	6	45	10	3	68	12
VIL.PAT.ORGANIC	67	5130	31	33	24	62	11	37	20	69	19	9	0	33	1	10	5	69	6	42	10	3	68	12
VIL.PAT.CROSS ROADS	67	5130	30	32	25	64	10	33	22	68	17	8	0	33	1	9	4	63	5	39	17	3	71	13
MANGO IN DWEL.YRD	67	12280	29	31	25	64	10	33	20	66	7	7	12	33	1	8	0	60	1	37	7	1	86	5
COCONUT IN DWEL.YRD	67	12290	28	29	25	64	10	33	25	65	7	7	7	23	3	7	1	60	4	36	7	1	43	17
VIL.PAT.LINE	67	5130	27	28	26	67	9	30	26	63	13	6	0	17	1	3	1	59	2	34	13	2	85	7
HOUSES HAVE SHED ADDED	67	8920	26	27	30	77	8	27	28	61	11	6	0	17	1	2	3	58	4	33	11	2	64	15
TEMP.MAIN BLDG.DWEL.ROOF	67	16220	25	26	32	82	7	23	26	59	13	5	0	17	0	1	6	55	6	32	13	2	54	17
INST.ROOF MULTIPLE	67	14540	24	25	33	85	6	20	27	57	12	5	0	17	0	1	6	50	6	29	12	2	50	10
TEMP.MAIN BLDG.SQARE	67	16190	23	24	34	87	5	17	25	55	14	4	0	17	0	1	9	45	0	26	14	2	36	30
INST.ROOF HIP	67	14450	22	23	34	87	5	17	30	54	9	3	0	17	0	1	4	37	4	21	9	2	56	17
HIP ROOFS	67	9620	21	22	34	87	5	17	33	52	6	3	0	17	0	1	1	33	1	19	6	1	83	5
COWLER DWELLINGS	67	9380	20	21	35	90	4	13	30	49	8	3	1	17	1	1	5	32	6	19	8	1	95	21
TIN ROOFS-DWEL.	67	10300	19	20	35	90	4	13	23	47	6	2	10	16	0	0	2	28	2	16	6	1	67	10
SCHOOLS	67	17140	18	19	35	90	4	13	34	45	5	2	0	8	0	0	1	24	1	15	5	1	80	12
INST.STREET ACCESS IN VIL.	67	15200	17	18	36	92	3	10	33	43	6	2	0	8	0	0	3	25	3	14	6	1	50	0
INST.ROOF A-FRAME	67	14380	16	17	36	92	3	10	33	41	5	2	1	8	0	0	2	23	2	13	5	1	60	8
TEMPLES	67	16140	15	16	37	95	2	7	33	38	6	1	0	7	0	0	4	21	4	12	6	1	33	21
INST.BLDG.ADJ	67	13540	14	15	37	95	2	7	27	36	4	1	8	7	0	0	2	19	2	10	4	1	50	47
INSTITUTIONS	67	13140	13	14	37	95	2	7	36	34	3	1	0	1	0	0	1	16	1	9	3	1	67	32
SHINGLED-TILED ROOFS-DWEL.	67	10160	12	13	39	100	1	3	33	32	5	1	0	1	0	0	6	15	6	8	6	1	0	98
AFRAME SHED LEANTO ROOFS	67	9580	11	12	39	100	1	3	35	29	4	1	0	1	0	0	4	10	4	5	4	1	0	34
OLD HILL RICE FIELDS	67	2420	10	11	39	100	1	3	37	27	2	0	0	1	0	0	2	6	2	3	2	0	0	91
VIL.HAS POTENT. NEW PADDY	67	3140	9	9	39	100	1	3	37	24	2	0	0	1	0	0	2	4	2	2	2	0	0	91
NEW HILL RICE FIELDS	67	2340	8	8	39	100	1	3	37	22	1	0	1	1	0	0	1	3	1	1	1	0	0	79
ROOFED PORCHES	67	9420	7	7	39	100	1	3	38	19	1	0	0	0	0	0	1	2	1	1	1	0	0	87
SECO.FOR.WITHIN 1KM OF VIL.	67	2500	6	6	39	100	1	3	38	16	1	0	0	0	0	0	1	1	1	0	1	0	0	13
SECO.FOR.BETW.NEXT VIL.SYS	67	2540	5	5	39	100	1	3	39	14	0	0	0	0	0	0	0	0	0	0	0	0	100	0
VIL.PAT.SCATERED	67	5130	4	4	39	100	1	3	39	11	0	0	0	0	0	0	0	0	0	0	0	0	100	0
PRIM.FOR.WITHIN 1KM OF VIL.	67	2500	3	3	39	100	1	3	39	8	0	0	0	0	0	0	0	0	0	0	0	0	100	0
NO FORES.BETW.NEXT VIL.SYS	67	2540	2	2	39	100	1	3	39	5	0	0	0	0	0	0	0	0	0	0	0	0	100	0
PRIM.FOR.BETW.NEXT VIL.SYS	67	2540	1	1	39	100	1	3	39	3	0	0	0	0	0	0	0	0	0	0	0	0	100	0

Scale 2A

9998T LOEI MAIN SCALE, 1967 AIR PHOTO DATA, 135 ITEMS, 039 CASES, 9/29/71

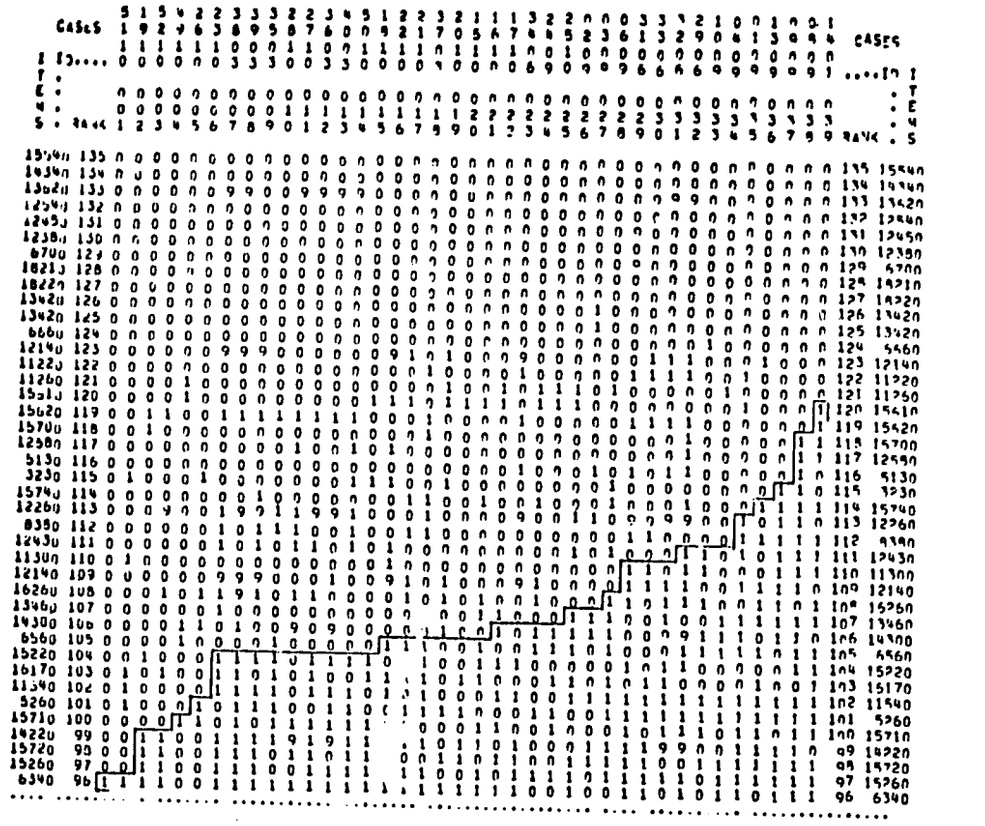
LARGEST SCALE



Scale 2B

9991 .OCI WAI. SCALE. 1967 AIR PHOTO DATA. 135 ITEMS. 039 CASES. 9/28/71

LARGEST SCALE



The Shadow Scale

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQ ONES P	FREQ ZEROS N	FREQ ZEROS P	FREQ NINES N	FREQ NINES P	DEVIATIONS ONES N	DEV ONES P	DEV ZEROS N	DEV ZEROS P	DEV TOTAL N	DEV TOTAL P	NON MODAL N	NON MODAL P	SCAL ARIL ITY	DIS PER SION
INST.KILNS	67	15540	135	142	0	0	47	157	0	130	39	150	0	133	0	248	0	221	0	233	0	0	100	0
INST.ROOF CONCRETE SLAB	67	14340	134	141	0	0	47	157	0	130	39	149	0	133	0	248	0	221	0	233	0	0	100	0
INST.BLDG.CONCRETE	67	13620	133	140	0	0	47	157	0	130	30	147	9	133	0	248	0	221	0	233	0	0	100	0
DUCK FARM	67	12540	132	139	0	0	47	157	0	130	39	145	0	125	0	248	0	221	0	233	0	0	100	0
COCONUT PLANTAT.	67	12450	131	138	0	0	47	157	0	130	39	144	1	125	0	248	0	221	0	233	0	0	100	0
COMMERC.TABAC.AREAS	67	12380	130	137	0	0	47	157	0	130	39	142	0	125	0	248	0	221	0	233	0	0	100	0
BARGE TYPE BOATS	67	6700	129	136	0	0	47	157	0	130	38	140	1	125	0	248	0	221	0	233	0	0	100	0
BRICK YARD	67	18210	128	135	0	0	47	157	0	130	39	138	0	124	0	248	0	221	0	233	0	0	100	0
TOBACCO	67	18220	127	134	0	0	47	157	0	130	39	137	0	124	0	248	0	221	0	233	0	0	100	0
INST.COMPLEX.BLDG.L	67	13420	126	133	0	0	47	157	1	130	39	135	0	124	1	248	0	221	1	233	1	0	0	32
INST.COMPLEX.BLDG.Y	67	13420	125	132	0	0	47	157	1	130	39	133	0	124	1	247	0	221	1	233	1	0	0	32
LARGE NAVIG.RIVER	67	6660	124	131	0	0	47	157	1	130	39	131	0	124	1	246	0	221	1	232	1	0	0	16
GARDENS AT WAT.AW.FROM VIL	67	12140	123	129	0	0	47	157	6	130	29	129	5	124	6	245	0	221	6	232	6	1	0	32
TREES IN SOLID PADDY AREA	67	11220	122	128	0	0	47	157	7	130	32	128	0	120	7	238	0	221	7	229	7	1	0	31
TREES IN SEATE.PADDY AREA	67	11250	121	127	0	0	47	157	8	129	31	127	0	120	8	230	0	221	8	225	8	1	0	47
INST.AREA WITH GRASS	67	15610	120	126	1	3	46	153	13	129	26	125	0	120	12	221	0	221	12	221	13	2	9	51
INST.AREA WITH BUSH-WEEDS	67	15620	119	125	1	3	45	153	17	128	22	124	0	120	16	208	0	221	14	215	17	3	6	69
INST.IN OR NEAR TOWN CNTR	67	15700	118	124	2	5	45	150	5	126	34	123	0	120	3	190	0	221	3	207	5	1	40	32
FISH POND	67	12580	117	123	2	5	45	150	6	126	33	121	0	120	4	197	0	221	4	206	6	1	33	35
VIL.PAT.GRID	67	5130	116	122	2	5	45	150	6	126	33	120	0	120	5	182	1	221	6	204	6	1	0	21
VIL.HAS NEW PADDY FIELDS	67	3230	115	121	3	8	44	147	9	125	30	118	0	120	7	176	1	220	8	201	9	2	11	50
INST.APARTMENT VIL.	67	15740	114	120	4	10	43	143	11	125	28	117	0	120	7	169	0	219	7	197	11	2	36	26
BANJO IN DWEL.YAD	67	12260	113	119	5	13	42	140	10	124	19	116	10	120	7	161	2	219	9	194	10	2	10	39
CENTRAL SECT.BARE OF TREES	67	8300	112	118	5	13	42	140	14	123	25	115	0	111	9	153	0	219	9	189	14	2	36	37
CITRUS PLANTAT.	67	12430	111	117	8	21	41	137	14	122	25	114	0	111	8	143	2	219	10	185	14	2	29	30
IRRIG.DITCHES	67	11300	110	116	11	29	40	133	9	121	30	113	0	111	2	134	4	219	6	180	0	2	33	10
GARDENS ATL.VIL.EDGE	67	12140	109	115	11	29	40	133	12	120	22	111	5	111	4	131	3	219	7	177	12	2	42	15
TEMP.MAIN BLDG.IN CENTER	67	16250	108	114	12	31	39	130	18	120	20	110	1	107	10	127	4	210	14	173	18	3	22	31
MT. COMPLEX BLDG. HAS WING	67	13460	107	113	14	36	38	127	13	118	26	109	0	107	3	116	4	204	7	167	13	2	44	11
INST.ROOF TIN	67	14300	106	112	18	46	37	123	15	117	20	108	4	107	4	112	5	203	9	163	15	3	40	20
EXIT ROAD WITH HOUSES	67	6540	105	111	24	62	36	120	17	116	22	107	0	103	2	108	9	198	11	150	17	3	35	21
INST.ROAD ACCESS OUTS.VIL.	67	15220	104	109	33	85	35	117	19	115	20	106	0	103	1	106	15	190	16	153	19	3	16	54
TEMP.MAIN BLDG RECTANG.	67	16170	103	108	33	85	35	117	19	114	20	105	0	103	2	104	16	177	18	145	19	3	5	53
RICE STRAW STACKS	67	11540	102	107	33	85	35	117	26	113	13	104	0	103	1	102	8	163	9	136	13	2	31	24
RESIDENTIAL SUBCOMMUNITIES	67	5260	101	106	34	87	34	113	25	111	14	104	0	103	1	101	10	156	11	132	14	2	21	28
INST.WITHIN SETLM.PAT.	67	15710	100	105	35	90	33	110	22	109	17	103	0	103	0	100	13	147	13	127	17	3	24	46
INST.ROOF TILE OR SHINGLES	67	14220	99	104	37	95	32	107	23	107	12	102	4	103	0	100	10	134	10	120	12	2	17	59
INST.AT EDGE OF VIL.	67	15720	98	103	37	95	32	107	25	106	14	102	0	100	0	100	12	127	12	115	14	2	14	41
INST.INSIDE VIL.PAT.	67	15260	97	102	37	95	32	107	27	104	12	101	0	100	0	100	10	117	10	109	12	2	17	36
JEEP-BACART TRAIL	67	6340	96	101	39	100	31	103	30	102	9	100	0	100	0	100	9	108	9	104	9	2	0	67

Table 5b

999T LOEI MAIN SCALE, 1967 AIR PHOTO DATA, 135 ITEMS, 039 CASES, 9/28/71

CASE STATISTICS

	RANK		SCALE SCORE		SCALE STEP		FREQUENCIES ONES		ZEROS		NINES		DEVIATIONS ONES		ZEROS		TOTAL		NON MODAL		SCAL ABIL ITY	DIS PER SION
ID	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P		
5110	1	3	12	13	1	3	13	1	122	6	0	0	0	0	0	0	0	0	13	1	100	0
1910	2	5	12	13	1	3	24	3	111	11	0	0	7	9	1	1	9	4	24	2	67	5
5210	3	8	15	16	2	7	23	4	112	16	0	0	1	9	0	1	1	4	23	2	95	1
4910	4	10	17	18	3	10	24	6	103	21	8	7	0	9	0	1	0	4	24	2	100	0
2610	5	13	20	21	4	13	31	8	104	26	0	7	8	18	2	3	10	9	31	3	59	5
2310	6	15	23	24	5	17	30	10	105	30	0	7	4	22	2	4	6	12	30	3	80	3
3803	7	18	24	25	6	20	40	13	85	34	10	15	4	27	1	5	5	15	40	3	87	2
3903	8	21	25	26	7	23	33	15	86	38	16	28	0	27	1	6	1	15	33	3	97	0
3503	9	23	25	26	7	23	37	18	88	42	10	36	2	29	1	7	3	17	37	3	92	2
2810	10	26	26	27	8	27	38	21	95	47	2	38	2	31	1	8	3	18	38	3	92	1
2710	11	28	26	27	8	27	36	23	93	51	6	43	4	36	1	9	5	21	36	3	86	2
3603	12	31	26	27	8	27	38	26	95	55	12	52	4	40	1	10	5	23	38	3	87	2
4003	13	33	26	27	8	27	37	28	83	59	15	65	5	46	0	10	5	26	37	3	86	2
5010	14	36	27	28	9	30	41	31	89	63	5	69	3	49	1	11	4	28	41	3	90	2
1810	15	38	30	32	10	33	32	34	103	68	0	69	1	51	8	19	0	32	32	3	72	4
2210	16	41	32	34	11	37	40	36	92	72	3	71	5	56	8	25	13	38	40	3	67	5
2110	17	44	32	34	11	37	46	40	89	76	0	71	2	58	2	26	4	40	46	4	91	1
3703	18	46	32	34	11	37	45	43	82	80	8	78	2	61	0	26	2	41	45	4	95	0
2010	19	49	33	35	12	40	40	46	95	84	0	78	1	62	4	30	5	44	40	3	87	2
1510	20	51	34	36	13	43	37	48	98	89	0	78	2	64	5	34	7	47	37	3	81	3
1610	21	54	34	36	13	43	44	51	91	93	0	78	0	64	1	35	1	48	44	4	98	0
1710	22	56	35	37	14	47	43	54	92	97	0	78	4	69	5	39	9	52	43	4	79	4
3406	23	59	39	41	15	50	44	57	81	101	10	86	2	71	2	41	4	54	44	4	91	1
2409	24	62	41	43	16	53	48	61	87	105	0	86	3	74	5	46	8	58	48	4	83	3
2510	25	64	42	44	17	57	42	64	93	109	0	86	0	74	8	53	8	62	42	4	81	4
209	26	67	43	45	18	60	57	68	78	113	0	86	3	78	1	54	4	64	57	5	93	1
309	27	69	43	45	18	60	54	72	81	117	0	86	7	85	5	58	12	70	54	5	78	6
609	28	72	45	47	19	63	60	76	75	120	0	86	5	91	4	61	9	74	60	5	85	3
3106	29	74	47	49	20	67	57	80	66	123	12	96	1	92	1	62	2	75	57	5	96	1
3306	30	77	48	51	21	70	50	83	72	126	13	107	1	93	7	68	8	79	50	4	84	3
3206	31	79	49	52	22	73	52	87	68	130	15	119	0	93	5	73	5	82	52	4	90	4
2906	32	82	50	53	23	77	64	92	54	132	17	133	4	98	2	75	6	85	54	5	89	3
1009	33	85	53	56	24	80	57	96	78	136	0	133	1	99	7	81	8	89	57	5	96	4
409	34	87	56	59	25	83	62	100	73	139	0	133	1	100	4	84	5	91	62	5	92	1
109	35	90	58	61	26	87	71	105	64	142	0	133	0	100	3	87	3	93	64	5	95	0
1309	36	92	61	64	27	90	72	110	63	145	0	133	0	100	3	89	3	94	63	5	95	2
909	37	95	68	72	28	93	81	116	54	147	0	133	0	100	3	92	3	96	54	5	94	1
809	38	97	80	84	29	97	101	123	34	149	0	133	0	100	0	92	0	96	34	3	100	0
1401	39	100	95	100	30	100	105	130	30	150	0	133	0	100	9	100	9	100	30	3	70	18

Table 5c

9997 LOEI. MAIN SCALE, 1967 AIR PHOTO DATA, 135 ITEMS, 039 CASES, 9/28/71 LARGEST SCALE

SCALE STATISTICS

ITEMS = 95

CASES = 39

SCALABILITY = 659

DISPERSION = 81

		N	P			
DEVIATIONS				NON-MODALS		
ZEROS	=	114	56	ITEMS	=	594
ONES	=	89	44	CASES	=	1186
TOTAL	=	203	100	MIN	=	594
SCALE SCORE				SCALE STEPS		
CELLS IN	=	1484	40	TOTAL	=	30
CELLS OUT	=	2221	60	STEPS/ITEM	=	32
TOTAL	=	3705	100	STEPS/CASE	=	77
FREQUENCIES						
ONES	=	1420	38			
ZEROS	=	2163	58			
NO DATA	=	122	3			
TOTAL	=	3705	100			

DEVIATIONS IN RANGE

RANGE	ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P
1	0	0	2	2	2	1
2	4	4	14	12	18	9
3	19	21	31	27	50	25
4	29	33	45	39	74	36
5	45	51	57	50	102	50
6	51	57	65	57	116	57
7	60	67	74	65	134	66
8	64	72	83	73	147	72
9	71	80	86	75	157	77
10	79	89	95	83	174	86
11	85	96	98	86	183	90
12	86	97	99	87	185	91
13	87	98	101	89	188	93
14	87	98	102	89	189	93
15	87	98	105	92	192	95
16	87	98	105	92	192	95
17	89	100	105	92	194	96
18	89	100	107	94	196	97
19	89	100	111	97	200	99
20	89	100	112	99	201	99
21	89	100	113	99	202	100
22	89	100	113	99	202	100
23	89	100	114	100	203	100

at the same rate. The significance for application is that with caution it is only necessary to measure the increasing complexity of one sector (or data category) to identify the relative development levels (knowledge processing structures) of settlements (or other units). One can assess the development state of other sectors as well if the relevant other "knowledge" content of the region has otherwise been determined.

For a more detailed analysis of the AP Scale one could proceed either by analyzing the development of "sectors" such as dwelling construction, agriculture or institutions or by analyzing groups of villages as they may represent "micro-stages" of development. The first is best analyzed by specific subscales which we had no time to produce but we will briefly demonstrate the second type of analysis. Villages 1 to 14 (by rank number) are remote and not even accessible by all weather dirt roads. They have a scattered or simple line village pattern, but most have at least a temple and a school and some complex dwellings and temple structures being to appear. All are growing rice but not much else.

The next group of villages (15 to 29) show some increasing sophistication in village pattern (cross-roads or organic) and in agriculture (growing fruits and vegetables). Institutions are becoming more conspicuous with the addition of Buddhist chapels, flag poles and entrance structures.

The last group of villages (30 to 38) reflects a growing modernization and commercialization: population density and land utilization is high; forest areas between villages have disappeared; commercial agriculture in vegetables and fruits is present and so is irrigation and double cropping; some dwellings and institutional structures are built of brick or concrete and institutional complexes are large with many buildings arranged in patterns. Some industrial and commercial structures are present in sub-communities of the largest villages near towns where modern public services in the form of water tanks, paved roads and streets have also appeared.

The last settlement, number 39, is the town of Loei which has signs of its provincial town status by having electric power, an airfield, a market hall, institutional recreation facilities and several different patterns in larger institutional compounds. If one compares the complexity of this town and the most developed six villages with the two least developed villages (rank 1 and 2), the tremendous difference in knowledge-processing structures becomes apparent. They seem worlds apart in terms of utilization of knowledge. One has to keep in mind, however, that many structures which make some villages "higher" developed (CVs), provide services (processed knowledge) to the rest of the villages in their micro-region by which these have more "utilities" available then shows in the scale. This is a most important aspect of CVs and micro-regions for relocation planning.

The interdependent relationship between the growth of complexity (development) and the economics of scale provided by higher population density, which in turn is dependent on land and other resources, is evident in a few of the correlations. Some quantitative variables were collected from the aerial photography and correlated with the AP Scale scores as part of the factor analysis program. Table 6 presents the most relevant correlation coefficients produced by the program.

TABLE 6

Loei AP Scale Scores Correlated with Variables Collected per Village from Aerial Photography

(per Village)	Correlation Coefficient
Number dwellings	.66
Km^2 paddy land	.64
Lack of forest area between next village code	.69
Ha. village area	.63
Number exit roads (all kinds)	.58
Number paved roads	.67
Number roads with new dwellings	.70
Number new dwellings	.79
Village pattern	.60
Village focus code	.61
Number commercial sub-communities	.61
Number industrial sub-communities	.64
Number institutions (Temples, schools, shops, etc.)	.67
Number institutional buildings	.60
Size of largest institution building	.75
Largest number wings on institution building	.67
Institutional boundary code (fences, hedges, wells, etc.)	.60
Institutional tree growth	.65
Number school rooms estimated	.77

2. The Structural Differentiation of Occupations in Settlements: 1970 Census Data

To show that aerial photography data can measure the same structural development pattern of settlements as do much more expensively collected ground data, a comparison is necessary. The most fitting set of data for this purpose are the 1970 Census data for Loei and Tha Bo districts. The data were compiled per village by the Thai National Statistic Office (NSO) for this project. The comparison has two objectives:

(1) to show that the development process at the village and micro-regional level is undimensional in terms of qualitative diversification and that any sample data set from the total knowledge universe of the surveyed area should measure the same structure, i.e., identify the same central and satellite village patterns or micro-regions.

(2) to show that air photo data are as appropriate and sufficient as ground data sets and are valid alternatives for the structural analysis of subregions.

The 1970 census data on occupations and accompanying industries, and on levels of education of various age groups in each settlement are somewhat more specialized information then the air photo data. But this specialized information is, according to the theory, representative of a central and major part of the knowledge processing structure in a community. Aerial photography data on the other hand, as we have seen, contain the physical manifestations of diversity in several categories related to the sophistication of agriculture, the construction of dwellings and other buildings, the layout patterns of settlements, the quality of access to settlements.

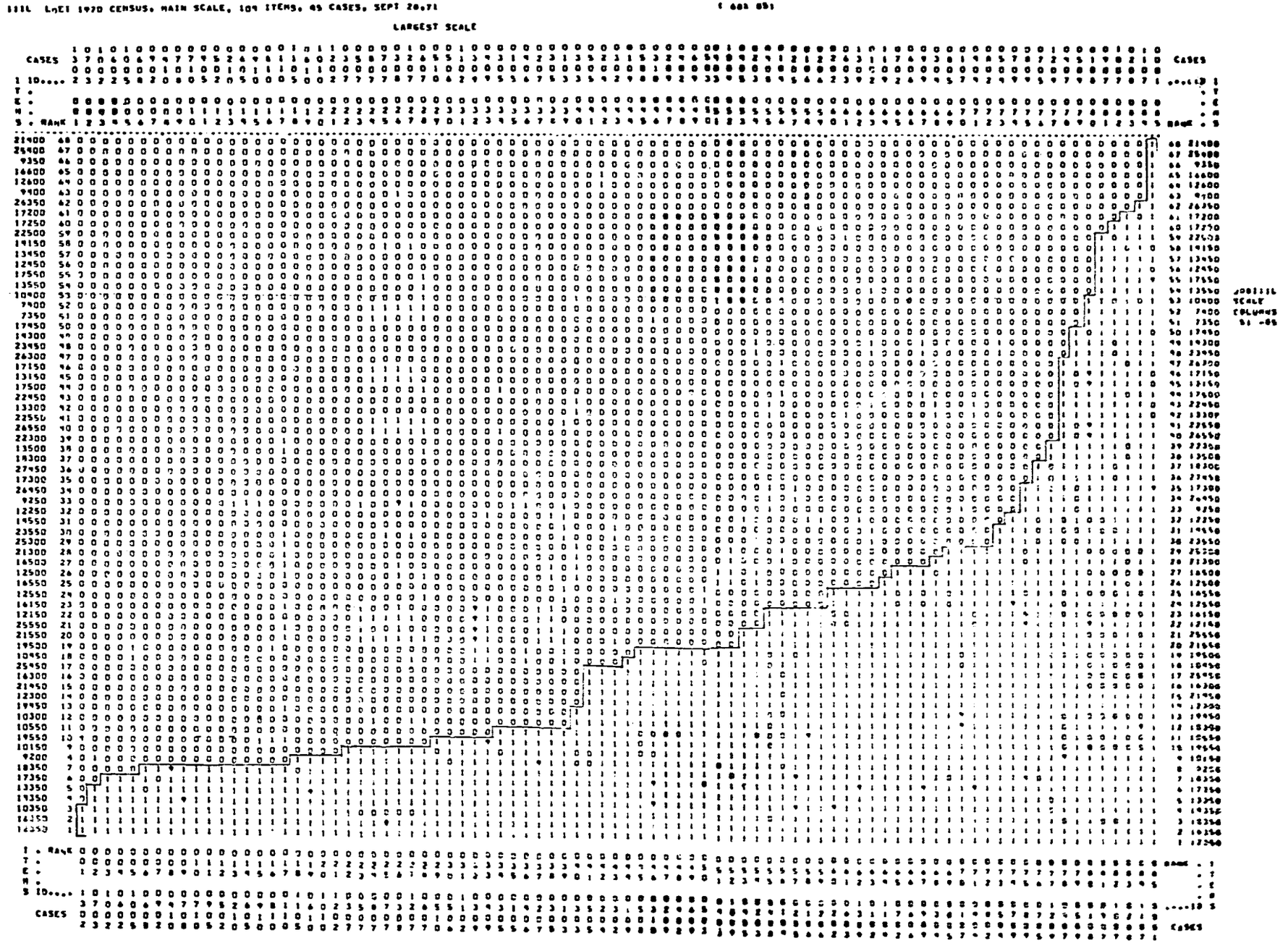
One problem became apparent only after the data were processed: the number of census villages (Scale 3) in both districts appeared to be substantially larger than identified on aerial photography (Scale 2). The reasons were found to be a peculiarity of the region which turns out to be very troublesome for structural analysis. Most larger villages and towns which appear as single contiguous settlements on aerial photography, contain several communities (villages) each with its own name and number in the ground data sets. These communities, first established as small settlements, have grown together to appear now as large villages or even towns. But since the village community is a very strong social unit in Thai and Lao society, they continue to function as sub-communities. Each still elects its own village headman for instance, and even where townships are declared, these communities remain functioning as a Buddhist parish around a temple compound. The respective governments generally recognize and respect these "self-conscious communities" administratively and in the census system as well.

For structural analysis these sub-division become highly artificial. Structural differentiation is related to population size in contiguous settlements. Thus specific structural attributes of large settlements though present in different sub-communities are serving the larger settlement as a whole.

Table 7a

ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQUENCIES ONES P	FREQUENCIES ZEROS N	FREQUENCIES ZEROS P	FREQUENCIES NINES N	FREQUENCIES NINES P	DEVIATIONS ONES N	DEVIATIONS ONES P	DEVIATIONS ZEROS N	DEVIATIONS ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCALABILITY	DISPERSION
ALL AGE.F.INDUST.CONST.REP70	21490	68	100	1	1	32	100	1	100	84	100	0	100	0	100	0	100	0	100	1	0	100	0
15-60 F.INDUST.ELEC.WATER 70	25490	67	99	1	1	32	100	1	100	84	98	0	100	0	100	0	100	0	100	1	0	100	0
OVER 60 SEC.ED.GENERAL 70	9350	66	97	1	1	32	100	1	100	84	96	0	100	0	100	0	100	0	100	1	0	100	0
OCCUP.15-60 F.WKR.UNCLASS.70	14600	65	96	1	1	32	100	2	100	83	94	0	100	1	100	0	100	1	100	2	0	50	25
ALL AGE.F.OCCUP.WKR.UNCLAS70	12600	64	94	1	1	32	100	2	100	83	92	0	100	1	99	0	100	1	100	2	0	50	25
OVER 60 SEC.ED.VOCATIONAL 70	9400	63	93	1	1	32	100	2	100	83	90	0	100	1	99	0	100	1	99	2	0	50	35
OVER 60 M.INDUST.CONST.REP70	26350	62	91	2	2	31	97	2	99	83	88	0	100	0	98	0	100	0	99	2	0	100	0
OVER 60 OCCUP.M.ADM.EXEC. 70	17200	61	90	3	4	30	94	2	99	83	86	0	100	0	98	1	100	1	99	2	0	50	1
OVER 60 OCCUP.M.CLERICAL 70	17250	60	88	4	5	29	91	4	99	81	84	0	100	0	98	0	99	0	99	4	0	100	0
UNDR.15 M.INDUST.TRANS.COM70	22500	59	87	5	6	28	88	5	99	80	82	0	100	1	98	1	99	2	99	5	0	60	5
UNDR.15 F.OCCUP.PROF.TECH.70	14150	58	85	5	6	28	88	5	99	80	80	0	100	2	98	2	99	4	98	5	0	20	28
UNDR.15 M.OCCUP.TRANS.COMM70	13450	57	84	5	6	28	88	5	98	80	78	0	100	0	97	0	98	0	97	5	0	100	0
ALL AGE.F.OCCUP.TRANS.COMM70	12450	56	82	5	6	28	88	5	98	80	76	0	100	1	97	1	98	2	97	5	0	60	7
OVER 60 OCCUP.M.SERV.RECRN70	17550	55	81	5	6	28	88	5	98	79	74	1	100	1	96	0	97	1	97	5	0	80	13
UNDR.15 M.OCCUP.SERV.RECRN70	13550	54	79	5	6	28	88	7	97	78	72	0	97	2	96	0	97	2	96	7	1	71	12
ALL AGES OCCUP.MINE.QUARRY70	10900	53	78	6	7	27	84	7	97	78	70	0	97	3	95	2	97	5	96	7	1	29	22
UNDER 15 SECONDARY ED.VOC.70	7400	52	76	6	7	27	84	11	97	74	68	0	97	5	93	0	96	5	94	11	1	55	30
UNDER 15 SECONDARY ED.GEN.70	7350	51	75	6	7	27	84	11	96	74	66	0	97	5	90	0	96	5	93	11	1	55	28
OVER 60 OCCUP.M.TRANS.COMM70	17450	50	74	7	8	26	81	5	95	80	64	0	97	0	87	2	96	2	92	5	0	60	2
UNDR.15 F.OCCUP.SALES 70	14300	49	72	7	8	26	81	10	95	75	62	0	97	4	87	1	95	5	91	10	1	50	7
UNDR.15 F.INDUST.COMMERCE 70	23450	48	71	7	8	26	81	10	94	75	61	0	97	4	85	1	94	5	90	10	1	50	7
OVER 60 M.INDUST.MANUFACT.70	26300	47	69	8	9	25	78	8	94	77	59	0	97	1	83	1	94	2	88	8	1	75	4
OVER 60 OCCUP.M.PROF.TECH.70	17150	46	68	8	9	25	78	9	93	75	57	1	97	4	83	2	93	6	88	9	1	33	30
UNDR.15 M.OCCUP.PROF.TECH.70	13150	45	66	8	9	25	78	9	93	75	55	1	94	4	80	2	92	6	86	9	1	33	30
OVER 60 OCCUP.M.CRAFT.MANF70	17500	44	65	8	9	25	78	11	92	74	53	0	92	4	78	1	91	5	84	11	1	55	15
UNDR.15 M.INDUST.COMMERCE 70	22450	43	63	8	9	25	78	12	92	73	51	0	92	5	76	1	90	6	83	12	1	50	10
UNDR.15 M.OCCUP.SALES 70	13300	42	62	8	9	25	78	12	91	73	49	0	92	5	73	1	90	6	81	12	1	50	10
UNDR.15 M.INDUST.SERVICE 70	22550	41	60	8	9	25	78	12	90	72	48	1	92	6	70	1	89	7	79	12	1	42	31
OVER 60 M.INDUST.SERVICE 70	26550	40	59	8	9	25	78	12	89	72	46	1	89	6	67	1	88	7	78	12	1	42	32
UNDR.15 M.INDUST.MANUFACT.70	22300	39	57	9	11	24	75	9	89	76	44	0	86	1	64	1	88	2	76	9	1	78	9
UNDR.15 M.OCCUP.CRAFT.MANF70	13500	38	56	9	11	24	75	10	88	75	42	0	86	2	63	1	87.	3	75	10	1	70	14
OVER 60 OCCUP.F.SALES 70	18300	37	54	10	12	23	72	8	88	77	40	0	86	0	62	2	87	2	74	8	1	75	1
OVER 60 F.INDUST.COMMERCE 70	27450	36	53	10	12	23	72	8	97	77	39	0	86	0	62	2	86	2	74	8	1	75	1
OVER 60 OCCUP.M.SALES 70	17300	35	51	11	13	22	69	11	87	73	37	1	86	2	62	1	84	3	73	11	1	73	5
OVER 60 M.INDUST.COMMERCE 70	26450	34	50	11	13	22	69	12	86	73	35	0	83	2	61	1	84	3	72	12	1	75	4
OVER 60 ELEM.ED.HIGHER 5-770	9250	33	49	11	13	22	69	20	85	64	33	1	83	10	60	1	83	11	71	20	2	45	28
ALL AGE.F.OCCUP.CLERICAL 70	12250	32	47	12	14	21	66	15	84	70	31	0	81	7	55	4	83	11	68	15	1	27	16
UNDR.15 F.OCCUP.SERV.RECRN70	14550	31	46	13	15	20	63	11	83	74	30	0	81	3	51	5	80	8	65	11	1	27	12
UNDR.15 F.INDUST.SERVICE 70	23550	30	44	13	15	20	63	17	83	68	28	0	81	7	49	3	77	10	63	17	2	41	19
15-60 F.INDUST.MANUFACT. 70	25300	29	43	17	20	19	59	15	82	70	26	0	81	4	45	6	76	10	60	15	1	33	15
ALL AGE.F.INDUST.MANUFACT.70	21300	28	41	18	21	18	56	20	81	65	25	0	81	4	43	2	72	6	57	20	2	70	8
OCCUP.15-60 F.CRAFT.MANF. 70	16500	27	40	21	25	17	53	22	79	63	23	0	81	7	41	6	71	13	56	22	2	41	16
ALL AGE.F.OCCUP.CRAFT.MANF70	12500	26	38	22	26	16	50	29	78	56	21	0	81	8	37	1	68	9	52	29	3	69	11
OCCUP.15-60 F.SERV.RECRTN.70	16550	25	37	26	31	15	47	19	76	66	20	0	81	2	33	9	67	11	49	19	2	42	12
ALL AGE.F.OCCUP.SERV.RECRN70	12550	24	35	26	31	15	47	25	75	59	18	1	81	4	32	4	62	8	46	25	2	68	6
OCCUP.15-60 F.PROF.TECH. 70	16150	23	34	31	36	14	44	27	74	56	17	2	78	6	30	9	60	15	44	27	3	44	17
ALL AGE.F.OCCUP.PROF.TECH.70	12150	22	32	31	36	14	44	34	72	48	16	3	72	8	26	3	54	11	40	34	3	68	10
15-60 F.INDUST.SERVICE 70	25550	21	31	33	39	13	41	36	70	49	14	1	64	7	22	4	53	11	37	36	3	69	11
ALL AGE.F.INDUST.ELEC.WATR70	21550	20	29	33	39	13	41	45	60	37	13	1	61	12	18	0	50	12	34	39	4	69	10
ALL AGE.INDUST.TRANS.COMM.70	19500	19	28	41	48	12	38	33	65	47	12	0	58	6	11	9	50	15	30	38	4	61	15
ALL AGES OCCUP.TRANS.COMM.70	10450	18	26	42	49	11	34	41	63	44	11	0	58	6	8	7	45	13	26	41	4	68	11
15-60 F.INDUST.COMMERCE 70	25450	17	25	45	53	10	31	39	61	46	10	0	58	0	5	6	41	6	22	39	4	85	9
OCCUP.15-60 F.SALES 70	16300	16	24	45	53	10	31	40	58	45	9	0	58	0	5	5	38	5	21	40	4	87	8
ALL AGE.F.INDUST.CONST.REP70	21450	15	22	45	53	10	31	44	56	41	8	0	58	0	5	1	35	1	19	41	4	98	1
ALL AGE.F.OCCUP.SALES 70	12300	14	21	45	53	10	31	45	53	40	7	0	58	0	5	0	34	0	19	40	4	100	0
ALL AGE.INDUST.COMMERCE 70	19450	13	19	46	54	9	28	38	51	46	6	1	58	1	5	8	34	9	19	38	4	76	12
ALL AGES OCCUP.SALES 70	10300	12	18	46	54	9	26	45	48	38	5	2	56	3	4	2	29	5	17	38	4	87	4
ALL AGES OCCUP.SERV.RECRTN70	10550	11	16	52	61	8	25	39	46	45	4	1	50	0	3	12	28	12	15	39	4	69	14
ALL AGE.INDUST.SERVICE 70	19550	10	15	57	67	7	22	52	43	32	3	1	47	4	3	8	21	12	12	32	3	62	19
ALL AGES OCCUP.PROF.TECH. 70	10150	9	13	64	75	6	19	57	40	27	2	1	44	0	1	6	17	6	8	27	3	78	5
OVER 60 ELEM.ED.LOWER 1-4 70	9200	8	12	68	80	5	16	63	37	21	1	1	42	1	1	5	13	6	7	21	2	71	9
OVER 60 OCCUP.F.FARM.FISH.70	18350	7	10	80	94	4	13	73	33	9	1	3	39	0	0	4	10	4	5	9	1	56	27
OVER 60 OCCUP.M.FARM.FISH.70	17350	6	9	83	99	3	9	76	29	4	0	5	31	0	0	2	8	2	4	4	0	50	15
UNDR.15 M.OCCUP.FARM.FISH.70	13350	5	7	84	99	2	6	81	24	3	0	1	17	0	0	2	7	2	3	3	0	33	32
UNDR.15 F.OCCUP.FARM.FISH.70	14350	4	6	84	99	2	6	79	19	2	0	4	14	0	0	1	6	1	3	2	0	50	45
ALL AGES OCCUP.FARM.FISH. 70	10350	3	4	85	100	1	3	76	15	9	0	0	3	0	0	9	5	9	3	9	1	0	57
OCCUP.15-60 F.FARM.FISH. 70	16350	2	3	85	100	1	3	84	10	0	0	1	3	0	0	0	0	0	0	0	0	100	0
ALL AGE.F.OCCUP.FARM.FISH.70	12350	1	1	85	100	1	3	85	5	0	0	0	0	0	0	0	0	0	0	0	0	100	0



SCALE 3 A Census Scale, Loei

Scale 3-B

The Shadow Scale

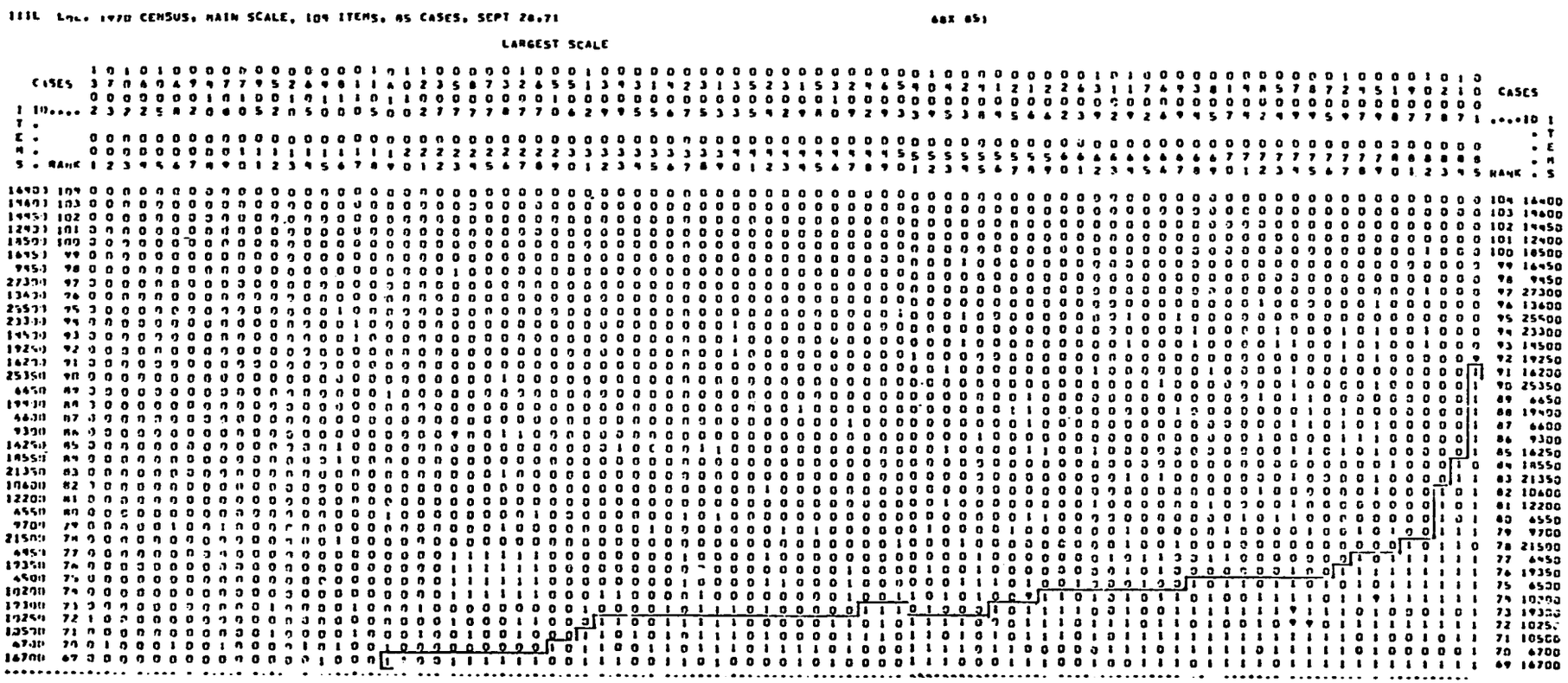


Table 7b

Shadow Scale ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	NINES N	NINES P	DEVIATIONS ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
OCCUP.15-60 F.MINE.QUARRY.70	16400	104	153	0	0	46	144	0	126	85	164	0	119	0	206	0	171	0	189	0	0	100	0
UNDR.15 F.OCCUP.WRK.UNCLAS70	14600	103	151	0	0	46	144	0	126	85	162	0	119	0	206	0	171	0	189	0	0	100	0
UNDR.15 F.OCCUP.TRANS.COMM70	14450	102	150	0	0	46	144	0	126	85	160	0	119	0	206	0	171	0	189	0	0	100	0
ALL AGE.F.OCCUP.MINE.QUARY70	12400	101	149	0	0	46	144	0	126	85	156	0	119	0	206	0	171	0	189	0	0	100	0
OVER 60 OCCUP.F.CRAFT.MANF70	18500	100	147	0	0	46	144	1	126	84	156	0	119	1	206	0	171	1	189	1	0	0	4
OCCUP.15-60 F.TRANS.COMM. 70	16450	99	146	0	0	46	144	1	126	84	154	0	119	1	205	0	171	1	188	1	0	0	37
OVER 60 TEACH.TRAIN.SPEC. 70	9450	98	144	0	0	46	144	1	126	84	152	0	119	1	205	0	171	1	188	1	0	0	74
OVER 60 F.INDUST.MANUFACT.70	27300	97	143	0	0	46	144	1	126	84	150	0	119	1	204	0	171	1	188	1	0	0	4
UNDR.15 M.OCCUP.WRK.UNCLAS70	13600	96	141	0	0	46	144	2	126	83	148	0	119	2	204	0	171	2	188	2	0	0	11
15-60 F.INDUST.TRANS.COMM.70	25500	95	140	0	0	46	144	5	126	80	146	0	119	5	203	0	171	5	187	5	0	0	42
UNDR.15 F.INDUST.MANUFACT.70	23300	94	138	0	0	46	144	7	125	78	144	0	119	7	200	0	171	7	186	7	1	0	28
UNDR.15 F.OCCUP.CRAFT.MANF70	14500	93	137	0	0	46	144	10	125	75	142	0	119	10	196	0	171	10	184	10	1	0	28
ALL AGE.INDUST.MINE.QUARRY70	19250	92	135	1	1	45	141	4	124	80	140	1	119	4	191	0	171	4	181	4	0	0	27
OCCUP.15-60 F.ADM.EXEC.MNG70	16200	91	134	1	1	45	141	5	124	80	138	0	117	4	189	0	171	4	180	5	0	20	19
15-60 F.INDUST.CONSTR.REP.70	25350	90	132	1	1	45	141	5	124	80	136	0	117	4	186	0	171	4	179	5	0	20	22
ALL AGES UNIVSTY.HIGH.DEG.70	6550	89	131	1	1	45	141	6	124	79	134	0	117	5	184	0	171	5	178	6	1	17	25
ALL AGE.INDUST.ELEC.WATER 70	19400	88	129	1	1	45	141	7	123	79	132	0	117	6	181	0	171	6	176	7	1	14	22
ALL AGES UNIVSTY.BACH.DEG.70	6600	87	128	1	1	45	141	7	123	79	130	0	117	6	178	0	171	6	174	7	1	14	17
OVER 60 SEC.ED.LOWER 1-3 70	9300	86	126	1	1	45	141	0	122	76	128	1	117	7	175	0	171	7	173	8	1	12	27
OCCUP.15-60 F.CLERICAL 70	16250	85	125	1	1	45	141	13	122	72	126	0	114	12	171	0	171	12	171	13	1	8	34
OVER 60 OCCUP.F.SERV.RECRN70	18550	84	124	2	2	44	138	3	121	82	125	0	114	2	164	1	171	3	167	3	0	0	29
ALL AGE.F.INDUST.CONST.REP70	21350	83	122	2	2	44	138	7	121	78	123	0	114	5	163	0	170	5	167	7	1	29	19
ALL AGES OCCUP.WORK.UNCLAS70	10600	82	121	3	4	43	134	5	121	80	121	0	114	3	161	1	170	4	165	5	0	20	13
ALL AGE.F.OCCUP.ADM.EXEC. 70	12200	81	119	3	4	43	134	6	120	79	119	0	114	4	159	1	169	5	164	6	1	17	15
ALL AGES TEACH.TRAIN.DIPL.70	6550	80	118	3	4	43	134	11	120	74	117	0	114	9	157	1	169	10	163	11	1	9	32
OVER 60 RELIGIOUS ED. 70	9700	79	116	3	4	43	134	16	119	69	115	0	114	13	152	0	168	13	160	16	2	19	35
ALL AGE.F.INDUST.CONST.REP70	21500	78	115	5	6	42	131	8	118	77	113	0	114	5	145	2	168	7	156	8	1	12	24
ALL AGES TEACH.TRAIN.SPEC.70	6450	77	113	8	9	41	128	21	118	64	111	0	114	14	142	1	167	15	154	21	2	29	30
ALL AGE.INDUST.CONSTR.REP.70	19350	76	112	9	11	40	125	21	117	64	110	0	114	12	134	0	166	12	150	21	2	43	26
ALL AGES TEACH.TRAIN.CERT.70	6500	75	110	18	21	39	122	29	115	56	108	0	114	16	128	5	166	21	147	29	3	28	21
ALL AGES OCCUP.ADM.EXEC. 70	10200	74	109	36	42	38	119	33	114	50	107	2	114	10	119	11	164	21	141	33	3	36	15
ALL AGE.INDUST.MANUFACTURE70	19300	73	107	38	45	37	116	32	112	52	106	1	108	9	114	14	157	23	135	32	3	28	19
ALL AGES OCCUP.CLERICAL 70	10250	72	106	54	64	36	113	37	110	46	104	2	106	4	109	19	149	23	128	37	4	38	19
ALL AGES OCCUP.CRAFT.MANUF70	10500	71	104	55	65	35	109	42	107	43	103	0	100	5	107	18	138	23	122	42	4	45	18
ALL AGES RELIGIOUS EDUCTN.70	6700	70	103	57	67	34	106	40	105	45	102	0	100	6	104	23	128	29	115	40	4	27	30
OCCUP.15-60 F.STUDENTS 70	16700	69	101	67	79	33	103	43	103	42	101	0	100	1	101	25	114	26	107	42	4	38	26

Table 7c

CASE STATISTICS

	RANK		SCALE SCORE		SCALE STEP		FREQUENCIES ONES		ZEROS		NINES		DEVIATIONS ONES		ZEROS		TOTAL		NON MODAL		SCAL ABIL ITY	DIS PER SION
ID	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P		
1302	1	1	3	4	1	3	5	0	99	2	0	0	1	1	0	0	1	0	5	0	80	2
703	2	2	5	7	2	6	7	1	97	5	0	0	1	1	0	0	1	1	7	0	86	0
1002	3	4	6	9	3	9	6	1	98	7	0	0	0	1	0	0	0	1	6	0	100	0
602	4	5	6	9	3	9	6	1	98	10	0	0	0	1	0	0	0	1	6	0	100	0
1005	5	6	6	9	3	9	8	2	96	12	0	0	2	2	0	0	2	1	8	1	75	5
608	6	7	7	10	4	13	8	2	96	14	0	0	0	2	1	1	1	1	8	1	87	0
902	7	8	7	10	4	13	6	3	98	17	0	0	0	2	1	1	1	2	6	0	83	0
410	8	9	7	10	4	13	6	3	97	19	1	3	0	2	0	1	0	2	6	0	100	0
708	9	11	7	10	4	13	8	4	95	21	1	6	0	2	0	1	0	2	8	1	100	0
710	10	12	7	10	4	13	7	4	97	24	0	6	0	2	0	1	0	2	7	0	100	0
905	11	13	7	10	4	13	7	4	97	26	0	6	0	2	0	1	0	2	7	0	100	0
502	12	14	7	10	4	13	9	5	95	29	0	6	0	2	0	1	0	2	9	1	100	0
210	13	15	7	10	4	13	8	5	96	31	0	6	1	3	0	1	1	2	8	1	87	5
605	14	16	7	10	4	13	9	6	95	33	0	6	1	3	0	1	1	2	9	1	89	4
910	15	18	7	10	4	13	10	7	94	36	0	6	2	4	0	1	2	3	10	1	80	4
810	16	19	7	10	4	13	14	7	90	38	0	6	2	5	0	1	2	3	14	1	86	2
110	17	20	7	10	4	13	23	9	81	40	0	6	12	12	0	1	12	7	23	2	48	16
1105	18	21	8	12	5	16	7	9	97	42	0	6	0	12	1	2	1	7	7	0	86	0
610	19	22	8	12	5	16	11	10	92	44	1	8	0	12	0	2	0	7	11	1	100	0
1010	20	24	8	12	5	16	9	10	95	47	0	8	0	12	0	2	0	7	9	1	100	0
1202	21	25	8	12	5	16	10	11	94	49	0	8	0	12	0	2	0	7	10	1	100	0
307	22	26	9	13	6	19	9	12	95	51	0	8	0	12	0	2	0	7	9	1	100	0
507	23	27	9	13	6	19	20	13	83	53	1	11	5	15	1	2	6	9	20	1	70	7
807	24	28	9	13	6	19	23	14	81	55	0	11	9	20	1	3	10	12	23	2	57	19
707	25	29	9	13	6	19	22	15	81	57	1	14	10	25	1	3	11	15	22	1	50	25
308	26	31	9	13	6	19	29	17	74	59	1	17	12	32	1	4	13	18	29	2	55	20
1207	27	32	9	13	6	19	29	19	75	61	0	17	13	39	1	5	14	22	29	2	52	22
607	28	33	9	13	6	19	29	21	75	63	0	17	13	46	0	5	13	26	29	2	55	25
510	29	34	10	15	7	22	10	21	94	65	0	17	0	46	1	5	1	26	10	1	90	0
506	30	35	10	15	7	22	9	22	95	68	0	17	0	46	1	6	1	26	9	1	89	0
1102	31	36	10	15	7	22	14	23	90	70	0	17	0	46	0	6	0	26	14	1	100	0
309	32	38	10	15	7	22	17	24	83	72	4	28	2	47	0	6	2	27	17	1	88	1
409	33	39	10	15	7	22	20	25	83	74	1	31	7	51	0	6	7	29	20	1	65	7
305	34	40	11	16	8	25	13	26	91	76	0	31	2	52	1	6	3	30	13	1	77	8
105	35	41	11	16	8	25	14	26	90	78	0	31	1	52	0	6	1	30	14	1	93	2
406	36	42	11	16	8	25	19	28	85	80	0	31	3	54	0	6	3	31	19	1	84	3
207	37	44	11	16	8	25	19	29	84	82	1	33	4	56	0	6	4	32	19	1	79	3
305	38	45	11	16	8	25	24	30	80	84	0	33	7	60	0	6	7	34	24	2	71	7
103	39	46	11	16	8	25	29	32	75	86	0	33	11	66	0	6	11	37	29	2	62	11
303	40	47	13	19	9	28	25	33	79	88	0	33	7	70	2	8	9	40	25	2	64	12
505	41	48	17	25	10	31	15	34	89	90	0	33	0	70	2	9	2	40	15	1	87	2
204	42	49	17	25	10	31	25	36	79	92	0	33	2	71	0	9	2	41	25	2	92	7
302	43	51	17	25	10	31	24	37	80	94	0	33	4	73	0	9	4	42	24	2	83	2
109	44	52	18	26	11	34	21	38	83	96	0	33	0	73	0	9	0	42	21	1	100	0
508	45	53	19	28	12	38	18	39	86	99	0	33	0	73	3	10	3	43	18	1	83	3
310	46	54	19	28	12	38	18	41	84	101	2	39	1	74	2	12	3	44	18	1	83	5
209	47	55	19	28	12	38	25	42	79	103	0	39	0	74	1	12	1	44	25	2	96	1
402	48	56	19	28	12	38	20	43	84	105	0	39	0	74	1	13	1	44	20	1	95	1
609	49	58	19	28	12	38	22	45	82	107	0	39	0	74	0	13	0	44	22	1	100	0
503	50	59	19	28	12	38	23	46	81	109	0	39	2	75	2	14	4	45	23	2	83	2
403	51	60	19	28	12	38	27	47	77	110	0	39	3	77	1	14	4	46	27	2	85	4
1009	52	61	19	28	12	38	29	49	75	112	0	39	4	79	1	15	5	48	29	2	83	3
905	53	62	21	31	13	41	28	51	75	114	1	42	1	79	0	15	1	48	28	2	96	5
203	54	64	21	31	13	41	34	53	70	116	0	42	6	83	1	16	7	50	34	2	79	7
408	55	65	23	34	14	44	26	54	78	118	0	42	5	85	7	20	12	53	26	2	54	10
104	56	65	23	34	14	44	26	56	78	120	0	42	4	87	5	23	9	56	26	2	65	7
205	57	67	23	34	14	44	26	58	76	122	2	47	2	89	1	23	3	57	26	2	88	2
106	58	68	23	34	14	44	33	60	69	123	2	53	1	89	0	23	1	57	33	2	97	0
206	59	69	23	34	14	44	31	61	73	125	0	53	1	90	0	23	1	57	31	2	97	0
202	60	71	25	37	15	47	26	63	77	127	1	56	0	90	2	24	2	58	26	2	92	0
603	61	72	25	37	15	47	27	65	77	129	0	56	2	91	2	25	4	59	27	2	85	4
1309	62	73	25	37	15	47	32	66	71	131	1	58	1	91	0	25	1	59	32	2	97	0
102	63	74	25	37	15	47	34	68	70	132	0	58	6	95	0	25	6	61	34	2	82	6
1109	64	75	26	38	16	50	37	71	67	134	0	58	0	95	0	25	0	61	37	2	100	0
702	65	76	27	40	17	53	30	72	74	136	0	58	0	95	2	27	2	62	30	2	93	0
606	66	78	27	40	17	53	35	75	69	137	0	58	0	95	0	27	0	62	35	2	100	0
909	67	79	27	40	17	53	36	77	67	139	1	61	3	96	2	28	5	63	36	2	86	3
304	68	80	28	41	18	56	35	79	69	141	0	61	2	97	1	28	3	64	35	2	91	2
805	69	81	29	43	19	59	35	81	69	143	0	61	0	97	3	30	3	65	35	2	91	2
107	70	82	29	43	19	59	33	83	69	144	2	67	1	98	2	31	3	65	33	2	91	1
404	71	84	29	43	19	59	34	85	69	146	1	69	2	99	2	32	4	67	34	2	88	2
802	72	85	29	43	19	59	38	87	66	148	0	69	0	99	0	32	0	67	38	3	100	0
504	73	86	31	46	20	63	41	90	63	149	0	69	2	100	0	32	2	67	41	3	95	2
709	74	87	32	47	21	66	46	92	55	150	3	78	0	100	0	32	0	67	46	3	100	0
809	75	88	35	51	22	69	39	95	61	152	4	89	0	100	3	34	3	68	39	3	92	1
705	76	89	37	54	23	72	38	97	66	154	0	89	0	100	4	36	4	69	38	3	89	3
1209	77	91	39	57	24	75	49	100	55	155	0	89	0	100	4	39	4	70	49	3	92	4
407	78	92	47	69	25	78	42	102	61	156	1	92	0	100	12	46	12	74	42	3	71	17
509	79	93	50	74	26	81	57	106	46	158	1	94	0	100	9	51	9	76	46	3	80	6
108	80	94	53	78	27	84	42	108	57	159	5	108	0	100	14	59	14	80	42	3	67	22
907	81	95	59	87	28	88	52	111	52	160	0	108	0	100	14	67	14	84	52	3	73	25
1007	82	96	60	88	29	91	52	114	52	162	0	108	0	100	19	78	19	89	52	3	63	28
208	83	98	61	90	30	94	56	118	48	163	0	108	0	100	17	88	17	94	48	3	65	27
1107	84	99	62	91	31	97	58	121	45	164	1	111	0	100	14	96	14	98	45	3	69	26
1	85	100	68	100	32	100	80	126	21	164	3	119	0	100	7	100	7	100	21	1	67	11

Table 7d

SCALE STATISTICS

ITEMS = 68

CASES = 85

SCALABILITY = 656

DISPERSION = 131

		N	P			
DEVIATIONS				NON-MODALS		
ZEROS	=	173	49	ITEMS	=	1036
ONES	=	183	51	CASES	=	1519
TOTAL	=	356	100	MIN	=	1036
SCALE SCORE				SCALE STEPS		
CELLS IN	=	1697	29	TOTAL	=	32
CELLS OUT	=	4083	71	STEPS/ITEM	=	47
TOTAL	=	5780	100	STEPS/CASE	=	38
FREQUENCIES						
ONES	=	1676	29			
ZEROS	=	4068	70			
NO DATA	=	36	1			
TOTAL	=	5780	100			

DEVIATIONS IN RANGE

RANGE	ONES N	ONES P	ZEROS N	ZEROS P	TOTAL N	TOTAL P
1	0	0	8	5	8	2
2	8	4	27	16	35	10
3	17	9	42	24	59	17
4	30	16	54	31	84	24
5	41	22	67	39	108	30
6	50	27	85	49	135	38
7	59	32	98	57	157	44
8	69	38	106	61	175	49
9	77	42	117	68	194	54
10	86	47	125	72	211	59
11	96	52	131	76	227	64
12	103	56	138	80	241	68
13	110	60	144	83	254	71
14	118	64	148	86	266	75
15	120	66	155	90	275	77
16	123	67	159	92	282	79
17	127	69	165	95	292	82
18	130	71	168	97	298	84
19	136	74	169	98	305	86
20	137	75	170	98	307	86
21	144	79	171	99	315	88
22	153	84	172	99	325	91
23	154	84	173	100	327	92
24	154	85	173	100	329	92
25	157	86	173	100	330	93
26	163	89	173	100	336	94
27	166	91	173	100	339	95
28	168	92	173	100	341	96
29	171	93	173	100	344	97
30	175	96	173	100	348	98
31	177	97	173	100	350	98
32	179	98	173	100	352	99
33	181	99	173	100	354	99
34	181	99	173	100	354	99
35	182	99	173	100	355	100
36	182	99	173	100	355	100
37	182	99	173	100	355	100
38	183	100	173	100	356	100

If, however, the structural differentiation of individual sub-communities is scaled, their relative content of structure is small and full of deviations. (The many blocks of "1" deviations in both the Loei and Tha Bo census scales are a clear demonstration of this problem.) For structural analysis, it is essential to combine sub-communities into structurally functioning settlement areas and measure the total structural content as one unit. For Loei which, for instance, contains at least eight sub-communities this summation was easy because the town area was identified as a special division in the district. For Tha Bo, however,"town-villages" were not separated from the rest of the villages in the sub-district (tambon) and the scale contains the ten sub-communities of Tha Bo individually. As a result Tha Bo shows a lower scale content than Loei and many sub-communities of Tha Bo scale very low. There has been no time to correct this by adding the sub-villages in Tha Bo and other settlements and produce a new scale. The importance of this fact in scalogram analysis must be re-emphasized for future analyses: only the sum of the structural content of individual sub-communities is usable in scalogram analysis.

The problem became apparent when plotting the Tha Bo census scale score-contours on the map for a comparison with the air data scale contours. Some of the shifting of central villages in Tha Bo can be attributed to the fact that in the census scale several large villages, which really are central villages, scale lower because their two or three sub-villages have been scaled individually, making neighboring homogeneous villages scale higher. The problem is compounded by the fact that some village data may still not be matched with their proper location on the map.

Keeping these limitations in mind, the following cursory interpretation of at least the Loei Census Scale (Scale 3) can be made. (Since the census data are for the whole Loei district the scale contains 85 villages.) As in the AP scale the villages appear to be grouped into three major development levels, the first group (rank numbers 1 to 39) contain predominantly farming and service occupations. Elementary education of people over 60 years of age goes only to the 4th grade. (Elementary education of other age groups is present everywhere and has not been put into the scale.) In the second group (rank 40 to 72) commercial and home craft industry occupations appear. The highest education of old people is still only the elementary 4th grade. In the last group (rank 73 to 85) service, commercial and manufacturing occupations have been added for the old and young. Education for the old goes beyond the elementary 4th grade to the 7th grade and even to secondary education. Secondary education, both general and vocational, has become available for all age groups. Modern public services in the form of water and electricity appear only in Loei town at the top of the scale.

The census scales represent only a first rough processing step to identify the village hierarchy of development in the two districts, and be sufficient for a comparison with the AP scales. For a detailed, careful analysis of 'processed knowledge content' considerable refinement through rescaling would be necessary which is beyond the scope of this project, both in purpose and resources. This refind analysis should be done however, The

scales and the geographic presentation below show that the census data can be highly valuable for the measurement of sub-regional development structure if they are compiled for villages instead of sub-districts (tambons). The elementary unit of local development is the village and town and invaluable information, collected at great costs, is lost by compiling it only for larger administrative units.

3. Aerial and Ground Data Comparison

The comparison of the aerial photo data and 1970 census data was made quantitatively by correlation and factor analysis and qualitatively by scalogram analysis on maps.

The scalogram analysis comparison is presented in the isopleth maps number 4 and number 15. The comparison maps of the air photo and census scales shows that in general the micro-región and central village locations are almost the same. We take this to be evidence that the air photo data are a valid and highly useful alternative to even very detailed data obtained on the ground. The major implication is that airphoto data can be used anywhere to measure development levels of micro-regions, but are especially useful in areas that are either very remote or otherwise have limited access for data surveys on the ground. They are also most applicable for any region where the collection of data from aerial photography is less expensive than ground surveys which is especially the case when aerial photography has already been taken for other purposes. *

The simplest quantitative comparison is by finding relevant correlations between ground and air data variables. For instance, the average population per village from the census data is 1,540 people. The average number of dwellings counted per village on aerial photography is 164, which turns out to be an average of 6.4 people per dwelling. In an area where most dwellings are occupied by a single family this number is highly significant when according to the census data the average number of people per household in Tha Bo is 6.4 and in Loei 6.1. Not surprisingly the correlation coefficient between census population per village and number of dwellings is .98. Other correlation coefficients between the census population per village and selected other variables and correlations between AP scale scores and census variables are shown in Table 8. These quantitative correlations further support our claim that aerial photography provides significant amounts of highly valuable qualitative and quantitative data for micro-regional analysis.

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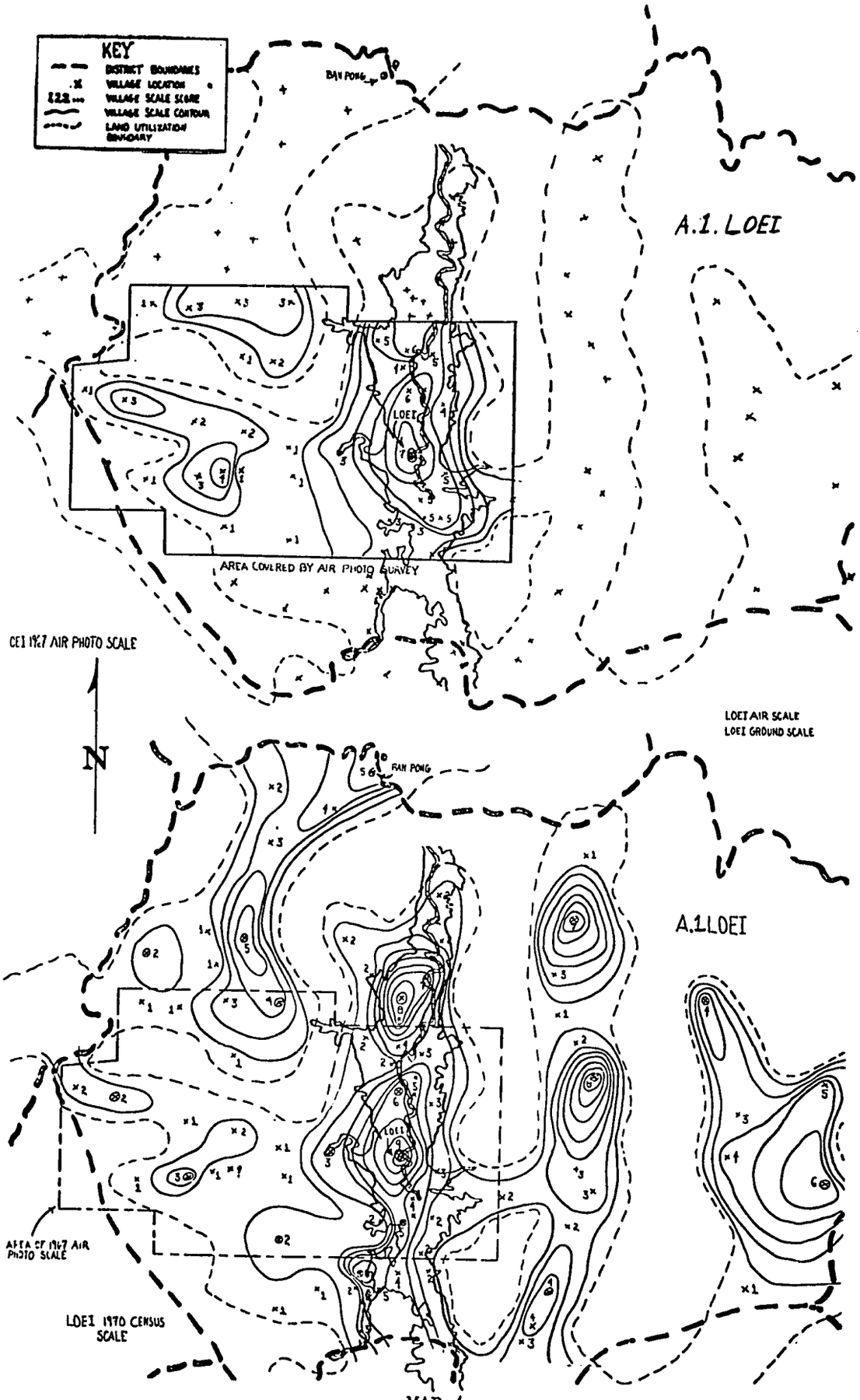
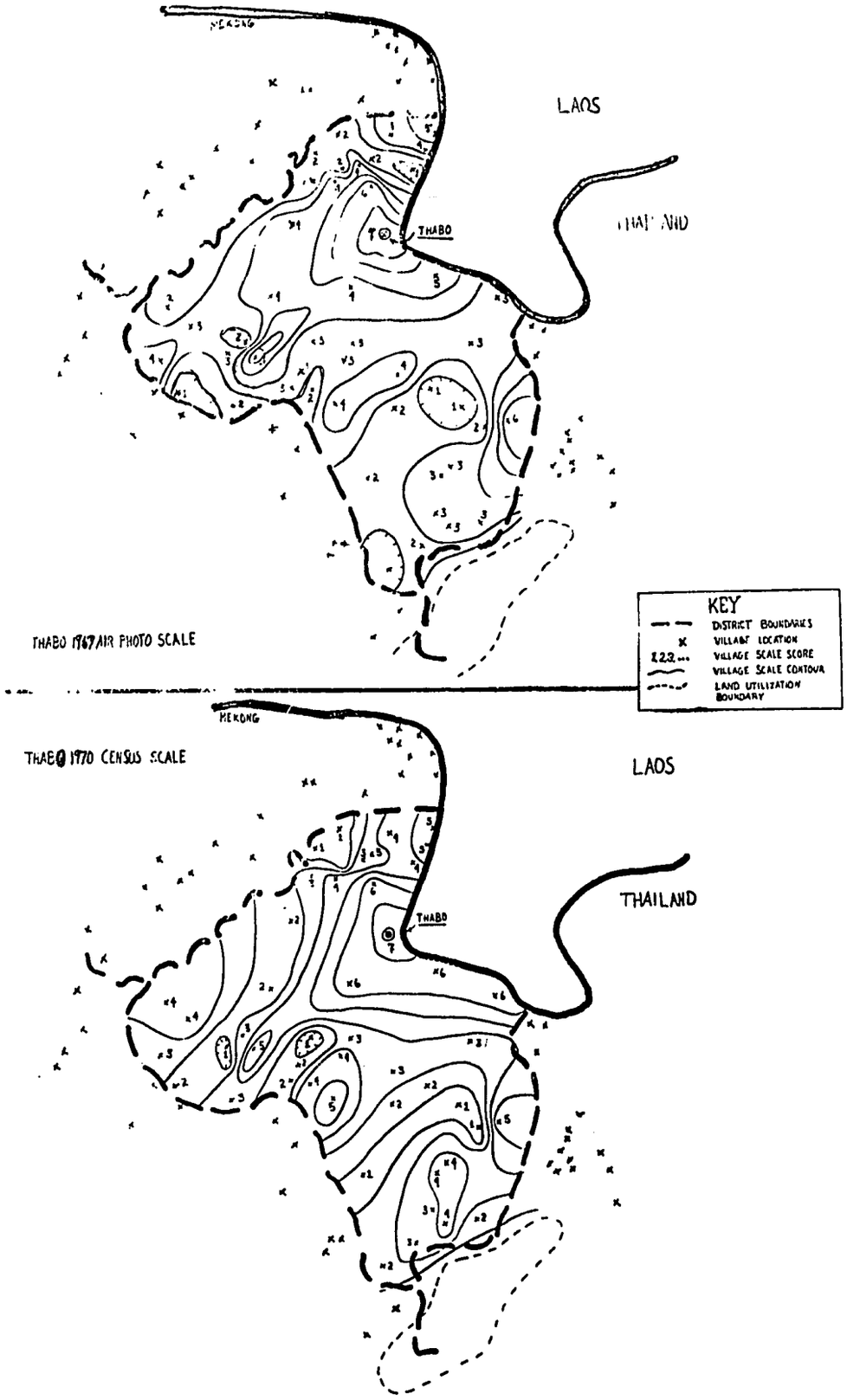
*Some indications on the cost of aerial photo surveys have been given by the Engineer Agency for Resources Inventories (EARI) in "A Program To Speed Land Distribution" March 1969, a report to the Agency for International Development (AID), p.I-3:

The costs for new aerial photography at a 1:10,000 scale taken in Vietnam by a private contractor are given as US \$13.00 per Km^2 and the assembling of a controlled photo mosaic as \$9.00/Km^2. This price for the excellent, high quality photography is considered low; the cost for the mosaic can be much reduced for socio-structural survey work since only map control and not geodetic control is necessary. The cost of the survey work would, on the average, be about one hour per settlement if done by trained professionals. This cost will depend on the salary rate for such personnel in a particular country.

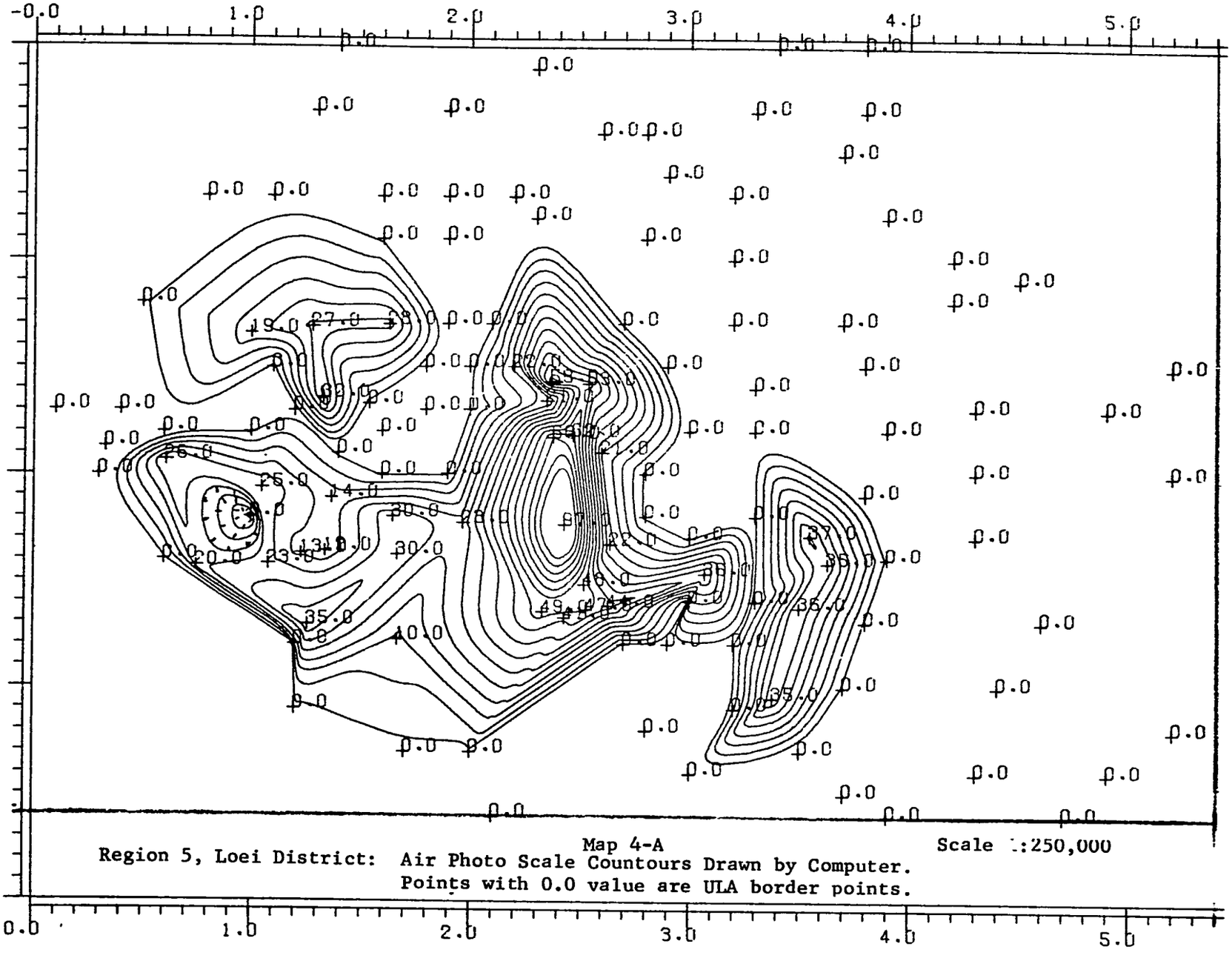


MAP 4

Region 5 District 1 only: Comparison of Air Photo and Ground Data Scale Contours (for scale content see Item Statistics Table)



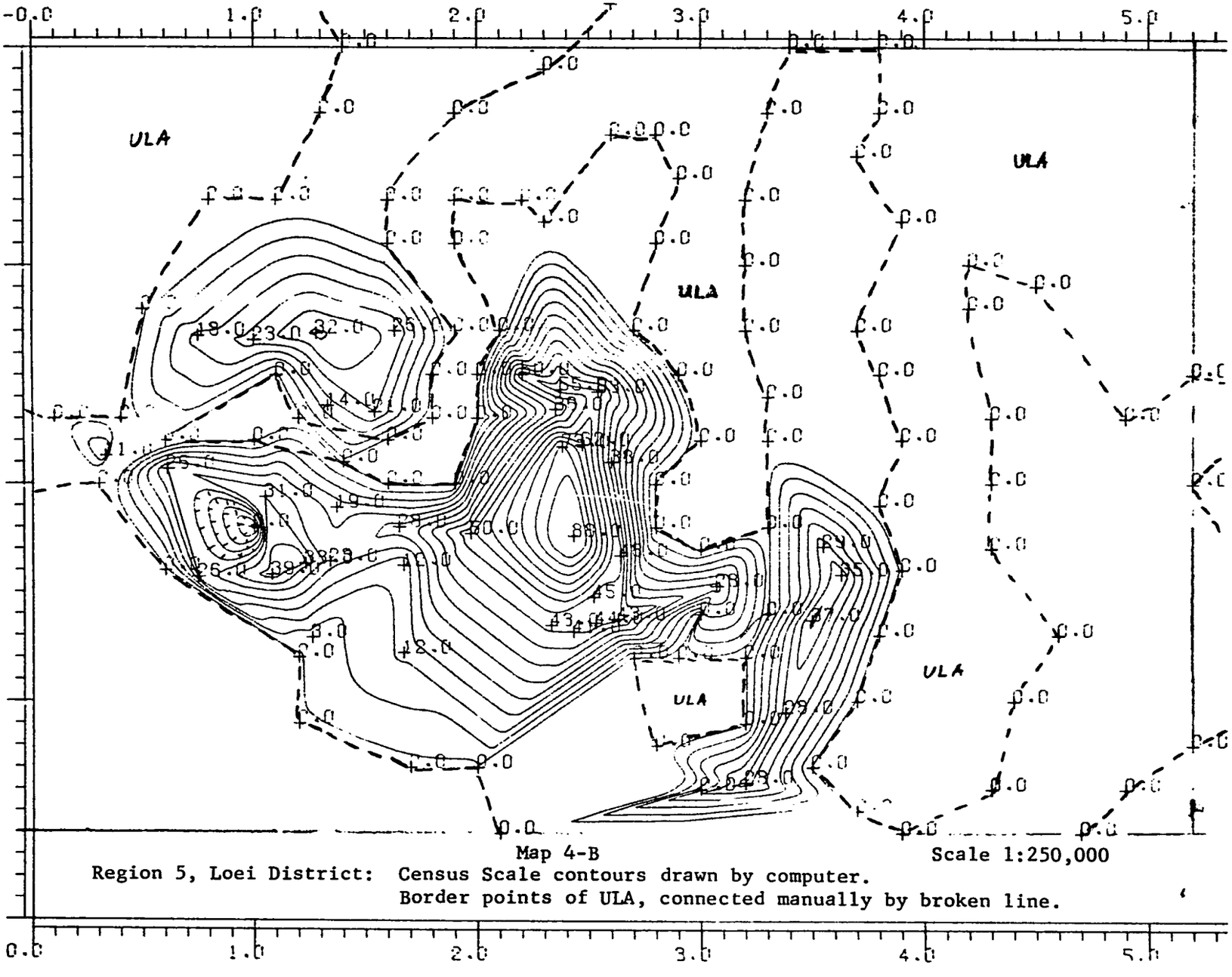
Map 15
Irrigation Region I-A: Comparison of Air Photo and Census Data Scale Contours (for scale content see item statistics table)



Map 4-A

Scale 1:250,000

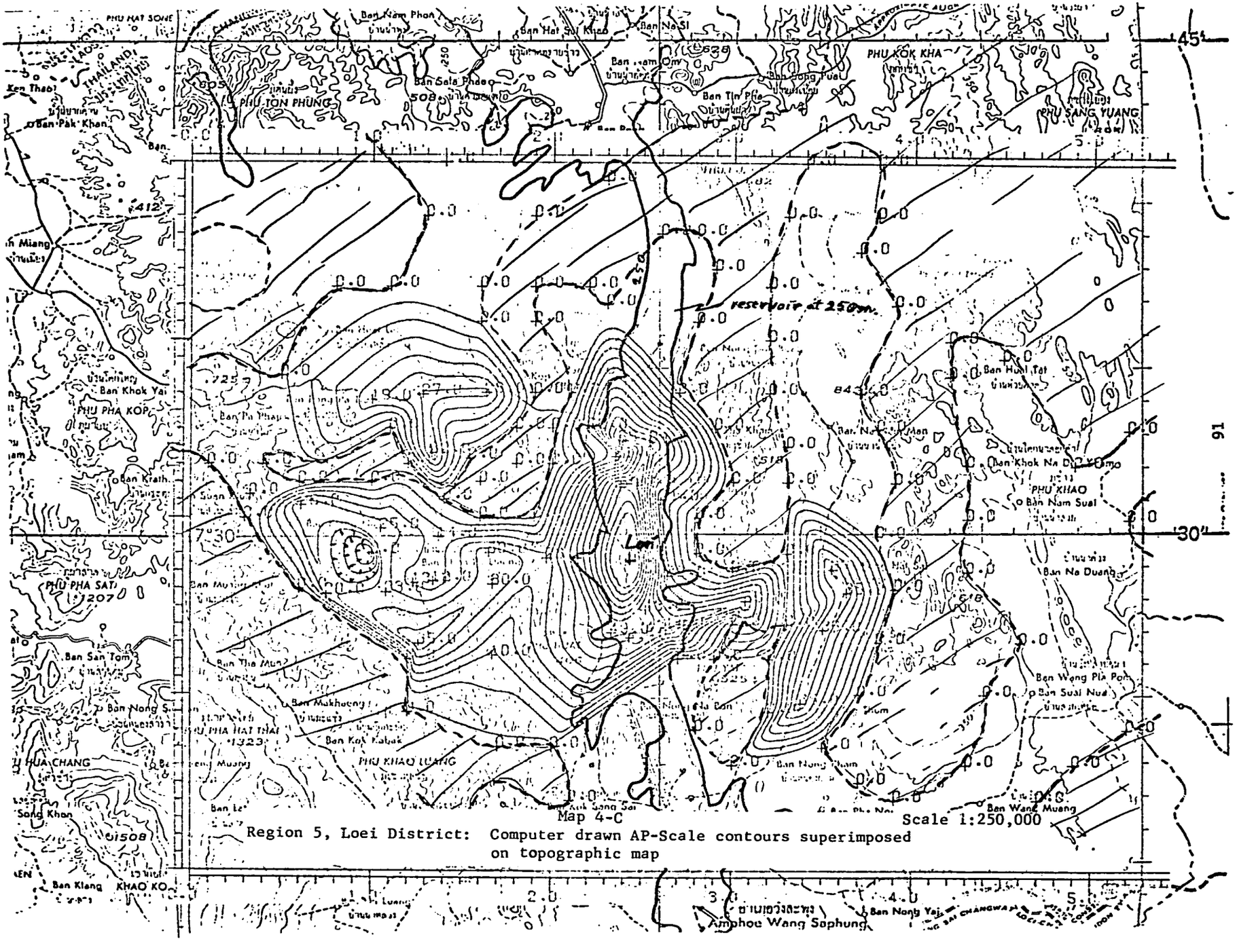
Region 5, Loei District: Air Photo Scale Countours Drawn by Computer.
Points with 0.0 value are ULA border points.



Map 4-B

Scale 1:250,000

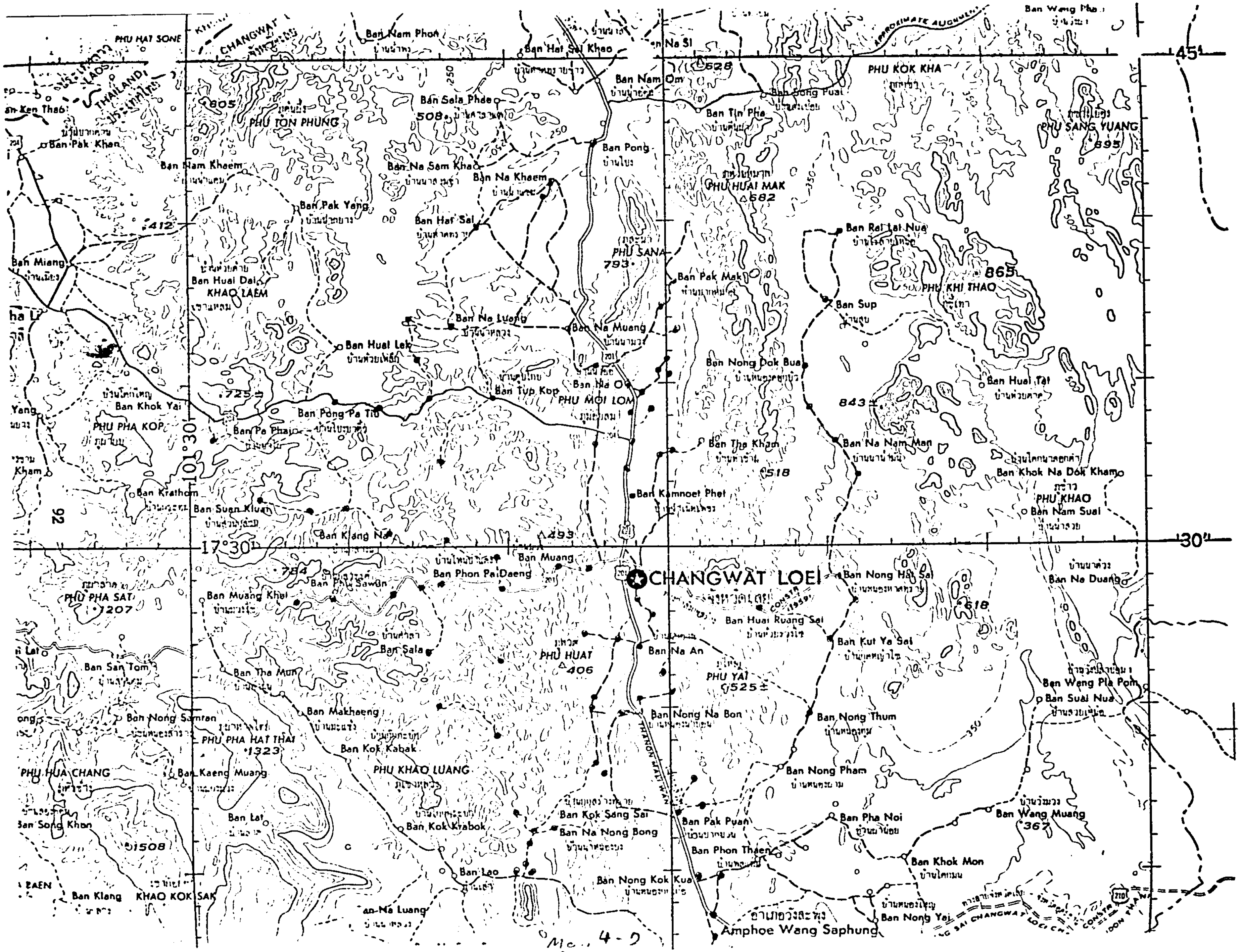
Region 5, Loei District: Census Scale contours drawn by computer.
Border points of ULA, connected manually by broken line.



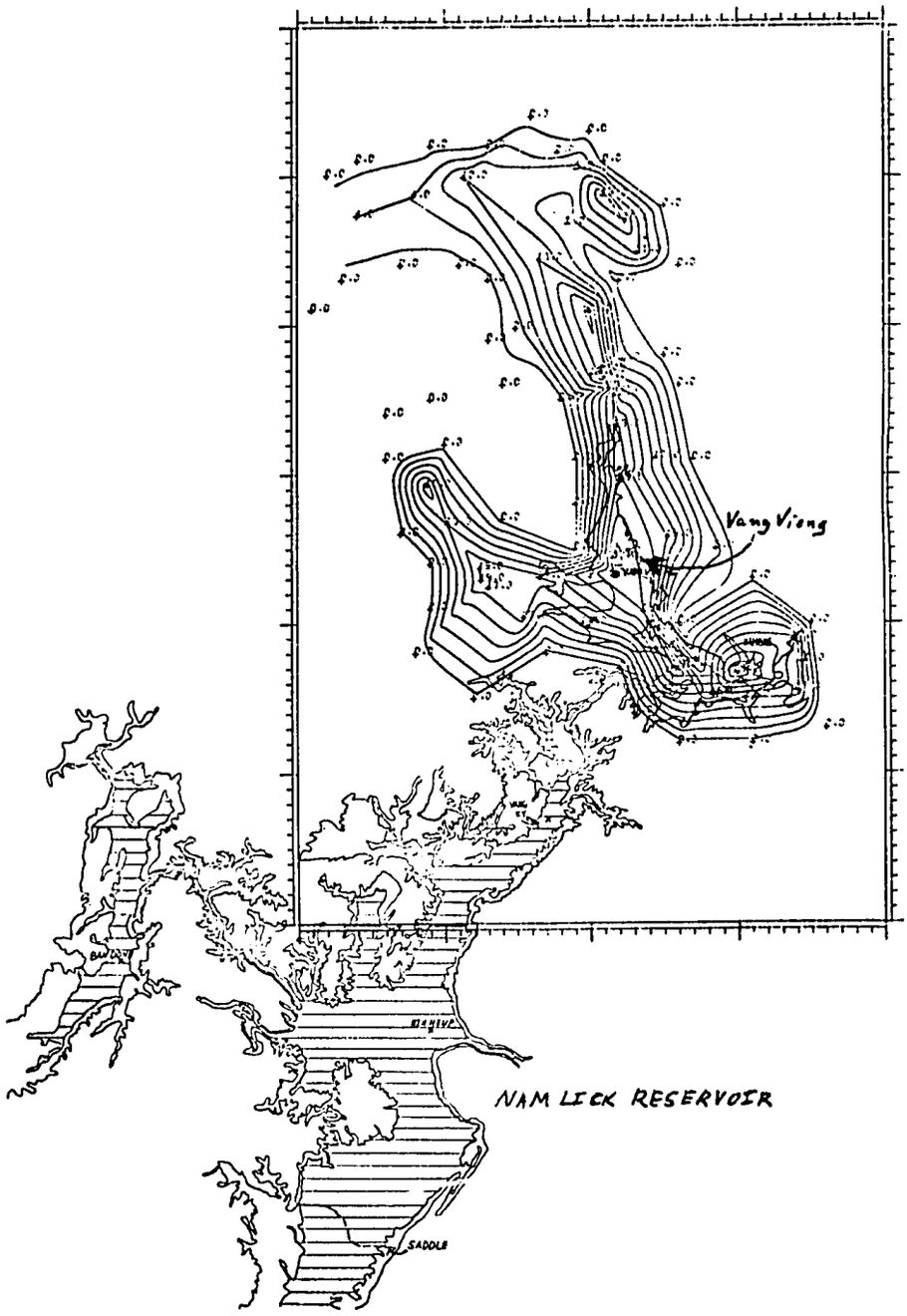
Map 4-C

Scale 1:250,000

Region 5, Loei District: Computer drawn AP-Scale contours superimposed on topographic map



PHU HAT SONE
CHANGWAT
LAOS
THAILAND
Ban Nam Phon
Ban Hat Sai Khao
Na Si
628
Ban Wang Phai
45'
Ban Ken Thao
805
PHU TON PHUNG
Ban Sala Phde
508
250
Ban Nam Om
Ban Song Puai
PHU KOK KHA
Ban Tin Pha
PHU SANG YUANG
895
Ban Pak Khan
Ban Nam Khaem
Ban Na Sam Khao
Ban Na Khaem
Ban Pong
PHU HUAI MAK
682
350
Ban Pak Yang
Ban Hat Sai
412
Ban Rai Lat Nua
Ban Miang
Ban Huai Dai
KHAO LAEM
PHU SANA
793
Ban Pak Mak
865
PHU KHI THAO
Ban Sup
Ban Na Luang
Ban Na Muang
Ban Huai Lek
Ban Nong Dok Bua
Ban Na O
Ban Tup Kop
PHU MOI LOM
Ban Huai Tat
725
Ban Khok Yai
Ban Pong Pa Tiu
843
PHU PHA KOP
101°30'
Ban Pa Phai
Ban Tha Kham
518
Ban Na Nam Man
Ban Khok Na Don Kham
Kham
Ban Krathom
Ban Kamnoet Phet
PHU KHAO
Ban Suan Kluai
Ban Nam Suai
92
Ban Klang Na
493
17°30'
30'
Ban Muang
784
Ban Phon Pai Daeng
CHANGWAT LOEI
Ban Nong Hai Sai
Ban Na Duang
Ban Pha Sawan
PHU PHA SAT
1207
Ban Muang Khai
CONSTR 1959
616
Ban Huai Ruang Sai
Ban Sala
Ban Na An
Ban Kut Ya Sai
Ban San Tom
PHU HUAT
406
Ban Tha Mun
PHU YAI
525
Ban Wang Pla Pom
Ban Suai Nua
Ban Nong Samran
Ban Makhaeng
Ban Nong Na Bon
Ban Nong Thum
PHU PHA HAT THAI
1323
Ban Kok Kabak
THANON MALI WAN
350
PHU HUA CHANG
Ban Kaeng Muang
PHU KHAO LUANG
Ban Nong Pham
Ban Song Khon
Ban Lat
Ban Kok Sang Sai
Ban Pak Puan
Ban Pha Noi
Ban Wang Muang
367
Ban Kok Krabok
Ban Na Nong Bong
1508
Ban Phon Thaen
Ban Khok Mon
Ban Lao
Ban Nong Kok Kua
Ban Klang
KHAO KOK SAK
Na Luang
Amphoe Wang Saphung
Ban Nong Yai
210
Ma. 4-2



MAP 11

Region 2: Van Vieng Air Photo Data Scale Contours and Nam Lick Reservoir Area.
(scale contours are plotted by computer)

TABLE 8

A. Means and Correlations of 1970 Census Population with Selected Variables

1. Population Means from 79 Villages in Loei and Tha Bo Districts:

Population Mean/Village 1970 Census		1,054
No. Dwellings Mean/Village 1967 Aerial Photo Data		164
Average No. People per Dwelling		6.4
Average No. People per Household (70 Census)	in Tha Bo	6.4
	in Loei	6.1

2. Census Village Population Correlated With:

	Correlation Coefficient
No. Dwellings/Village from Aerial Photography	.98
No. Institutions/Village from Aerial Photography	.97
No. Paved Roads/Village from Aerial Photography	.80
No. Temples/Village from Aerial Photography	.64
No. Estimated School Rooms/Village from Aerial Photography	.55
The percentile Census Scale Score	.75
The percentile Air Photo Scale Score	.64

B. Correlations between AP Scale Scores and Selected Census Variables

(per Village)	Correlation Coefficient
Census Scale Score	.72
Population	.65
Population in Agriculture	.63
No. people literate	.65
Percent males illiterate	-.54
No. people with secondary education	.65
No. people with vocational education	.61
No. people working in electric and water services	.65
No. people working in construction and repair	.55
No. people working in manufacturing	.55

Means and Correlations were computed by the BMD Factor Analysis Program at the Bureau of Standards Computer Center at Gaithersburg, Maryland.

Factor analysis was used not only to check on the results of scalogram analysis but also to process the considerable amounts of quantitative data collected from aerial photography and contained in the census data. We were also anxious to see how the factor scores per village produced by factor analysis would compare with the scale scores in the identification of central villages and micro-regions. We discovered that the relationship between factor scores and scale scores becomes very close if the scores of certain factors are added before they are compared with the scale scores. Figure 1 demonstrates (for Loei only) the close relationship that comes about if only the first two factors (out of 10) were added from a factor analysis of combined ground and air photo data. The relationship becomes almost a 45 degree line which to us means that the scores can be perfect alternatives in measuring development differences between villages. To test this we plotted the data in figure 1 on a map to see if the same central villages would be identified. It was to late to have the results printed so we can only report that almost exactly the same villages were identified as central villages in this small sample area. Those villages identified as central are indicated in the figure 1. In one case only did the neighboring village become the central village, village AP 9 for village AP-8, and here the two villages are contiguous and should be taken as one unit.

We also tried to find an explanation for why certain factor scores have to be added before they correlate highly with scale socres. Examining the factors which are correlating with the scale scores, one notices that the variables contained in these factors also represent qualitative differentiation. In other words, they can be reduced to represent the presence or absence of a quality, for instance, the industries and educational levels present in the ground data scale, and in the air data scale, the number of institutional buildings, school rooms, types of road, temples, estimated hectares of gardens, paddy fields and hill rice fields.

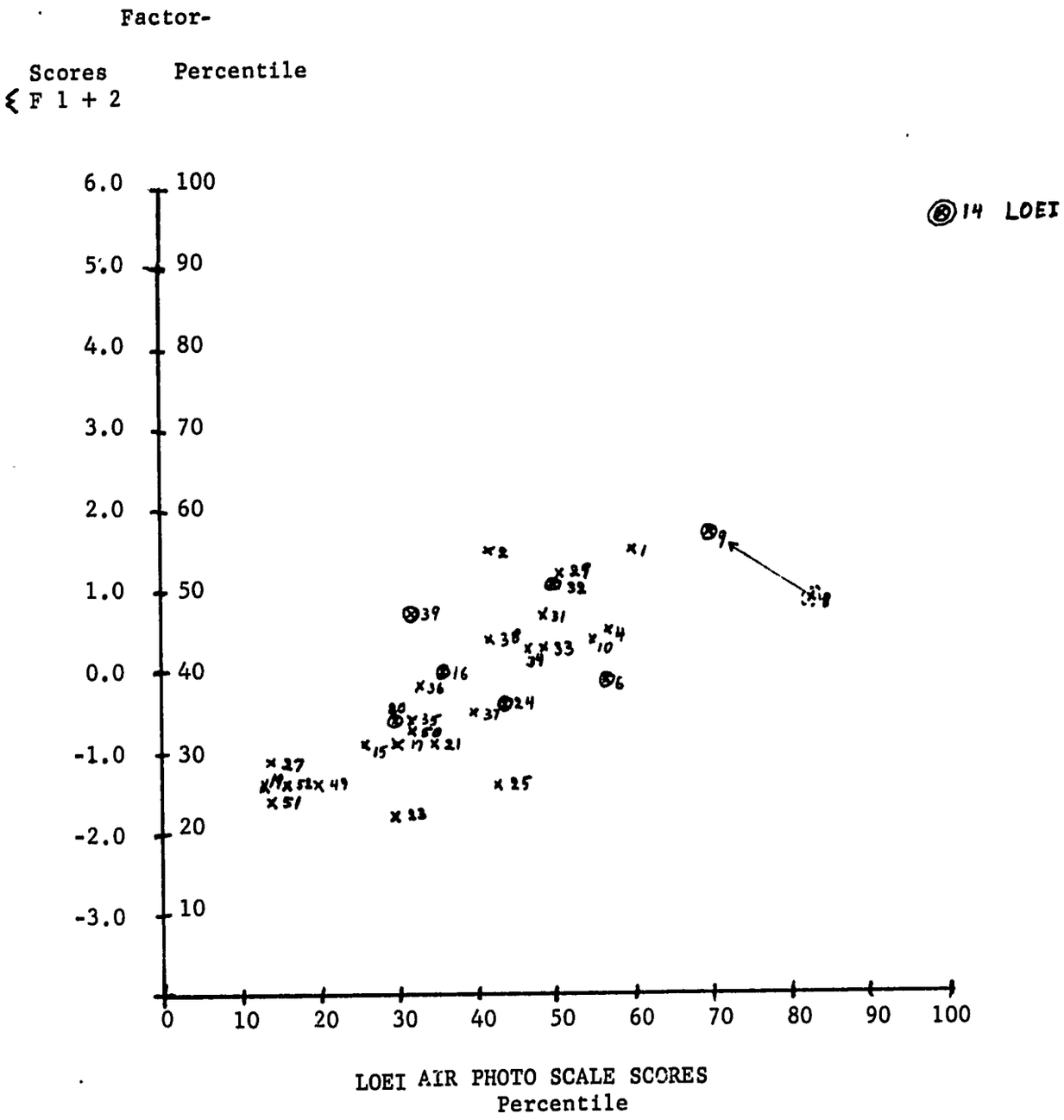
Factor analysis identifies qualitative specializations from quantitative variance. It does so by grouping some of the qualitative differentiation into those groups of villages which are stronger quantitatively in certain qualities, such as high education and larger numbers of non-agricultural population in agriculture (one factor) versus larger areas of paddy fields, higher percentages and numbers of population in agriculture and higher uniformity of village dwellings and villages patterns (another factor). Those factors which are additive in terms of measuring levels of total development can usually be recognized by adding the scale scores to the factor analysis. We found that the addition of these variables does not significantly alter the factors in the factor matrix, but invariable the scale scores load in several factors. We have found generally scale scores to load in those factors which if added present the closest correlation with the factor scores.*

The comparison of ground and air data in both qualitative and quantitative data to us means that: (1) the two methodologies can be valid alternatives in measuring relative development levels of villages and (2) that they process and measure two different kinds of information in data, each one presenting valuable information for regional analysis.

* Since one needs the scale scores to identify the factors to be added for development contours, factor analysis alone does not appear to be a useful method for structural development mapping.

Figure 18

SCALE AND FACTOR SCORE CORRELATION



Village Score and AP number

Central Village by factor and scale score

Central Village by scale score shifted to neighboring village by factor score

The scale methodology through the scale and the scale scores identifies very detailed differences in quality between villages in micro-regions. Factor analysis in the factor scores measure the quantitative difference between villages but it does not identify except very grossly the qualitative difference between villages on which the quantities are based. In essence the two methodologies complement each other here very highly and since both air photo and ground data always contain both qualitative and quantitative information, processing the data by both methods produces more insights into the micro-regional structure than if only one or the other methodology is used alone.

We are also interested in a more general conclusion: the qualitative presence of an attribute in a unit can be assumed to increase quantitatively (as a variable) as the unit adds further attributes, i.e., rises in the scale. The two types of data, qualitative and quantitative can serve as substitutes for each other as the availability of reliable data and processing facilities favor one or the other.

For instance, even on the printed aerial photographs in this report one can see the close relationship between levels of qualitative variety and the increasing quality and quantity of improvements. This relationship must have a reflection in the monetary value in terms of existing market prices in each community or in terms of replacement costs. This relationship could be measured in selected sample areas which should not be randomly selected but have to be geographic areas which slice across the development contours from high to low. The relationship to be measured is the correlation between the development gradient of qualitative diversification of villages and the gradient of market prices or replacement costs of improvements.

Similarly, the highest quality of the individual property of families can be seen as being determined by the level of structural quality of their village. More specifically under this upper level the value of each property is determined by the relative level of each family within the hierarchy of families in a community. Again this can be detected on aerial photography. If one compares on the photos the most prosperous looking dwelling compounds between different villages one can see evidence for the village level determinant. One can also see within each community a range of residential complexity from the most prosperous to the poorest reflecting a hierarchy of property values within the village.

---

*The close relationship between quality and quantity can be clarified by the following three premises:

1. a) Any quantity is generated by a structure which is qualitative or vice versa

   b) Functioning of structure must generate and/or use quantity.

2. a) Qualitative differences in structure in most cases generate different quantities - or vice versa

   b) different quantities have in most cases been generated by different qualities.

3. One can measure quantity by qualitative data of structure or vice versa, any quantity contains qualitative data to measure structure.

A technique can be developed to standardize quality (value) levels of individual dwellings within the limits of the value levels of particular communities by systematically combining structural air photo data and ground data on replacement value. This relationship can then be employed over the whole region of Pa Mong for total cost estimation and compensation and/or replacement planning. So far, this relationship appears highly probable. The actual measurement of it will have to be done by a carefully done study.

All of the data sets found usable for scalogram analysis were submitted to factor analysis but to present the obtained results would be a report in itself and far beyond the scope of this study, the primary aim of which is after all the demonstration of structural-symbolic and scalogram analysis and the establishment of their validity in comparison with quantitative analysis methods such as factor analysis. We may therefore turn toward the scalogram analysis of several data sets on the Pa Mong Region which became available from Thailand.

C. The Function of Central Villages and Micro-Regions Identified in Innovation, Agriculture and Needs Data

1. Central Villages as Innovation Nodes: Annual Village Survey Data from the National Statistic Office (NSO)

The Thai National Statistic Office (NSO) annually sends a questionaire to each village headman in Thailand. The questionaire is only two or three pages long and asks questions about population, how much of the major crops is grown at the present and previous year, how many of the major animals are present in the village and what the major four occupations are out of a list of nine. It also asks whether the village has a school and clinic or what the distance to the nearest clinic is. The data returned are not considered to be very accurate by statisticians in the NSO offices. In fact they are used only to produce population estimates and it was difficult to obtain these data because of the claimed inaccuracies.

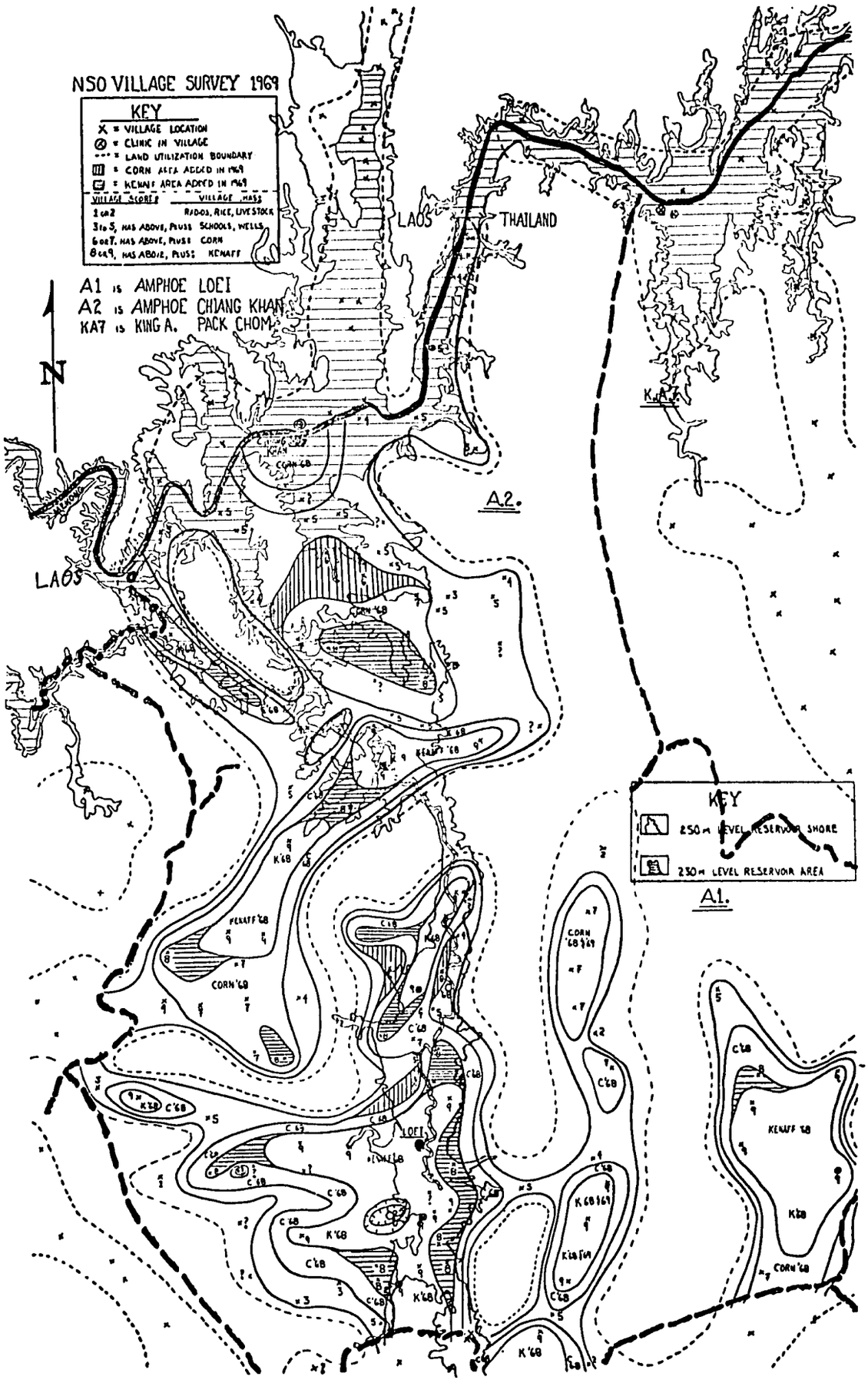
As pointed out earlier, quantitative inaccuracies are not important for scalogram analysis. All quantitative data are reduced to their qualitative content in terms of one-zero magnitude anyway. As suspected, the NSO village data have proved to be extremely valuable. Scale 4 was produced from these data which contains very few items, but two extremely interesting ones: corn and kenaf. These two crops have been spreading rapidly throughout Thailand during the last decade. Most of the other items in the scale are structurally not sufficiently diverse. It is well known that almost all villages grow rice, have water buffalos and raise pigs. Perhaps more interesting is the fact that also all villages have radios and most have a school and private or public wells. We did not find a way to include the occupational information because the construction of the questionaire provides only information on the four most important occupations out of a total of nine. If the questionaire could provide information on presence or absence of all nine occupations, it would provide ideal structural data since occupations are a primary measure of structural differentiation. (See Census Scale in II-B-2.)

What remains then are the data on two crops. What they reveal makes up for all other problems of relevancy the scale may have. It shows that a certain number of villages have either the corn or the kenaf crop in only one of the two years (1968 and 1969). We thought it important to see if this could be used to identify the diffusion of these crops from central villages. Map #5 shows that this is indeed the case. If one plots the presence or absence of two crops on the maps according to their presence and then shades in those areas which had one or the other crop in 1969 but not in 1968 areas of expansion of the crops can be identified (or vice versa contraction). Close inspection will reveal that the expansion areas in Loei (Map 5) are in peripheral areas of micro-regions furthest away from central villages. On Map 16 we can see that the shaded areas of contraction of the kenaf crop are merely a reversal of the diffusion process. Cultivation of kenaf was stopped apparently in areas which last started growing it. The maps present a more significant demonstration of the function of central villages as innovation nodes. They provide a validation of the theory which hypothesizes that central villages are communication nodes through which new knowledge passes first when spreading out into the surrounding micro-regions. The effectiveness of scalogram analysis in making quantitatively suspect data useful for analysis is also demonstrated. Not only do central place and structural-symbolic theories predict that there are such innovation nodes, diffusion theory as well has recognized this phenomenon.

While our data are for only two years, the 1969 Annual Report of the International Rice Research Institute in the Philippines (IRRI) reports of a diffusion study conducted in the central Luzon on the spread of the high yielding rice varieties between 1966 and 1969. Figure number 13 identifies the district and its towns and villages. Figures 14 through 17 show the spread of new variety throughout the district by points of new adopters. We have added isopleth lines around villages which had at least one adopter in a year and have shaded each are differently to which the new varieties spread during a particular year. The time series of four maps show that within four years the district was covered by new varieties. One can see how earlier adoptors were near the central town of the district and in villages close to it. At the same time as new varieties spread to new villages, diffusion also spread within these villages into their hamlets. These maps are a perfect demonstration of the communication channels for new knowledge in micro-regions and the growth of knowledge processing structure (cultivation of new varieties) along these same channels. Generally, this phenomenon has been investigated for the development of diffusion theory.

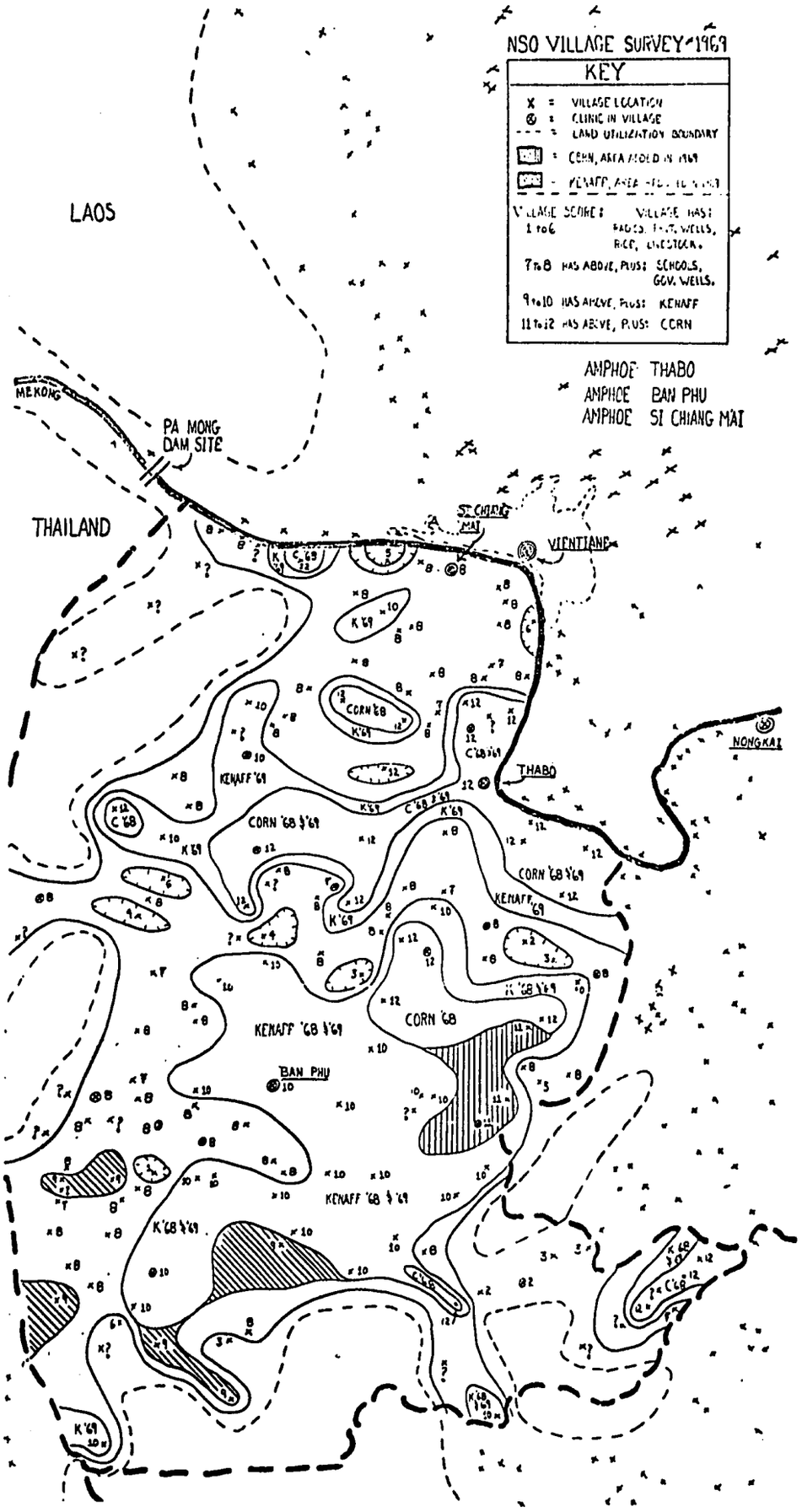
A diffusion model was purposed by Hagerstrand in 1965:

> "The purpose of the actual diffusion model is to show how society operates as a communication system when a "disturbance" of the innovation type enters at some point and subsequently is propagated through the network.
>
> "....it is important to note that innovations which emanate from the same center but start spreading at different points in time still tend to propagate along similar "roads" and in the same



MAP 5

Region 5: Kenaff and Corn Diffusion from Agricultural Innovation Nodes 1968 to 1969.



Map 16
Irrigation Region I-A: Kenaff and Corn Diffusion from Agricultural Innovation Nodes 1968 and 1969

THAI HSO VILL. DATA, PROV. 2, CASE NON-MODAL RUN, AUG 18

ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQUENCIES ONES P	FREQUENCIES ZEROS N	FREQUENCIES ZEROS P	FREQUENCIES NINES N	FREQUENCIES NINES P	DEVIATIONS ONES N	DEVIATIONS ONES P	DEVIATIONS ZEROS N	DEVIATIONS ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCALABILITY	DISPERSION
CLINICS # OF	69	4300	16	107	0	0	10	111	17	101	111	128	0	100	17	177	0	100	17	116	17	6	0	40
KENAFF FAMILY.PLANT.IN	68 69	2400	15	100	30	23	9	100	32	100	95	100	1	100	2	100	0	100	2	100	32	11	94	4
KENAFF FAMILY.PLANT.IN	69.69	2350	14	93	49	38	8	89	54	98	73	76	1	95	10	91	4	100	14	98	54	18	74	12
CORN # FAMILY.PLANT.IN	68.69	2200	13	87	67	52	7	78	55	94	73	58	0	89	2	45	14	95	16	85	55	18	71	10
CORN NO. FAM. PLANT IN	69.69	2150	12	80	75	59	6	67	73	91	54	40	1	89	5	36	6	79	11	70	54	18	80	9
WELLS PRIVATE # OF	69	4400	11	73	103	80	5	56	87	86	41	27	0	84	2	14	18	71	20	59	41	14	51	24
WELLS GOVT.# OF	69	4450	10	67	114	89	4	44	98	80	28	16	2	84	1	5	15	50	16	41	28	9	43	27
SCHOOLS # OF	69	4250	9	60	119	93	3	33	110	73	18	9	0	74	0	0	9	32	9	25	18	6	50	22
COWS # FAMILY.68.	69	3200	8	53	127	99	2	22	121	66	5	5	2	74	0	0	4	21	4	17	5	2	20	11
COWS # FAMILY.69.	69	3150	7	47	127	99	2	22	120	58	4	4	4	63	0	0	3	17	3	13	4	1	25	12
PIGS # FAMILY.68.	69	2600	6	40	128	100	1	11	122	50	4	3	2	42	0	0	4	13	4	10	4	1	0	47
PIGS # FAMILY.69.	69	2550	5	33	128	100	1	11	124	42	3	2	1	32	0	0	3	8	3	7	3	1	0	44
NO. FAMILIES CULT. RICE	69	1600	4	27	128	100	1	11	125	34	2	1	1	26	0	0	2	5	2	4	2	1	0	31
RADIOS # FAMILY.WITH	69	4150	3	20	128	100	1	11	126	25	2	0	0	21	0	0	2	2	2	2	2	1	0	58
W.BUFFALO # FAMILY.68.	69	3400	2	13	128	100	1	11	126	17	0	0	2	21	0	0	0	0	0	0	0	0	100	0
W.BUFFALO # FAMILY.69.	69	3350	1	7	128	100	1	11	126	8	0	0	2	11	0	0	0	0	0	0	0	0	100	0

THAI HSO VILL. DATA, PROV. 1 AND 3. CASE NON MODAL RUN, AUG 18.

ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQUENCIES ONES P	FREQUENCIES ZEROS N	FREQUENCIES ZEROS P	FREQUENCIES NINES N	FREQUENCIES NINES P	DEVIATIONS ONES N	DEVIATIONS ONES P	DEVIATIONS ZEROS N	DEVIATIONS ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCALABILITY	DISPERSION
CLINICS # OF	69	4300	16	107	0	0	13	108	22	101	162	119	0	100	22	144	0	100	22	110	22	5	0	51
CORN # FAMILY.PLANT.IN	68.69	2200	15	100	30	16	12	100	40	100	144	100	0	100	10	100	0	100	10	100	40	9	75	16
CORN NO. FAM. PLANT IN	69.69	2150	14	93	34	18	11	92	46	98	138	83	0	100	14	80	2	100	16	96	46	10	45	16
KENAFF FAMILY.PLANT.IN	69.69	2350	13	87	62	34	10	83	47	95	136	66	1	100	1	52	16	99	17	89	47	10	64	11
KENAFF FAMILY.PLANT.IN	68 69	2400	12	80	68	37	9	75	48	93	135	50	1	94	2	50	21	90	23	81	48	10	52	15
SCHOOLS # OF	69	4250	11	73	136	74	8	67	137	91	47	34	0	88	11	46	10	78	21	71	47	10	55	19
WELLS GOVT.# OF	69	4450	10	67	154	84	7	58	134	83	50	28	0	88	11	24	31	73	42	62	50	11	16	34
COWS # FAMILY.68.	69	3200	9	60	161	88	6	50	134	76	45	22	5	88	0	2	22	55	22	44	45	10	51	23
COWS # FAMILY.69.	69	3150	8	53	162	86	5	42	141	69	40	17	3	59	0	2	18	43	18	34	40	9	55	22
PIGS # FAMILY.68.	69	2600	7	47	171	93	4	33	160	62	27	12	2	41	0	2	9	33	9	26	22	5	59	20
PIGS # FAMILY.69.	69	2550	6	40	171	93	4	33	163	54	19	9	2	29	1	2	7	28	8	22	19	4	58	21
W.BUFFALO # FAMILY.68.	69	3400	5	33	177	94	3	25	175	45	9	7	0	18	0	0	2	24	2	19	9	2	78	9
W.BUFFALO # FAMILY.69.	69	3350	4	27	177	96	3	25	176	36	6	6	0	18	0	0	1	23	1	18	8	2	87	8
WELLS PRIVATE # OF	69	4400	3	20	183	99	2	17	153	27	30	5	1	18	0	0	29	22	29	17	30	6	3	52
RADIOS # FAMILY.WITH	69	4150	2	13	183	99	2	17	170	19	12	1	2	12	0	0	11	6	11	5	12	3	8	43
NO. FAMILIES CULT. RICE	69	1600	1	7	184	100	1	8	184	10	0	0	0	0	0	0	0	0	0	0	0	0	100	0

Table 9

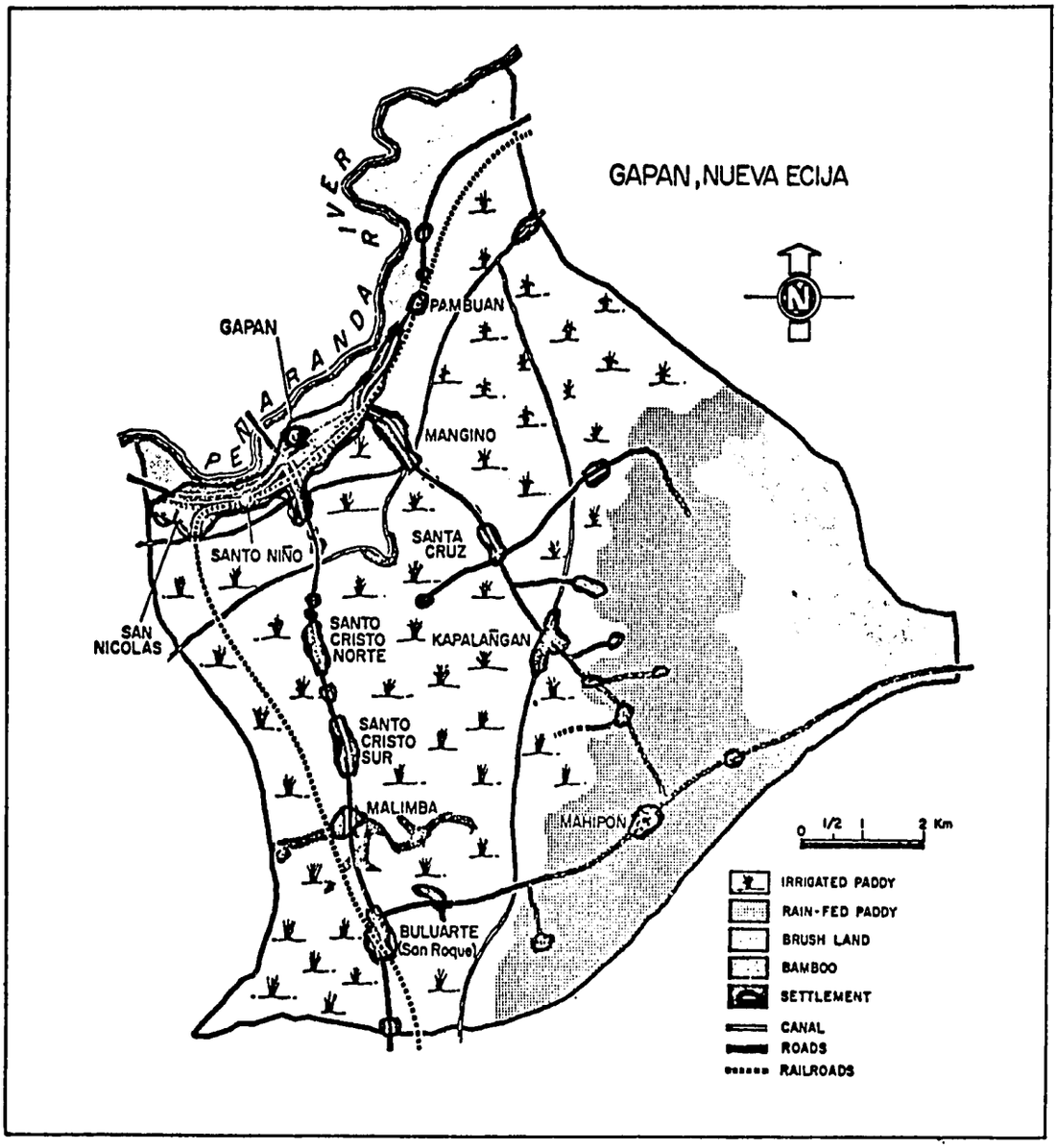


Fig. 13. Land use pattern, Gapan, Nueva Ecija, Philippines.

Source Figures 13 to 17:
The Annual Report of the International Rice Research Institute (IRRI) Los Banos, Philippines. 1969

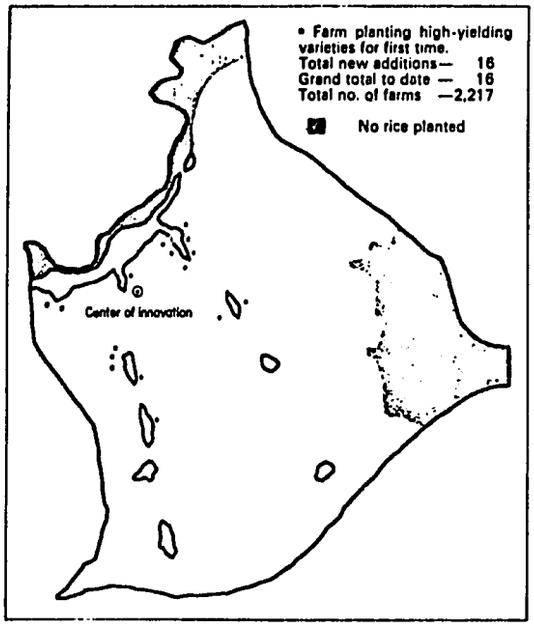


Fig. 14. Concentration of 16 original adopters of high-yielding varieties 1966.

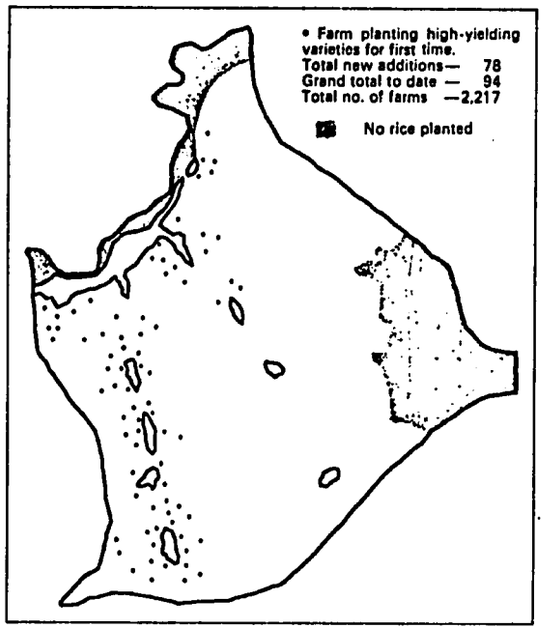


Fig. 15. Concentration of 78 new adopters of high-yielding varieties, 1967.

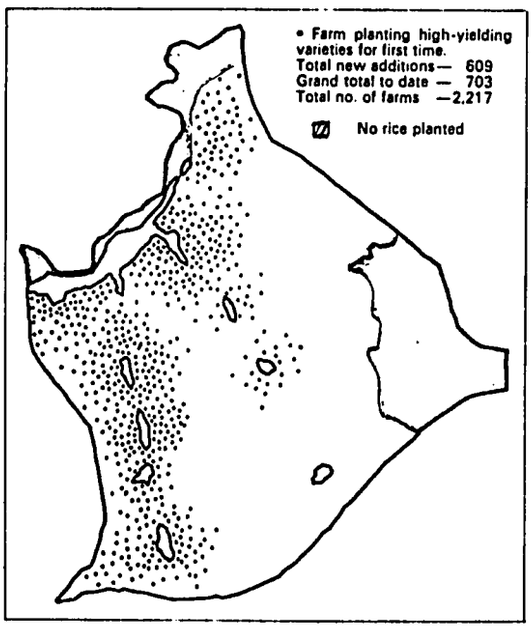


Fig. 16. Concentration of new adopters of high-yielding varieties, 1968.

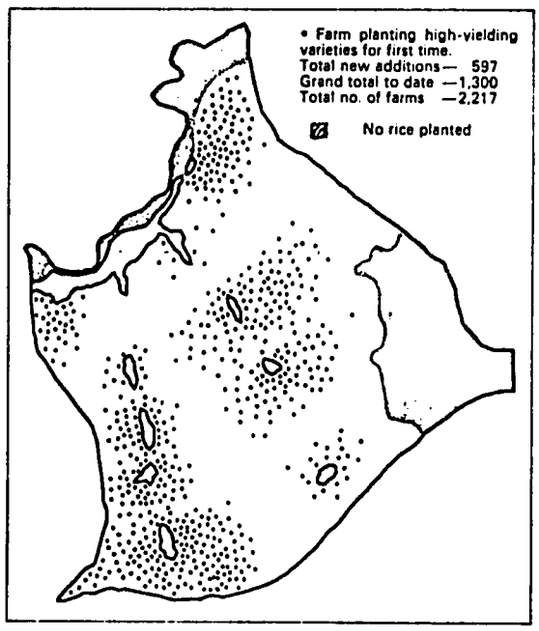


Fig. 17. Concentration of new adopters of high-yielding varieties, 1969.

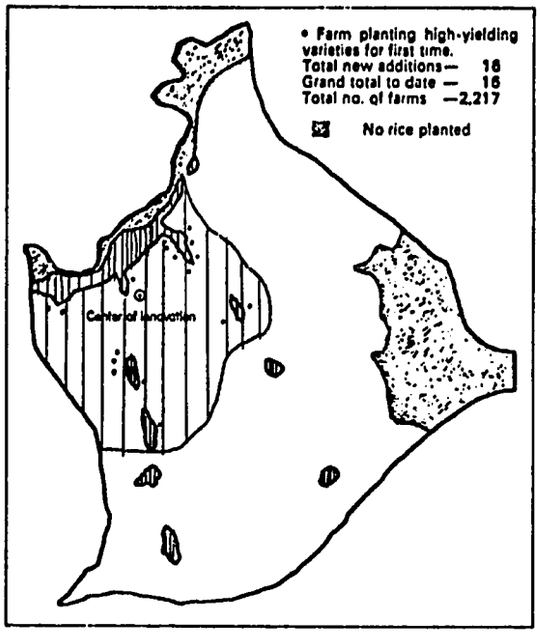


Fig. 14. Concentration of 16 original adopters of high-yielding varietie 1966.

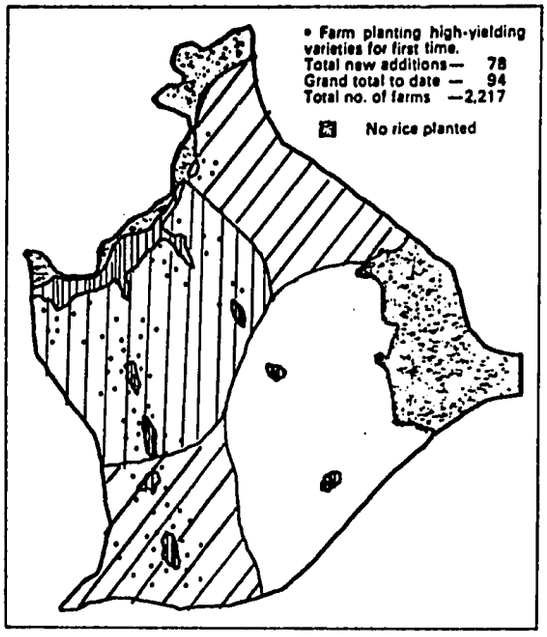


Fig. 15. Concentration of 78 new adopters of high-yielding varieties, 1967.

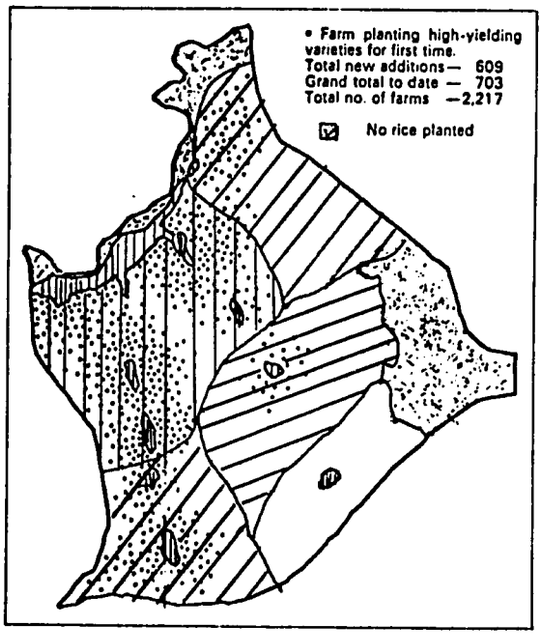


Fig. 16. Concentration of new adopters of high-yielding varieties, 1968.

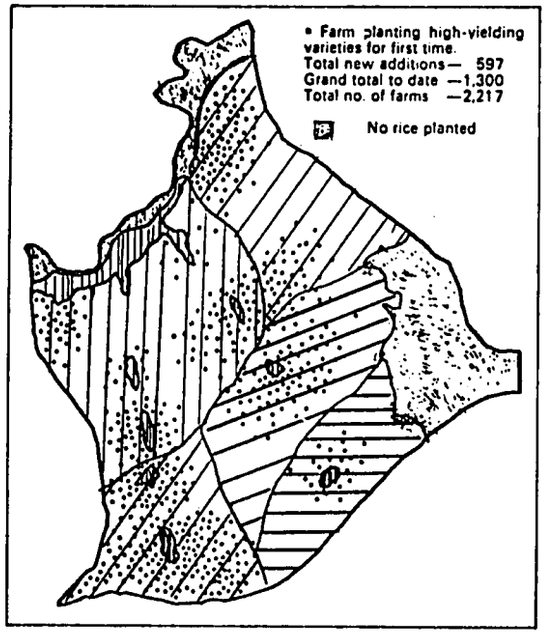


Fig. 17. Concentration of new adopters of high-yielding varieties, 1969.

Shadings added for this study.

spatial pattern, without of course repetition in details. One gets the impression that information and influences travel in a system of communication with a rather stable spatial configuration. The number of links between areas and places seem to remain very much the same over time even when the acting individuals change.

"A closer analysis shows that the spread along the initial 'frontier' is led through the urban hierarchy. The point of introduction in a new country is its primate city; sometimes some other metropolis. Then centers next in rank follow. Soon, however, this order is broken up and replaced by one where the neighborhood effect dominates over the pure size succession."*

One can readily see that this model abstracts from emperical data what structural theory hypothesizes should happen. Diffusion theory was further developed and refined by Morrill in 1970 who depicts diffusion as taking the form of an "innovation wave." The graphs of his model reproduced from his paper represent better than any narrative description the diffusion of new knowledge (which we feel is shown on Maps 5 and 16 and the maps from the Philippines) eminating from central villages into micro-regions.

We have presented the material from outside the Pa Mong Region as evidence supporting the central village function as an innovation node. We want to emphasize that central villages are highly important in sub-regional communication systems, functioning between the district market center, the relay point to the outside world in the region, and the majority of villages in the market areas. They act as communication centers for any new knowledge coming into micro-regions and as initiators in the construction of knowledge processing structure to obtain utility. To do this central villages must have a relative higher level of education and motivation in at least some of its people. Such people of course are mostly developing out of the local population. It may also be that they are attracted to central villages from the surrounding villages because they find there the better climate for their aspirations and the resources to implement them.

If we were able to achieve highly useful results with scalogram analysis from village survey data of only one year, then the NSO has a virtual gold mine of qualitative diffusion data. The village survey has been collected for at least the last five years. More importantly the village survey, with some slight alternations and expansion, could be made to yield many times over the qualitative information needed for a simple on-going but effective social inventory survey covering the whole country. Professor Young proposed in 1970 at the Seadag Rural Development Seminary that every country should and could have such a social accounting system.** The

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*Torsten Hagerstrand, "Aspects of the Spatial Structure of Social Communication and the Diffusion of Information", Regional Science Association Papers, XVI, Cracow Congress, 1965 pp. 28-29.

**F.W. Young: "A Research and Training Program on Social Indicators of Development", Cornell University Department of Rural Sociology, 1968 mimiographed.

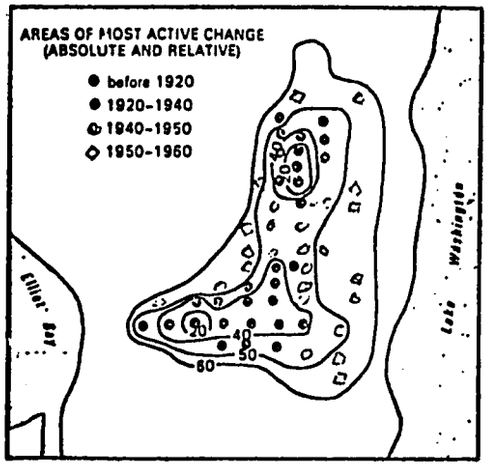

FIG. 1. Expansion of the Seattle black ghetto. Contours represent the time by which 25 percent saturation was reached for the years 1920, 1940, 1950, and 1960.

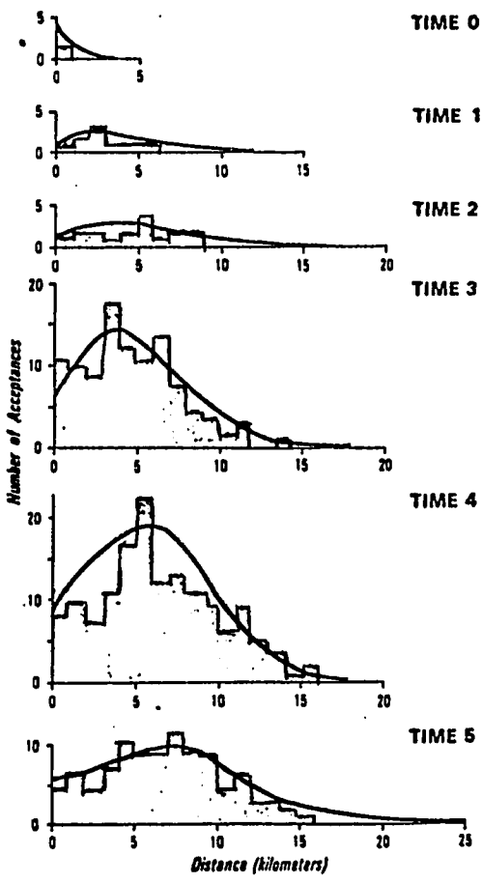

FIG. 6. Number of acceptances by distance for various time periods, pasture-grazing subsidy.

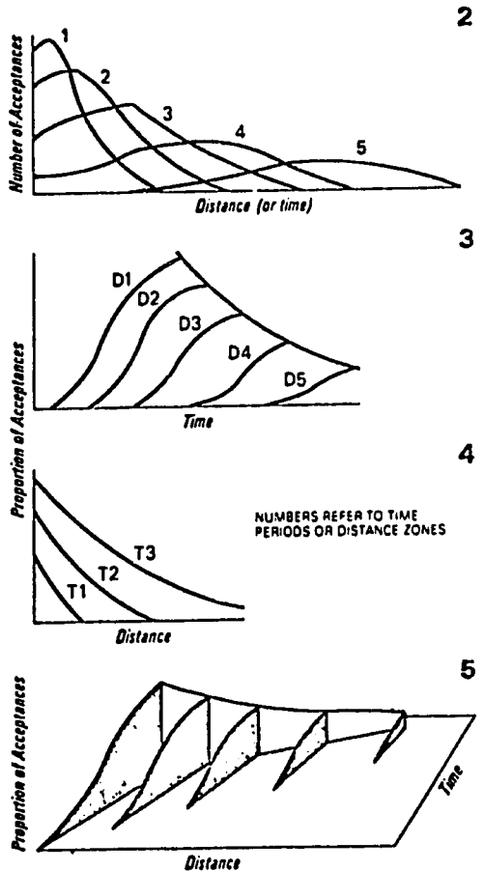

FIG. 2. Changing form of an innovation wave.

FIG. 3. Cumulative acceptance at different distances.

FIG. 4. Proportion of acceptance with distance from origin at different times (expanding points of innovation).

FIG. 5. Acceptance of an innovation in space and time.

From: Richard L. Morrill "The Shape of Diffusion in Space and Time"
Economic Geography pp. 260-261

Thai NSO system proves that the system is feasible and potentially already working for even very underdeveloped regions. Development and diffusion maps could be produced from the NSO village data available today covering at least those regions covered presently by the system. Combined with computer processing capabilities for scaling and contour mapping (see Appendixes C & E)micro-regional development maps could be produced for the whole country and kept updated; rural development trends could be monitored in almost 'real time' speed.

2. Agricultural Diversity in Micro-Regions: ARD 1968 Survey Data

The Accelerated Rural Development Program (ARD) made data from its 1968 village survey in Pa Mong districts available to this study. The data presented considerable difficulties in translation and coding because of lack of direct communication with the survey takers. The fact that the original questionnaire was not available made the explanation of some inconsistencies and problems difficult to correct. There are indications that the same questionnaire was used in all the districts on which we have data but that the survey was not applied the same way in every district. Some questions were not answered on a district wide basis. Answers to some open ended questions are very uniform, again on a district wide basis. What data we used had to be analyzed for each district separately. Still the data appear very spotty and quantitatively suspect; a problem which, though much reduced, remained even for scalogram analysis.

Nevertheless, we feel that the data contain some useful information on agricultural diversity and its distribution in micro-regions of the Pa Mong area, much more anyway then otherwise available. The agriculture of the region is of significant importance for relocation planning and basin development. Maps 6, 7 and 10 show the isopleth contours of the agricultural diversification scales for the sub-regions covered by the data. One important phenomenon can be identified at once: high points in the agricultural diversification contours are not perfectly matching the major central villages and towns. They especially shift away from those market towns and central villages which have substantial areas of good, flat paddy land.

There are two reasons which may explain this shift. First, the ARD-Agn. scales contain more data on crop diversification then on specialization and technological differentiation.* The forces for crop diversification are strongest where the land quality and/or market do not permit profitable specialization such as in rice or tobacco. The second reason is social structure. Diversification can only take place where the knowledge of, and markets for, diverse crops is available. These two factors meet most often outside, but near central towns or major central villages. Central places relay necessary information and inputs and also provide market channels to the outside. From the available data on the Pa Mong Sub-region it appears that high points of agricultural diversification will occur in the hilly footlands next to flat areas where towns or major villages are located.

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*Agriculture has this scaling peculiarity: crop diversification scales and technological differentiation do not always correlate closely geographically. Crop diversification is influenced by the factors mentioned here while technological differentiation will follow more closely the general development gradient as in the AP-scale.

These are areas were flat paddyland becomes less and less available and uplands have to be cultivated more intensively. This requires diversification into commercial upland crops such as corn, kenaf, cotton, or tobacco. The scales also show that in animal husbandry the raising of cattle is becoming important in the modernization of more remote, hilly regions.

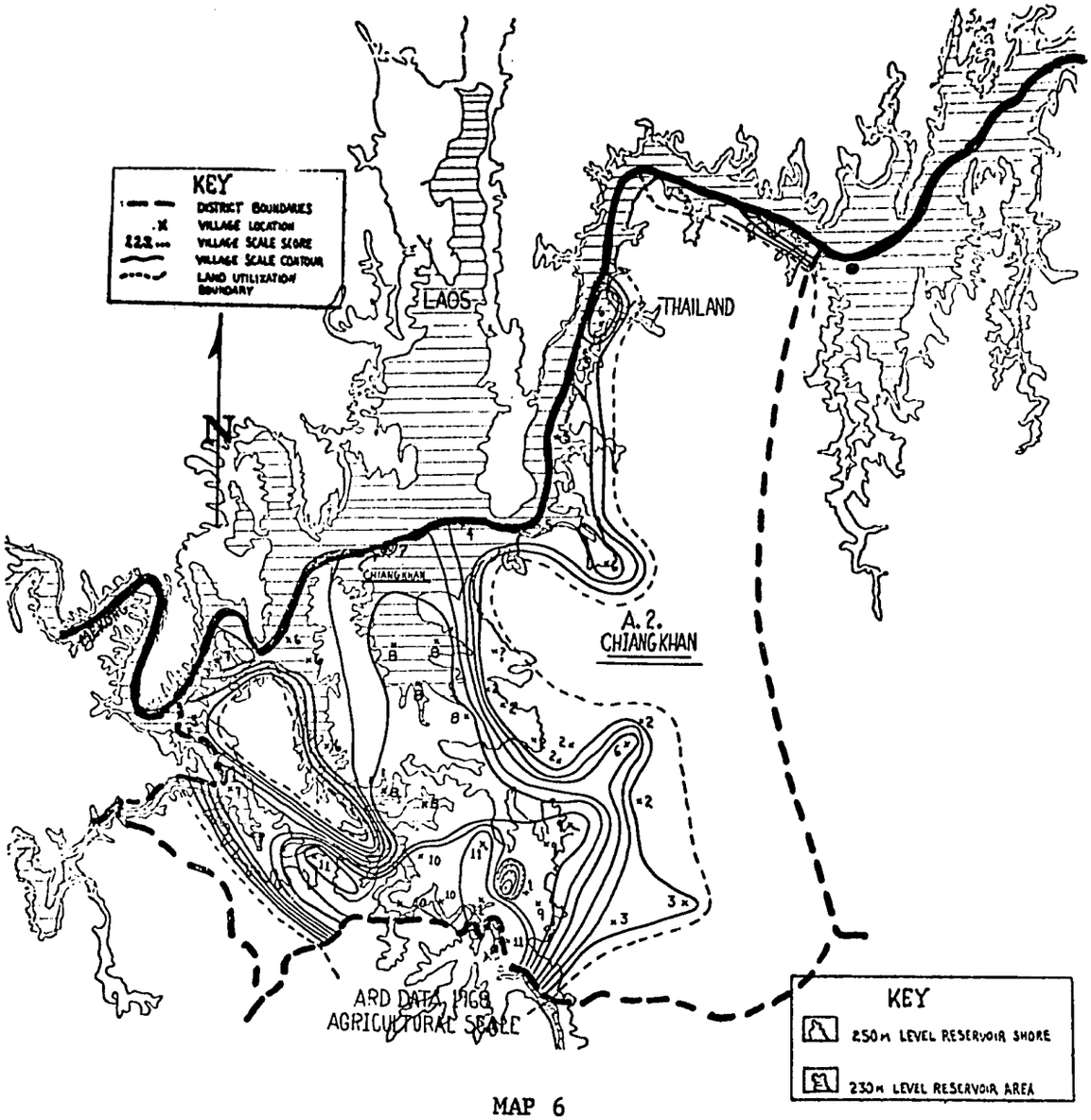
The ARD scales on agriculture must be taken as tentative. They are presented because so little detail is known on agricultural development in the Pa Mong Reservoir Sub-regions. They do contain more information on the structure of agriculture than either the AP or NSO scales which they do not contradict but complement. Further analysis can be done by combining the agricultural data from the three data sets into one scale. The ideal would be, however, to obtain better data from both aerial photography and somewhat expanded NSO village surveys.

3. The Structure of Expressed Needs in Micro-Regions: ARD 1968 Survey Data

The expressed needs of villages is socially structured new knowledge without access to utility producing structure. If new knowledge, as we have seen in the previous sections, flows down the development gradient (village hierarchy) of micro-regions after entering through central villages, then the high points or the greatest variety of such new knowledge expressed in needs should be in or near these innovation nodes. Many central villages which have already access to the processing structure of new knowledge will not express such needs but their neighboring villages will.

Expressed needs are more than simply new knowledge: they are also the beginnings of solidarity effort for it takes a certain amount of unity to express such needs for whole communities. The best questions to tap such community concensus on needs should be open ended with only a general subject lead is given. The 1968 ARD Survey contained three such questions, namely, what does a community need: (a) for work (b) for security and (c) for welfare. Responses to such open ended questions present a problem for scaling the information. Usually the answers are given on different aspects of a single problem. For instance, for work needs different villages mention new varieties, others new seeds, better seeds or new crops. All are related to improved plant varieties. Another group of specific aspects is related to extention teaching. Such needs are expressed as desire for training about new varieties or about new crops, for teaching on the use of fertilizer and insecticides or the need to control pests. Only once was the need for a government agent to do the training mentioned specifically. The second group of non-agricultural needs related primarily to facilities and services and more or better government attention and protection.

Because of the necessary refining and combining of need data, we were not able to process the non-agricultural data into presentable scales by the program. We had to complete the scales manually without typed outputs. Neither was there enough time to produce isopleth maps from these scales. We were able, however, to plot scores of the Need Scale on maps and check the high points to test the above hypothesis that their location should be near but outside central places.



MAP 6
Region 5 District 2 only: ARD Agricultural Data Scale
(for scale content see Item Statistics Table)

Scale 4

RD DATA, PROVINCE 2, DIST. 2, AGRICULTURE SCALE, 39 ITEMS, 44 CASES

LARGEST SCALE

RANK	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	RANK	ITEMS NAME	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P
CASES	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0								
	2	6	7	5	4	3	2	1	2	4	0	9	4	1	7	6	5	6	4	3	3	3	5	1	1	5	2	4	3	2	6	5	1	8	7	1	5	4	1	3	4	3	2	2	CASES							
	1	3	2	2	2	2	2	2	5	7	3	3	1	5	5	5	1	2	5	5	1	7	5	1	7	7	7	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3								
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39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	6750COCONUT PLANTATION	39	205	0	0	16	145
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	7270REAS.LOAN:HIRE HELP	38	200	0	0	16	145
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36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	3550JUTE CROP	36	189	0	0	16	145
35	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	35	3170NEED FOR WK:LIVEST FEEDS	35	184	0	0	16	145
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	5550ECONDA.INC:PEANUTS	34	179	0	0	16	145
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32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	2200KITCHEN GARDENS	32	168	0	0	16	145
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29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	29	4700FRUIT ORCHARD	29	153	0	0	16	145
28	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	5750CHILLY PEP.CROP	28	147	0	0	16	145
27	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	7260REAS.LOAN:TOOLS	27	142	0	0	16	145
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24	0	1	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	24	5560ECONDA.INC:SESAME	24	126	2	5	15	136
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22	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	22	5520ECONDA.INC:COTTON	22	116	4	9	13	118
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19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	9	9	9	9	0	0	0	0	0	0	0	1	1	1	1	19	4450NEED FOR WF:FORES CONSERV	19	100	4	9	11	100
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	18	5580ECONDA.INC:GALANGA SPICE	18	95	8	18	10	91
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14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	1	1	14	5410SECONDA.INC:FARMING	14	74	28	64	6	55
13	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	13	5540ECONDA.INC:GLUT.RICE	13	68	31	70	5	45
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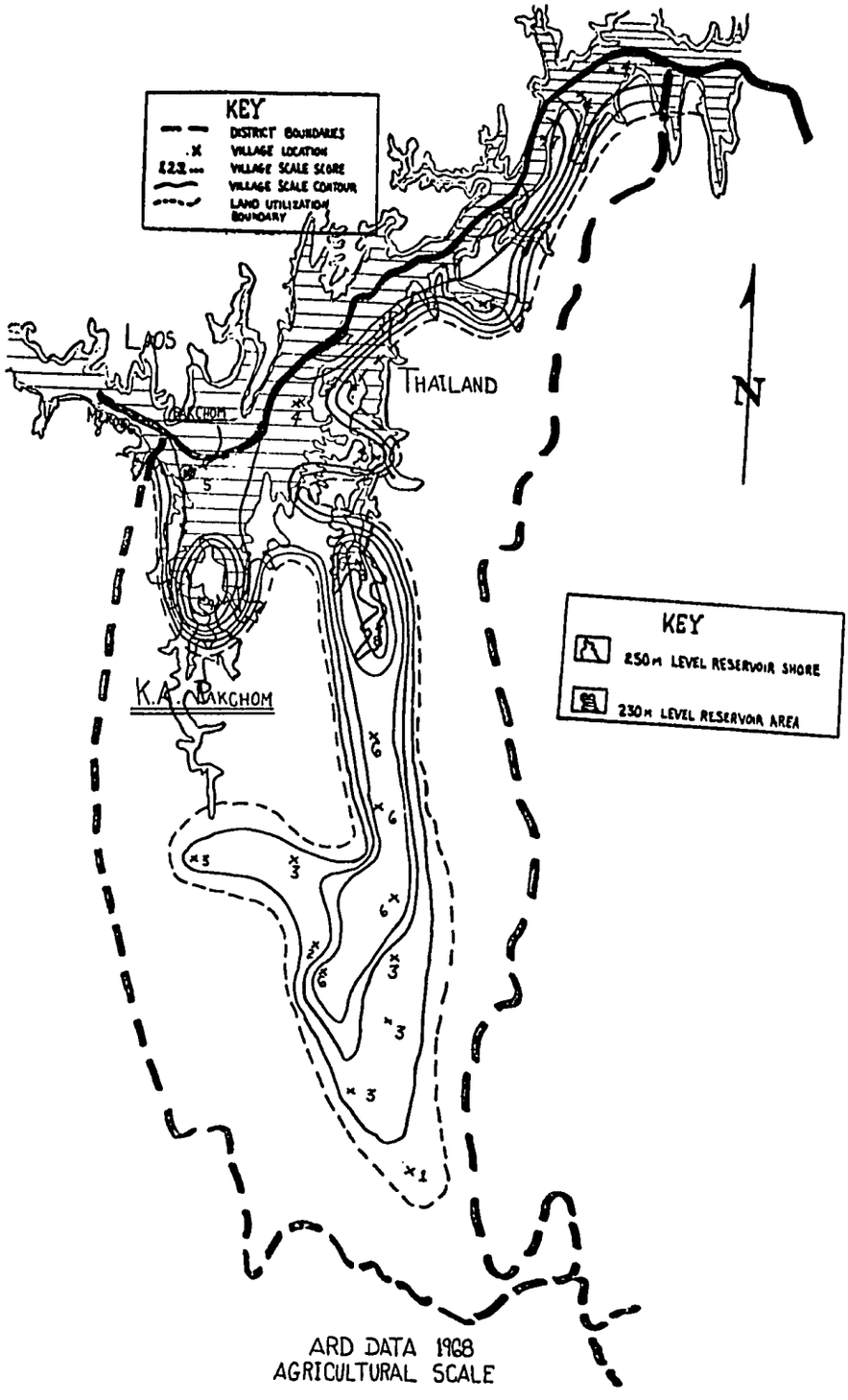
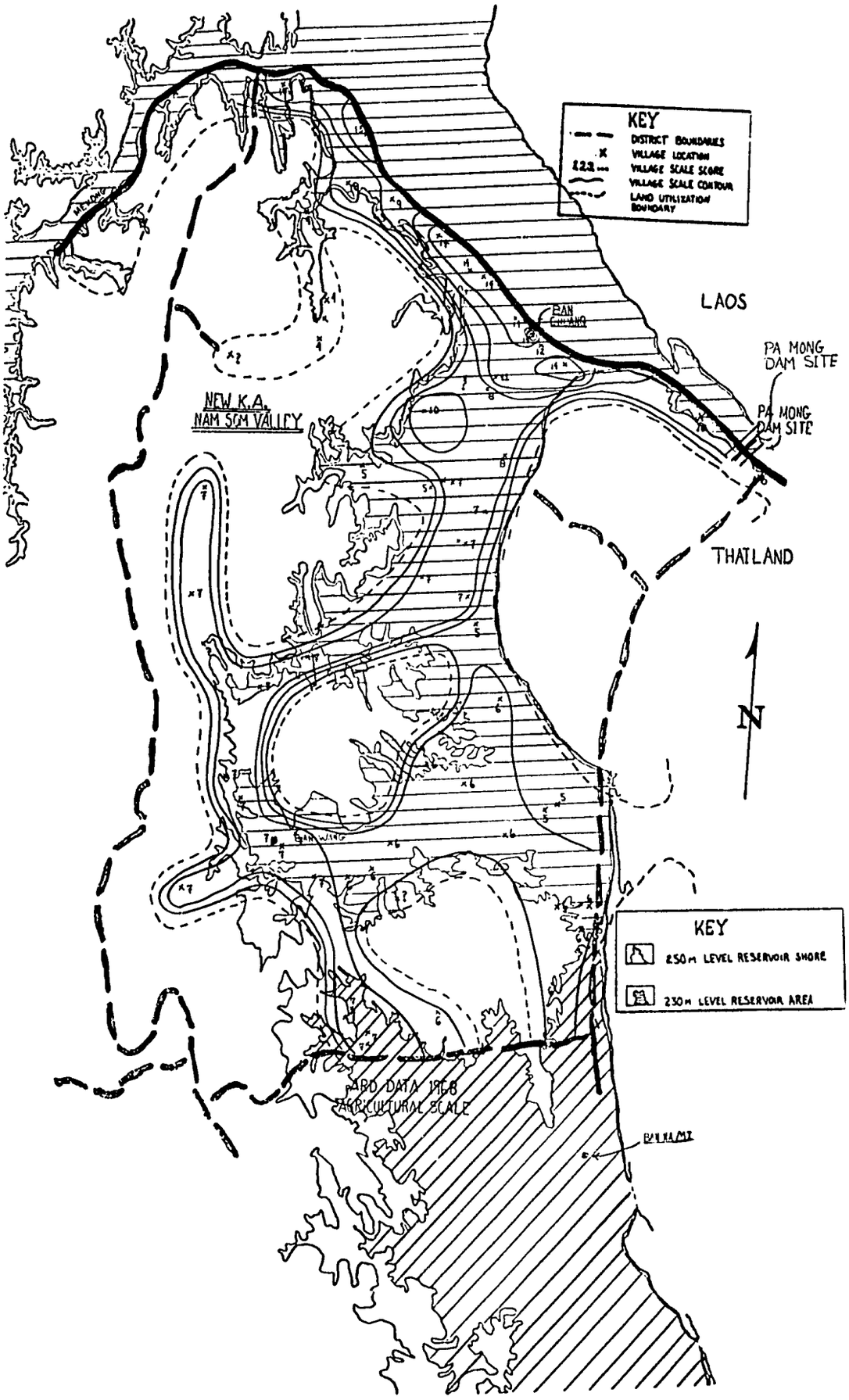
9	0	0	1	1	1	1	1	1	0	1	1	1	0	0	1	1	0	1	0	0	1	1	1	0	0	0	1	9	9	9	9	9	9	1	1	1	1	1	1	1	1	1	1	1	9	3160NEED FOR WK:IMPR.AN.BREED	9	47	42	95	2	18
8	0	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	0	9	9	9	9	9	9	1	1	1	1	1	1	1	1	1	1	1	8	3120NEED FOR WK:IMPRV.VARIET.	8	42	42	95	2	18
7	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	0	1	1	1	1	1	9	9	9	9	9	9	1	1	0	0	0	0	0	0	0	0	0	7	3110NEED FOR WK:IRRIG.WATER	7	37	44	100	1	9
6	9	9	1	1	1	1	1	1	1	0	1	1	9	1	1	1	9	1	1	1	9	1	1	1	0	0	1	1	9	9	1	1	1	1	1	1	9	9	9	1	9	1	9	9	6	2300PASTURE	6	32	44	100	1	9
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	5	2400UNCULTIVATED LAND	5	26	44	100	1	9
4	1	9	1	1	1	1	1	1	1	1	9	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	9	9	9	9	9	9	9	9	9	9	9	4	2650VILLAGERS IN DEBT	4	21	44	100	1	9
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	4550COTTON CROP	3	16	44	100	1	9
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	5200WAT.BUFFALO	2	11	44	100	1	9
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5150COWS	1	5	44	100	1	9
RANK	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	RANK	ITEMS						
....	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	....ID							
	2	6	7	5	4	3	2	1	2	4	0	9	4	1	7	6	5	6	4	3	3	3	5	1	1	5	2	4	3	2	6	5	1	8	7	1	5	4	1	3	4	3	2	2								
CASES	1	3	2	2	2	2	2	2	5	7	3	3	1	5	5	5	1	2	5	5	1	7	5	1	7	7	7	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	CASES							
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2								



MAP 7

Region 6: ARD Agricultural Data Scale Contours.
(for scale content see Item Statistics Table)



MAP 10
Region 7: ARD Agricultural Data Scale Contours
(for scale content see Item Statistics Table)

Table 10a

LARGEST SCALE

DOOR AREA IN ARES, PROV. IN AND 3, AGRICULTURE SCALE.

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQUENCIES ONES P	FREQUENCIES ZEROS N	FREQUENCIES ZEROS P	FREQUENCIES NINES N	FREQUENCIES NINES P	DEVIATIONS ONES N	DEVIATIONS ONES P	DEVIATIONS ZEROS N	DEVIATIONS ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
PEANUT CROP	68	3700	56	400	0	0	16	145	0	159	58	694	0	158	01075		0	287	0	424	0	0	100	0
WATERMEL.CROP	68	4600	55	393	0	0	16	145	0	159	58	678	0	158	01075		0	287	0	424	0	0	100	0
FRUIT ORCHARD	68	4700	54	386	0	0	16	145	0	159	58	662	0	158	01075		0	287	0	424	0	0	100	0
NEED FOR WK:LAND-LAND-SRV	68	3180	53	379	0	0	16	145	0	159	58	646	0	158	01075		0	287	0	424	0	0	100	0
PRIMARY INC:COTTON	68	5330	52	371	0	0	16	145	0	159	58	631	0	158	01075		0	287	0	424	0	0	100	0
SECONDA.INC:TRADING	68	5370	51	364	0	0	16	145	0	159	58	615	0	158	01075		0	287	0	424	0	0	100	0
SECONDA.INC:FARMING	68	5410	50	357	0	0	16	145	0	159	58	599	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:CASAVA	68	5450	49	350	0	0	16	145	0	159	58	583	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:DORT DIGGING	68	5470	48	343	0	0	16	145	0	159	58	567	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:LIVESTOCK	68	5480	47	336	0	0	16	145	0	159	58	551	0	158	01075		0	287	0	424	0	0	100	0
RENTED LAND	68	2550	46	329	0	0	16	145	0	159	58	536	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:FRUITS	68	5530	45	321	0	0	16	145	0	159	58	520	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:SESAME	68	5560	44	314	0	0	16	145	0	159	58	504	0	158	01075		0	287	0	424	0	0	100	0
ECONDA.INC:GALANGA SPICE	68	5580	43	307	0	0	16	145	0	159	58	488	0	158	01075		0	287	0	424	0	0	100	0
SECONDA.INC:WATER MELON	0	5600	42	300	0	0	16	145	0	159	58	472	0	158	01075		0	287	0	424	0	0	100	0
SESAME CROP	0	5700	41	293	0	0	16	145	0	159	58	456	0	158	01075		0	287	0	424	0	0	100	0
REAS.LOAN:TOBACCO	68	7170	40	286	0	0	16	145	0	159	58	440	0	158	01075		0	287	0	424	0	0	100	0
REAS.LOAN:PUMP	68	7290	39	279	0	0	16	145	0	159	58	425	0	158	01075		0	287	0	424	0	0	100	0
REAS.LOAN:WAT.BUFFALO	68	7300	38	271	0	0	16	145	0	159	58	409	0	158	01075		0	287	0	424	0	0	100	0
REAS.LOAN:DIKING	68	7310	37	264	0	0	16	145	0	159	58	393	0	158	01075		0	287	0	424	0	0	100	0
NEED FOR WK:MARKET	68	3200	36	257	0	0	16	145	1	159	57	377	0	158	11075		0	287	1	424	1	1	0	26
NEED FOR WK:IMPR.AN.BREED	68	3160	35	250	0	0	16	145	1	159	57	361	0	158	11063		0	287	1	422	1	1	0	49
SECONDA.INC:SUGAR CANE	0	5610	34	243	0	0	16	145	1	159	57	346	0	158	11050		0	287	1	420	1	1	0	81
SECONDA.INC:CHICKEN	0	5630	33	236	0	0	16	145	1	158	57	330	0	158	11038		0	287	1	417	1	1	0	58
SECONDA.INC:EGGPLANT	0	5640	32	229	0	0	16	145	1	168	57	315	0	158	11025		0	287	1	415	1	1	0	68
ECONDA.INC:COCONUT	68	5440	31	221	0	0	16	145	2	158	56	299	0	158	21013		0	287	2	413	2	1	0	97
SUGAR CANE	68	2250	30	214	0	0	16	145	2	157	32	284	24	158	2 988		0	287	2	409	2	1	0	54
NEED FOR WK:LIVEST FEEDS	68	3170	29	207	0	0	16	145	3	156	55	275	0	135	3 963		0	287	3	404	3	2	0	89
ECONDA.INC:FOREST PRODUCT	68	5460	28	200	0	0	16	145	3	156	55	260	0	135	3 925		0	287	3	398	3	2	0	47
NEED FOR WK:PRICE SUPPORT	68	3130	27	193	0	0	16	145	4	155	54	245	0	135	4 888		0	287	4	391	4	3	0	77
NEED FOR WK:EXTENSION SRV	68	3140	26	186	0	0	16	145	5	154	53	230	0	135	5 838		0	287	5	383	5	4	0	35
CUCUMBER CROP	68	3650	25	179	0	0	16	145	6	152	52	216	0	135	6 775		0	287	6	372	6	4	0	53
CHICKEN	68	5250	24	171	0	0	16	145	6	150	52	202	0	135	6 700		0	287	6	359	6	4	0	51
PIGS	68	5270	23	164	0	0	16	145	6	149	52	187	0	135	6 625		0	287	6	346	6	4	0	51
DUCKS	68	5300	22	157	0	0	16	145	6	147	52	173	0	135	6 550		0	287	6	333	6	4	0	51
SECONDA.INC:CUCUMBERS	0	5620	21	150	0	0	16	145	6	145	52	159	0	135	6 475		0	287	6	320	6	4	0	61
CORN CROP	68	3600	20	143	0	0	16	145	12	143	46	145	0	135	12 400		0	287	12	307	12	9	0	61
PASTURE	68	2300	19	136	2	3	15	136	5	140	16	132	37	135	3 250		0	287	3	280	5	4	40	10
PRIMARY INC:GENERAL FARM.	68	5320	18	129	27	47	14	127	22	138	36	128	0	100	7 213		12	287	19	274	22	16	14	40
PRIMARY INC:GLUTIN.RICE	68	5310	17	121	49	84	13	118	36	132	22	118	0	100	2 125		15	255	17	233	22	16	23	45
JUTE CROP	68	3550	16	114	58	100	12	109	35	121	23	112	0	100	0 100		23	216	23	196	23	17	0	85
SECONDA.INC:JUTE	68	5400	15	107	58	100	12	109	37	111	21	106	0	100	0 100		21	155	21	146	21	15	0	89
.....																								
SECONDA.INC:BANANA	68	5430	14	100	6	10	11	100	7	100	51	100	0	100	1 100		0	100	1	100	7	5	86	2
BANANA CROP	68	3750	13	93	7	12	10	91	8	98	50	86	0	100	2 88		1	100	3	98	8	6	62	3
ECONDA.INC:FISHING	68	5490	12	86	9	16	9	82	9	96	49	72	0	100	1 63		1	97	2	91	9	7	78	1
NEED FOR WK:IRRIG.WATER	68	3110	11	79	10	17	8	73	12	93	46	59	0	100	4 50		2	95	6	87	12	9	50	18
SECONDA.INC:VEGETABLES	68	5390	10	71	13	22	7	64	12	89	46	46	0	100	0 0		1	89	1	74	12	9	92	1
KITCHEN GARDENS	68	2200	9	64	14	24	6	55	14	86	20	34	24	100	0 0		0	87	0	72	14	10	100	0
SECONDA.INC:TABACCO	68	5360	8	57	17	29	5	45	17	82	41	28	0	77	0 0		0	87	0	72	17	12	100	0
TOBACCO	68	2150	7	50	37	64	4	36	15	77	19	17	24	77	0 0		2	87	2	72	15	11	87	7
NEED FOR WK:TRACTOR	68	3190	6	43	49	84	3	27	35	72	23	12	0	55	0 0		14	82	14	67	23	17	39	54
NEED FOR WK:IMPRV.VARIET.	68	3120	5	36	54	93	2	18	37	62	21	6	0	55	0 0		17	45	17	37	21	15	19	63
UNCULTIVATED LAND	68	2400	4	29	58	100	1	9	58	51	0	0	0	55	0 0		0	0	0	0	0	0	100	0
WAT.BUFFALO	68	5200	3	21	58	100	1	9	58	34	0	0	0	55	0 0		0	0	0	0	0	0	100	0
COCONUT PLANTATION	0	6750	2	14	58	100	1	9	58	17	0	0	0	55	0 0		0	0	0	0	0	0	100	0
PADDY RICE B	68	2450	1	7	58	100	1	9	0	0	0	0	58	55	0 0		0	0	0	0	0	0	100	0

Table 10b

99A ARD DATA, AGRI, SCALE, PROV. 1, DT.3, DT.7, SUB 1,2,4,6. (21X1094)

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	FREQ ONES P	FREQ ZEROS N	FREQ ZEROS P	FREQ NINES N	FREQ NINES P	DEVIATIONS ONES N	DEV ONES P	DEV ZEROS N	DEV ZEROS P	TOTAL N	TOTAL P	NON MODAL N	NON MODAL P	SCAL ABIL ITY	DIS PER SION
CUCUMBER CROP	68	3650	51	243	0	0	20	118	0	113	104	520	0	116	0	242	0	138	0	179	0	0	100	0
NEED FOR AK:PRODUC.LOANS	68	3220	50	238	0	0	20	118	0	113	104	505	0	116	0	242	0	138	0	179	0	0	100	0
PRIMARY INC:GENERAL FARM.	68	5320	49	233	0	0	20	118	0	113	104	490	0	116	0	242	0	138	0	179	0	0	100	0
SECONDA.INC:FARMING	68	5410	48	229	0	0	20	118	0	113	104	475	0	116	0	242	0	138	0	179	0	0	100	0
ECONDA.INC:FISHING	68	5490	47	224	0	0	20	118	0	113	104	460	0	116	0	242	0	138	0	179	0	0	100	0
OTHER LAND HOLDING	68	2600	46	219	0	0	20	118	0	113	95	445	9	116	0	242	0	138	0	179	0	0	100	0
REAS.LOAN:TOOLS	68	7260	45	214	0	0	20	118	0	113	104	432	0	110	0	242	0	138	0	179	0	0	100	0
REAS.LOAN:SICK LIVESTK.	68	7240	44	210	0	0	20	118	1	113	103	417	0	110	1	242	0	138	1	179	1	0	0	50
ECONDA.INC:CASAVA	68	5450	43	205	0	0	20	118	1	112	103	402	0	110	1	241	0	138	1	178	1	0	0	93
ECONDA.INC:FOREST PRODUCT	68	5460	42	200	0	0	20	118	1	112	103	387	0	110	1	240	0	138	1	178	1	0	0	100
ECONDA.INC:OBRT DIGGING	68	5470	41	195	0	0	20	118	1	112	103	372	0	110	1	239	0	138	1	177	1	0	0	96
REAS.LOAN:BUY RICE	68	7250	40	190	0	0	20	118	1	112	103	358	0	110	1	237	0	138	1	177	1	0	0	50
NEED FOR AK:IRRADIC.RATS	68	3210	39	186	0	0	20	118	2	112	102	343	0	110	2	236	0	138	2	176	2	0	0	97
NEED FOR AK:MARKET	68	3200	38	181	0	0	20	118	2	112	102	328	0	110	2	233	0	138	2	175	2	0	0	92
SECONDA.INC:TRADING	68	5370	37	176	0	0	20	118	2	112	102	314	0	110	2	230	0	138	2	174	2	0	0	84
NEED FOR AK:LIVEST FEEDS	68	3170	36	171	0	0	20	118	2	112	102	299	0	110	2	227	0	138	2	173	2	0	0	71
ECONDA.INC:LIVESTOCK	68	5480	35	167	0	0	20	118	2	112	102	284	0	110	2	225	0	138	2	172	2	0	0	93
NEED FOR AK:IMPR.AN.BREED	68	3140	34	162	0	0	20	118	2	111	102	270	0	110	2	222	0	138	2	171	2	0	0	63
SECONDA.INC:DAY LABOR	68	5300	33	157	0	0	20	118	3	111	101	255	0	110	3	219	0	138	3	170	3	1	0	85
COCONUT PLANTATION	68	6750	32	152	0	0	20	118	3	111	101	241	0	110	3	215	0	138	3	168	3	1	0	86
NEED FOR AK:LAND-LAND-SRV	68	3100	31	148	0	0	20	118	4	111	100	226	0	110	4	211	0	138	4	166	4	1	0	71
REAS.LOAN:JUTE	68	7230	30	143	0	0	20	118	4	111	100	212	0	110	4	205	0	138	4	164	4	1	0	50
SECONDA.INC:BANANA	68	5430	29	138	0	0	20	118	5	110	99	198	0	110	5	200	0	138	5	162	5	1	0	96
ECONDA.INC:COCONUT	68	5440	28	133	0	0	20	118	7	110	97	183	0	110	7	193	0	138	7	159	7	1	0	88
BANANA CROP	68	3750	27	129	0	0	20	118	8	109	96	169	0	110	8	184	0	138	8	156	8	2	0	87
REAS.LOAN:TOBACCO	68	7170	26	124	1	1	19	112	4	109	100	156	0	110	3	173	0	138	3	151	4	1	25	56
NEED FOR AK:EXTENSION SRV	68	3140	25	119	1	1	19	112	11	108	93	141	0	110	10	168	0	138	10	150	11	2	9	65
SUGAR CANE	68	2250	24	114	1	1	19	112	14	108	78	128	12	110	13	155	0	138	13	144	14	3	7	42
NEED FOR AK:TRACTOR	68	3190	23	110	1	1	19	112	28	107	76	117	0	101	27	137	0	138	27	137	28	6	4	52
UNCULTIVATED LAND	68	2400	22	105	104	100	18	106	60	104	42	106	2	101	0	100	42	138	42	123	42	9	0	76
REAS.LOAN:COTTON	68	7220	21	100	1	1	17	100	1	100	103	100	0	100	0	100	0	100	0	100	1	0	100	0
RENTED LAND	68	2550	20	95	17	16	16	94	35	100	69	85	0	100	18	100	0	100	18	100	35	7	49	28
REAS.LOAN:CROPS	68	7210	19	90	31	30	15	88	41	97	63	75	0	100	14	75	4	100	18	90	41	9	56	16
CORN CROP	68	3600	18	86	36	35	14	82	46	94	58	66	0	100	13	56	3	76	16	81	46	10	65	15
SECONDA.INC:JUTE	68	5400	17	81	47	45	13	76	42	91	42	58	0	100	3	38	8	94	11	72	42	9	74	9
NEED FOR AK:IMPRV.VARIET.	68	3120	16	76	49	47	12	71	47	88	57	49	0	100	6	34	8	87	14	66	47	10	70	11
PIGS	68	5270	15	71	54	52	11	65	53	84	51	41	0	100	0	26	1	79	1	58	51	11	98	1
PASTURE	68	2300	14	67	61	59	10	59	7	80	32	34	65	100	6	26	0	79	6	58	7	1	14	24
SECONDA.INC:VEGETABLES	68	5390	13	62	68	65	9	53	71	80	33	29	0	56	9	18	6	79	15	55	33	7	55	15
DUCKS	68	5300	12	57	81	78	8	47	78	74	26	24	0	56	1	5	4	73	5	46	26	5	81	3
NEED FOR AK:CROP SUPPLIES	68	3150	11	52	83	80	7	41	79	69	25	21	0	56	0	4	4	70	4	44	25	5	84	4
NEED FOR AK:PRICE SUPPORT	68	3130	10	48	88	85	6	35	83	63	21	17	0	56	1	4	6	66	7	42	21	4	67	10
TOBACCO	68	2150	9	43	90	87	5	29	85	56	19	14	0	56	0	3	5	61	5	38	19	4	74	9
CHICKEN	68	5250	8	38	95	91	4	24	92	50	12	11	0	56	2	3	5	56	7	35	12	3	42	6
KITCHEN GARDENS	68	2200	7	33	99	95	3	18	95	43	9	10	0	56	0	0	4	52	4	31	9	2	56	5
NEED FOR AK:IRRIG.WATER	68	3110	6	29	100	96	2	12	97	36	7	8	0	56	0	0	3	48	3	29	7	1	57	9
REAS.LOAN:FARMING	68	7160	5	24	104	100	1	6	66	29	38	7	0	56	0	0	38	46	38	28	38	8	0	60
PADDY RICE B	68	2460	4	19	104	100	1	6	61	24	13	2	30	56	0	0	13	12	13	7	13	3	0	64
VILLAGERS IN DEBT	68	2650	3	14	104	100	1	6	52	19	0	0	52	35	0	0	0	0	0	0	0	0	100	0
WAT.BUFFALO	68	5200	2	10	104	100	1	6	104	16	0	0	0	0	0	0	0	0	0	0	0	0	100	0
PRIMARY INC:GLUTIN.RICE	68	5310	1	5	104	100	1	6	104	8	0	0	0	0	0	0	0	0	0	0	0	0	100	0

499A ARD DATA, AGRI, SCALE, PROV. 1, DT.3, DT.7, SUB 1,2,4,6. LARGEST SCALE

Invariable high points of the need scales are the neighboring villages of central villages. Often these high points of needs match the high points of the agricultural differentiation scales described in the previous section. But not all agriculturally highly differentiated villages have also high scores on the agricultural need scales.

As theorically expected, central villages do not scale high in these need scales; but several non-scaling needs which were expressed such as needs for a market or electricity should have and did come only from central villages. Of the five markets desired, four were identified to have come from central villages. The other from a village where the name and location had to be estimated and the chance is high that it is misplaced. The need for electricity was expressed by two villages which are adjacent to Chiang Khan where electricity is already available.

The content of the agricultural need scales is presented in the items statistics tables 11a and b and scale 5. The most often mentioned items are irrigation water, crop supplies, improved varieties and tractors. The extent to which these needs are recognized in nearly all villages in the sub-regions in the Pa Mong area is surprising. It shows to what extent a real potential exist for modernizing the agriculture in the region. Whether this potential will be realized or not will largely depend on whether the marketing structure and transportation, i.e., the institutional distribution system for inputs and outputs of agricultural production can be constructed or not. The vigorous road building program by the ARD program certainly appears to be a big step in the right direction.

The non-agricultural needs scales are equally enlightening and also more interesting. The most universally felt needs are for improved government attention and protection. The second most felt need is for improved health services. Other needs expressed are for facilities for drinking water such as wells or water works and better roads or streets. One specific need aspect expressed for the first most important need category, government attention and protection, is particularly important to be mentioned: better government performance. Needs were expressed most generally as, "the need for officials," but some were more pointed in expressing a need for "more humble officials or better informed officials, or for a district inspector, or for 'on guard' officials". The last group of specific needs concerns security needs which most often were expressed as either the need for police, or arms, milita volunteers, attention to communist or communist control, government explanations about communists, or sometimes simply bandit control."

The security need expressions are particularly important in that they indicate the following potential problems that could arise during the development of the Pa Mong project: relocation justice; the formulation of preparatory policies and the actions to be taken before the relocation project can begin. The expressed needs signify both an opportunity and a danger to the concerned governments. At least those people in each village which answered the ARD survey and expressed these needs appear to be on the side of the governments and are willing to contribute their own effort and cooperation in solving security problems. These people also appear to be expecting a government capability to improve its own performance both through the action of its officials as well as by providing arms and personnel for better self protection.

Table 11a

080N ARD DATA, AGRICULTURE SCALE, PROVINCE 2, DT. 2 NEED SCALE.

ITEM STATISTICS

NAME	ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	NINES N	NINES P
NEED FOR WK:LAND-LAND-SRV 68	3180	12	240	0	0	6	120	0	102	38	487	0	0
NEED FOR WK:PRICE SUPPORT 68	3130	11	220	0	0	6	120	0	102	38	431	0	0
NEED FOR WK:IRRADIC.RATS 68	3210	10	200	0	0	6	120	0	102	38	375	0	0
NEED FOR WK:PRODUC.LOANS 68	3220	9	180	0	0	6	120	0	102	38	319	0	0
NEED FOR WK:EDUCAT.LOANS 68	3230	8	160	0	0	6	120	0	102	38	263	0	0
NEED FOR WK:LIVEST FEEDS 68	3170	7	140	0	0	6	120	1	102	37	207	0	0
NEED FOR WK:MARKET 68	3200	6	120	0	0	6	120	2	102	36	153	0	0
.....													
NEED FOR WK:TRACTOR 68	3190	5	100	12	32	5	100	14	100	24	100	0	0
NEED FOR WK:CROP SUPPLIES 68	3150	4	80	24	63	4	80	26	89	12	65	0	0
NEED FOR WK:IMPR.AN.BREED 68	3160	3	60	29	76	3	60	27	67	11	47	0	0
NEED FOR WK:IMPRV.VARIET. 68	3120	2	40	33	87	2	40	31	45	7	31	0	0
NEED FOR WK:IRRIG.WATER 68	3110	1	20	37	97	1	20	24	20	14	21	0	0

Table 11b

0060 ARD DATA PROVINCE 1, AGRICULTURE SCALE, NEEDS. 12 ITEMS

ITEM STATISTICS

NAME		ID	RANK N	RANK P	SCALE SCORE N	SCALE SCORE P	SCALE STEP N	SCALE STEP P	FREQUENCIES ONES N	ONES P	ZEROS N	ZEROS P	NINES N	NINES P
NEED FOR WK:PRODUC.LOANS	68	3220	12	200	0	0	7	117	0	103	102	313	0	0
NEED FOR WK:EDUCAT.LOANS	68	3230	11	183	0	0	7	117	0	103	102	277	0	0
NEED FOR WK:LIVEST FEEDS	68	3170	10	167	0	0	7	117	2	103	100	241	0	0
NEED FOR WK:MARKET	68	3200	9	150	0	0	7	117	2	102	100	206	0	0
NEED FOR WK:IRRADIC.RATS	68	3210	8	133	0	0	7	117	2	102	100	170	0	0
NEED FOR WK:LAND-LAND-SRV	68	3180	7	117	0	0	7	117	4	101	98	135	0	0
.....														
NEED FOR WK:IMPR.AN.BREED	68	3160	6	100	1	1	6	100	2	100	100	100	0	0
NEED FOR TRACTOR	68	3190	5	83	25	25	5	83	28	99	74	65	0	0
NEED FOR WK:IMPRV.VARIET.	68	3120	4	67	53	52	4	67	47	91	55	38	0	0
NEED FOR WK:CROP SUPPLIES	68	3150	3	50	76	75	3	50	77	77	25	19	0	0
NEED FOR WK:PRICE SUPPORT	68	3130	2	33	85	83	2	33	81	53	21	10	0	0
NEED FOR WK:IRRIG.WATER	68	3110	1	17	96	94	1	17	95	29	7	2	0	0

Scale 5

DOS ARD DATA, AGRICULTURE NEED SCALE, PROVINCE 2, DT. 7

LARGEST SCALE

ITEMS	RANK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	NAME	
	CASES ID	137	137	157	147	137	937	837	737	637	727	527	427	327	227	137	117	437	337	237	627	617	117	537	127	CASES ID	
3170	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:LIVEST FEEDS	68
3180	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:LAND-LAND-SRV	68
3130	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:PRICE SUPPORT	68
3200	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:MARKET	68
3210	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:IRRADIC.RATS	68
3220	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:PRODUC.LOANS	68
3230	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	NEED FOR WK:EDUCAT.LOANS	68
3190	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	NEED FOR WK:TRACTOR	68
3110	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	NEED FOR WK:IRRIG.WATER	68
3160	3	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	NEED FOR WK:IMPR.AN.BREED	68
3120	2	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	NEED FOR WK:IMPRV.VARIET.	68
3150	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	NEED FOR WK:CROP SUPPLIES	68

The danger presented by this information is this: if this initial degree of cooperative solidarity is disappointed and instead is given fuel in the form of social injustice it will have little difficulty in growing rapidly into an anti-government force which will certainly be capable of preventing the Pa Mong project or halting it at any time during its construction. This danger is all the more real if exploited skillfully from the outside by anti-government interests.

A note of irony may be pointed out: if it is assumed that the construction of a road network in the remote regions of Pa Mong will by itself contribute to the reduction of anti-social or anti-government agitation then this assumption is perhaps tragically wrong. Along these roads will flow ever more increasing amounts of new knowledge which per force will raise expectations rapidly for access to the utilities from such new knowledge. If access to such utilities in the form of new crops and new varieties, better markets and better prices and in general higher levels of living from a better service performance of both public and private structures is not forth coming, than the new road system will ultimately contribute only new fuel to the present stress and agitation and have the opposite effect of the one desired.*

One other important relationship should be mentioned at this point. Expressed needs are central to the concept, if not ideology, of community development. We have shown above that these expressed needs are theoretically predictable and methodically measurable. In fact, structural-symbolic theory and methodology were first conceived to be applied as a potential theory of community development.**

Though the theory and application have grown far beyond the community level, both still are the best available tools for measuring and demonstrating the validity of the community development concept. As such the application can contribute much towards the reduction of the more ideological and highly subjective aspects of past and present community development programs.

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*T. NAKAHARA and R.A. WITTON, "Development and Conflict in Thailand". Data paper No. 80, SEA Program Cornell University, Ithaca, N.Y., 1971.

**Frank W. Young and Ruth C. Young: Toward a Theory of Community Development, in R. J. Ward "The Challenge of Development", Aldine Publishing Co., Chicago, 1967, pp. 455-463.

CHAPTER III

PA MONG QUANTITATIVE RELOCATION DIMENSIONS

A. The Pa Mong Reservoir Population and Settlements:

1. According to Bureau of Reclamation, Report and Appendixes.

The only resettlement quantity given in the Bureau of Reclamation report is the numbers of families in Thailand and in Laos to be resettled (on page IX-15 in the main report). Thus 24,550 families in Thailand and 19,905 families in Laos will have to be evacuated from the reservoir. This information is referenced to studies done by the Department of Social Welfare in Thailand and to a Cadastral Survey in Laos. Both of these surveys are reproduced in Appendix 7 "Corollary Studies" of the USBR report.

The USBR report does not state the total number of people nor the number of settlements involved in the relocation problem. (The paragraphs on resettlement identified in the USBR report during the course of this study, have been reproduced and are presented in Appendix B to this study.) It is customary for resettlement costs to be given in dollars per person displaced, while the extent of the problem is often expressed in numbers of settlements to be inundated. Although the Bureau Study does not present this information it may be derived from data contained in the report and appendices. Study 7, in Appendix VII, presents the cost estimates for population to be resettled from Thai areas of the Pa Mong Reservoir. Numbers are given per district involved. Adding the number of people of about four districts one arrives at the total of 169,078 people for the Thai part of the reservoir. Study 11, the "Pa Mong Reservoir Cadastral Survey"in Laos, gives the total number of people to be 104,465. Adding both, one arrives finally at the number of people to be 273,543 in the Pa Mong Reservoir. The Bureau of Reclamation resettlement cost figures therefore are based on a population of about 275,000 to be relocated. It must be kept in mind that these are 1968 population estimates and not estimates of the population likely to be in the reservoir when flooded.

2. Estimation from Older Maps

During the course of this study various other sources where examined and numbers of settlements, families and population were estimated. Each time a new source was found the figures improved in accuracy. The first source of new information was the village count done by EARI on 1:250,000 scale maps for its Pa Mong Islands Study. The affected number of settlements was estimated to be 500. Based on an average population per village it was estimated that in 1990 the reservoir area would have a total population of about 500 to 520 thousand people. These figures were presented to the May 1971 SEADAG Mekong Seminar.

A second attempt for more accurate data was made by identifying the 250-meter contour line on 1:50,000 scale maps. This second count of villages below the 250-meter contour line identified 476 villages to be inundated by the 250-meter level reservoir. At the same time it was possible to identify villages which were located between the 230 and 250-meter elevations and which therefore were spared by a 230-meter level reservoir. The affected number of settlements was thus reduced from 476 to 252. Subtracting also the Nam Lick

and Nam Mong basins the minimum number became 159 villages or 33% of the 476 villages affected by the maximum 250-meter reservoir.

3. Estimation from 1:20,000 Scale Maps and Survey Data

The Bureau of Reclamation recognized during its study that the 1:50,000 scale maps contained some inaccurate contour lines for certain areas in the Pa Mong Reservoir area. The whole reservoir area needed aerial photography of better quality than the previous one for a new set of maps. The new aerial photography was flown in 1967. Maps were produced under contract for AID at a scale of 1:20,000. A set of these maps were use by EARI for its Pa Mong Islands study. These maps contain contour intervals of 5 meters. Settlement areas are identified fairly accurately to the point of drawing individual buildings. The maps contain the latest and most accurate contour lines and therefore the shorelines of the Pa Mong Reservoir as well as all settlement areas within the defined reservoir areas. AID agreed during the course of this project to add a brief service contract for the counting of all identifiable settlement on these maps. All approximate settlement centers were recorded by UTM coordinates.

This latest count of settlements in the respective reservoir areas presented in Table 12-A produced some surprises. The total number of villages in the whole reservoir went down to 394. However, several large contiguously populated areas were counted as one settlement while the actual number of villages involved in these areas was higher. The approximate number could be identified on 1:50,000 scale maps and the 1970 Thai census data for the areas involved especially the Loei Valley. Twenty-two settlements were added to produce a total of 416 villages in the total reservoir area. With the exact locations of settlements known, a breakdown into Thai and Lao, and Nam Lick and Nam Mong areas could be made.

The new population estimate, based on the number of settlements derived from 1:20,000 scale maps and ground and air survey data is presented in Table 12-A. The maximum number of people to be relocated at the 250-meter level in 1968-70 would be 220,000 people or about 55,000 people less than the USBR report base figure. However, at an average annual rate of 3% this population would grow to 397,000 or about 400,000 people by 1990. The new figures can be considered fairly accurate for the Thai portion of the reservoir and highly probable for the Laos side. They do present a substantial reduction of estimates based on the older and smaller scale maps and even those used by the Bureau of Reclamation.*

Two reasons could be identified for this reduction. The new contour lines leave a large number of villages outside the reservoir, especially in Laos (minus 56 villages) mostly along the upper Mekong, in Region 1. At the time this reduction was partially reversed by the identification of a number of additional villages both in Laos and Thailand in remote Regions 3, 4, 7 and 8, which were not marked on any of the older maps (plus 5 villages). But these "new" villages are all below the 230-meter level which explains the lesser reduction in the number of settlements from the 250 to the 230-meter level then was the case in the counts on the older maps (to 43% rather than 33%).

*For qualifications see last paragraph of section A-4 in this chapter.

TABLE 12-A

Estimated Population and Settlements Inundated
by Proposed Mekong-Pa Mong Reservoir
In Thailand and Laos

	1970				1990	
	At 250m No.	%	At 230m No.	230 m as % of 250 Max.	At 250m No.	At 230m No.
Total:					Max.	
Settlements	416	100	263	63	-	-
Minus Nam Lick-Nam Mong	279		174	43	-	-
Families (000)	40	100	23	58	72	42
Minus Nam Lick-Nam Mong	28		15	38	51	27
People (000)	220	100	135	61	397	244
Minus Nam Lick-Nam Mong	154		87	40	278	157
						Min.
Thailand:						
Settlements	226	55	145	64	-	-
Nam Mong	59	14	51		-	-
Families (000)	25	62	14	56	45	25
Nam Mong	6	15	5		11	9
People (000)	149	68	90	61	268	162
Nam Mong	34	15	33		61	59
Laos:						
Settlements	190	45	118	62	-	-
Nam Lick	78	19	38		-	-
Families (000)	15	38	9	60	27	16
Nam Lick	6	15	3		11	5
People (000)	71	32	45	64	127	81
Nam Lick	32	15	15		57	27
Nam Lick + Nam Mong						
Settlement	137	33	89		-	-
Families (000)	13	30	8		23	14
People (000)	66	30	48		119	86

Sources Table 12-A

1. Settlements:

Computed from data determined by EARI from 1:20,000 scale maps. The 1:20,000 scale maps are part of a special project produced from 1967 aerial photography by AERO Service Corporation, Division of Litton Industries under contract to AID. These data were checked against the sources below:

1:50,000 scale maps.
1970 Thai Census Data.

The settlement count determined from the 20,000 scale maps was 390 at the 250m. reservoir level and 260 at the 230m. level. The maps did not identify the individual settlements which comprise large contiguous populated areas such as in the Loei Valley in Thailand and around Vang Vieng in Laos. Consequently 22 settlements had to be added to the 250m. level count and 5 to the 230m. level count from all sources. Settlements were located and recorded by UTM Coordinates.

2. Population

1970 census data from the Loei and Tabo districts were available. For the Chiang Khan district in Region 5, the Pack Chom District, Region 6, and the Nam Mong valley, regions 7 and 8, data from the Accelerated Rural Development (ARD) Program survey were available. It was exceedingly difficult and time consuming to match village numbers and names in the ground data with those on the maps. We feel about 90% of these villages were eventually correctly matched. For some of the Pa Mong Regions on the Thai side (Regions 5, 6 and 7) we have recent population data on from 70 to 80 percent of the total number of villages to be ununda ted, while for the Nam Mong Valley we have only a 9 percent sample.

For Laos, village population figures were available only for Van Vieng and nearest villages. Some population figures were first collected in a 1966 ground survey conducted by the author. Later in 1968 the area surveyed was largely extended by the aerial photography survey which included house counts on 1967 aerial photography. From this information the upper Nam Lick or Vang Vieng villages are estimated to contain about 100 families per village with five people per family. The rest of the villages in Laos were assumed to be more or less equal to the Nam Som valley in Thailand and an average 75 families per village at the 250-meter level were assumed.

For estimating the 1990 population a compound 3.0 percent population increase for 20 years was assumed which amounts to a factor of 1.806 for the two decades 1970 to 1990. Except for the 1970 census the data used for estimation are for 1967 and 1968 and no correction has been made for these two years.

At the same time, at the 230-meter level Vang Vieng will now not be inundated while on the older maps the printed 230-meter contour lines clearly include Vang Vieng and a number of villages above it within the 230-meter level reservoir. (See Map 11 Chapter II-B-3).

Another significant change is noted at the Nam Mong saddle which now has a minimum height of about 235 meters. This means that the saddle is a natural dike for the 230-meter level reservoir and if the Nam Mong Valley is to be included in the Pa Mong Reservoir at 230-meter level, a rather deep channel will have to be cut through the saddle. Because of this possibility the population figures for the Nam Mong Valley have been included in the full 230-meter level reservoir population count. To save the Nam Lick Valley a dike still needs to be build at the 230-meter level but it is substantially shorter and lower than previously indicated (see Table 12-B).

TABLE 12-B

Requirements at Saddles to Exclude Nam Lick-Nam Mong Valleys

	At 250m	At 230m
Nam Lick Saddle		
(Lowest elevation approx. 22m)		
Approx. Length of Diking in km :	8.4	3.4
Approx. Max. Height of Diking in m :	35	15
Nam Mong Saddle		
(Lowest elevation approx. 235m)		
Approx. Length of Diking in km :	3.4	0*
Approx. Max. Height of Diking in m :	20	0

*The Nam Mong Saddle forms a natural levy above the 230m. reservoir level. A channel of about 0.5km length is required to include the Nam Mong Valley in the 230m level reservoir.

Source: Same as Table 12-A.

4. Distance of Inundated Settlements to the Shoreline.

The total length of the shoreline in this multiple-branched reservoir is estimated to be between 12,000 and 15,000 km based on a ratio of length of reservoir to shoreline of 1:18. This ratio is quoted for the Volta and Nasser Lakes and some sample measurements on 1:100,000 scale maps showed it to applicable to Pa Mong.

Several significant facts affecting the relocation problem were identified when the distances from each settlement center to the nearest shoreline above was measured to the nearest one-tenth kilometer. For villages on the shoreline (zero distance) the percentage of the settlement area inundated was estimated. The results are presented in Tables 12-C and 12D. The most significant factor, which has very important implication for formulating a relocation strategy, is the closeness of (to be) inundated villages to the nearest shoreline.

Over one half of the villages to be inundated at either reservoir level lie within one kilometer from the shoreline and over 80 percent of the villages are within 3 km from the nearest shoreline. For the remaining villages the largest distances is about 9 kilometers. Adding to this the annual 10 m drawdown reduction of the reservoir which will expose large areas of inundated lands belonging to the displaced villages the followind can be expected:

a. The average utilized land area of a village extends to about 3 km from the village and most villages will have some of their village land area remain outside of the reservoir. The owners of such land would not want to leave the larger village area but would be determined to relocate at the shoreline on their land.

b. The villages as a whole will favor simple creeping up to an elevation above the shoreline and remain within their traditional village area. This tendency will be stronger the more colonizable lands are available above the reservoir and within the larger village area. The determination of such potentially cultivatable lands is another important requirement for formulating a relocation strategy.

c. Every dry season most of the villages will have a large portion of their former cultivated land become available during the drawdown period. To utilize these lands a settlement location on the shoreline is practically essential. The extent to which inundated land will become available during drawdown time can not be estimated at present. What is needed is a fairly accurate study of the contours between 220 and 230 or 240 and 250 m elevations to identify what areas will become available and for what periods of time. In conjuction with this, investigations of what crops can best be grown under the given land, water and time conditions are essential if drawdown agriculture is to be made feasible.

The next three factors will cause the population estimates in table 12-A to either decrease or increase:

First, of the total number of villages which will be inundated 54 at the 250 m level and 56 at the 230 m level reservoir will be only partially flooded. At least half of these villages are less than 50 percent inundated (Table 12-D). This has implications on the numbers of people to be relocated. While a certain percent reduction of the population presented on table 12-A will occur in terms of fewer people losing their dwelling, these families may still lose some of their land and thus part of their livelihood. Unfortunately the extent of a reduction of the relocation problems cannot be estimated from the data at hand. This is just one more factor contributing toward the need for an early land titling project which for the sake of speed, costs and efficiency can be done from aerial photography with identification of property owners on the ground.

The second factor which may change the total number of people requiring relocation or land replacement is that lands of many villagers who are located in villages above the respective reservoir levels and not included in the settlement count in Table 12-A will lose some or all of their lands. The extent of such lands could not be determined on the 1:20,000 scale maps. That determination can be made however to some degree from aerial photography by identifying lands belonging to each village from the trail pattern. The

TABLE 12-C
Inundated Settlements: Distance to Nearest Shoreline

	At 250m.			At 230m.			230
	No.	%	Cumulative %	No.	%	Cumulative %	as % of 250
0*	54	13	13	56	21	21	104
0.1-0.9	173	41	54	101	38	59	60
1.0-2.9	115	28	82	72	28	87	64
3.0-419	37	9	91	21	8	95	57
5.09-9.9**	37	9	100	13	5	100	35
10.0 and over	0	0	0	0	0	0	
TOTAL:	416	100		263	100		

*Shoreline passes through village.
**Largest distance 8.8km. at 230m,; 9.2km. at 250m.

TABLE 12-D
Inundated Settlements: Degree of Partial Inundation

	At 250m.		At 230m.		230 as % of
	No.	%	No.	%	250
Total no. of settlements:	416	100	263	100	64
Settlements totally inundated:	358	87	209	79	56
Settlements partially (1-95%) inundated:*	54	13	56	21	104
Villages more than 1/2 (51-95%) inundated:	30	7	24	9	80
Villages less than 1/2 (1-50%) inundated:	24	6	32	12	132

Note: The reservoir's elevations of 230m and 250m are taken literally and do not allow for extreme crest elevations such as 234m or even 251.5 meters. If such crests cannot be avoided the certain annual flooding of many settlement areas and fields will require their inclusion in the above count for relocation. Modifications of dam design may however largely alleviate this problem.

SOURCE: Same as table 12-A(2)

land titling survey would again be more accurate required anyway for the reservoir area below and above the shoreline. The importance of this factor for relocation strategy and costing is that people who have lost all of their lands or a substantial part of it will have livelihood resources reduced below survival and will either need to be relocated or have their lost land replaced. On the other hand, drawdown cultivation of their land may modify the severity of this aspect considerably.

An other factor affecting the population estimate is the crest elevation of the reservoir. The village count and therefore population estimation was based on the 250 and 230 meter contours respectively. The USBR report indicates that crest elevations of the two reservoir levels may reach either 251.5 meters or 234 meters during flood volumes of the Mekong. It appears that these crest elevations could be sustantially reduced by modifying the dam design to allow a larger volume of flood waters to pass through. However, if these crest elevation cannot be reduced to a maximum of about half a meter above normal (250 or 230) the annual flooding of the shore areas will make it necessary to relocate a larger number of people than presented in Table 12-A. Both dwellings and fields will be affected by such recuring floods. Depending on the elimination of this problem, the number of people to be relocated and/or reimbursed with cultivated lands may rise significantly.

A very rough estimate of the additional population potentially needing relocation by both crest elevation flooding and land inundated of villages located above the reservoir would be 25 to 30%. This would bring the total population affected by 1990 back to the previously stated figure of 500,000 people. The guessing game is not yet over and a final cost estimate and feasibility determination is still far from being made realistically.

CHAPTER IV

APPLICATIONS: IMPLEMENTING RELOCATION THROUGH THE MICRO-REGIONAL STRUCTURE

A. Planning and Implementing Settlement Relocation.

1. The Range from Total Neglect to Total Supervision.

There is a wide range of alternative relocation strategies available between the extremes of total neglect of the displaced population to assuming total responsibility for even minute details of life. The five principal strategy categories and their effects are outlined in Table 13 A and B. Almost all these strategies, except the very extreme ones, have been tried by one project or another in the world, but most can probably be placed under categories II and IV. For each of these strategies one can roughly predict a certain village-population response as well as the major long-range costs and benefits. Items 1 to 4 as suggested by Professor Young are intended to very roughly identify what the responses, costs and benefits, and the relative ratios would be from each of these strategy categories. Items 5 to 10 have been added to provide some examples of types of costs and benefits.

The most important fact observable on this table is what we believe to be the least costly and most beneficial strategy. Strategy III involves to the utmost the interests and abilities of to-be-relocated populations. This means that displaced communities plan and implement their own relocation as much as possible with only resources, guidance, and training provided by government and project personnel. Since this strategy has been the least used in any past relocation programs, it must either be the most difficult or it was generally underestimated as an available strategy alternative. In reality both causes may have been involved. Letting the local community and micro-regional structure handle relocation to any large degree requires a recognition and comprehension of this structure to a degree that has neither been possible in government agencies nor at policy-making levels, public and private, in either host or donor countries. Furthermore, for feasibility study and implementation program intensive training of personnel is required to make this strategy workable. It is significantly more difficult for a government or private agent to work with and behind a community leadership in executing a self-relocation program than to simply supervise the execution of centrally conceived and "efficient" settlement plans.

Too often plans have been made to follow Strategy IV or even V when lack of resources made the implementation come out in terms of Strategy II and sometimes I. Strategies have usually been chosen first by criteria of present policy, then perhaps considered in terms of necessary resources, and only sometimes squarely in terms of resources available. The greatest dangers of misjudgment have been, first, in assessing the resources required and, second, realistically facing the facts of how many resources actually are available.

The second cause is more difficult to recognize and overcome early enough. The opinion that illiterate or barely literate people, living at a technological level of subsistent agriculture, are unable to manage substantial change in their community or agricultural practices is deep seated, though not always admitted among most officials in the host or donor countries alike.

TABLE 13-A THE RELATIVE RANGE OF ALTERNATIVE STRATEGIES AND THEIR LONG RANGE COSTS FOR RELOCATING RESERVOIR DISPLACED SETTLEMENTS

1. Strategies	I	II	III	IV	V
2. Primary Action by Government	total neglect	limited and/or lagging attention	supervising village and regional self-relocation	paternalistically, imposed program	total responsibility by imposed authoritorian program
3. Response of Displaced Communities and People	blind violent protest	"Dog eat Dog" competition for survival and benefits	channeled community mobilization	disatisfied or hostile compliance	corrupt, mute dependency
4. Long Range Relative Total Costs: (Policial, Social, Economic	very high	moderately high	lowest	moderately high	very high
5. Examples of Costs: A. Political	large expenditure for military or police controls and/or punitive action; violent animosity by population	passive but exploitable animosity of loosers' towards society and government	some loss of central government political and bureaucratic control; local corruption	increased administrative and other agency resources expenditures;moderate bureaucratic corruption	overwhelming costs of administrative and other agency resources;high bureaucr.corrup.
B. Social	destruction of societal fabric and human capital	extorsion of weaker human resources	increased,substantive local divisions on planning and implementation	reduction of 'self help' motivation and innovation	any remaining 'self help' motivation and innovation channeled into corruption
C. Economic	destruction of productive capital; development funds channeled into non-productive structure and actions	net loss in economic productive structure and production	some waste of resources by low local technical expertise and by frictions to achieve consensus.	some waste of resources by inept bureaucracy; loss of production by stiffled motivation	waste and misallocation of resources; low productivity from lack of motivation

Strategies	I	II	III	IV	V
6. Long Range Benefits for the Country	very few	some	most	some	few
7. Examples of Benefits: A. Political	central government strengthened by build. of police and military forces or overthrow of government by their exhaustion	strengthening of pro-government interest groups and elites.	optimal distribution of opportunities; development of local governments and service bureaucracy	political and administrative control over project and people	absolute political and administ. control over population but not the bureaucracy.
B. Social	"change" forces strengthened but radicalized	development of entrepreneuship, though uncontrolled exploitative	max. 'climate' for motivation and innovation; progressive orientation of society	imposed innovation; institutionalization of bureaucratic control; some social security	enforced innovation; large growth in consumption and social security cost
C. Economic	project savings, population reduction by warfare; destruction of traditional production structure	some project savings; some generation of productivity	generation of local resources and productivity; long range economic growth	increased productivity and production; foundation for structural economic growth after project completion	some production; residual physical strucutre after project completion
8. Probable Costs - Benefit Ratio Costs: Benefits:	6/-2 4/0 3/1	1/1 1/2	1/3	1/2 1/1	2/1 3/1
9. Present Ranges of Policy and/or Action: Optimal Range:					
10. Graphical estimation of relative costs and benefits					

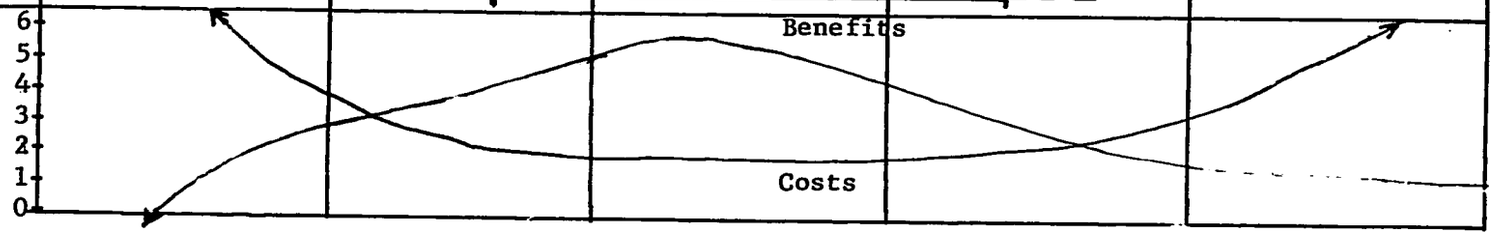

TABLE 13-B THE RELATIVE RANGE OF ALTERNATIVE STRATEGIES AND THEIR LONG RANGE BENEFITS FOR RELOCATING RESERVOIR DISPLACED SETTLEMENTS

Whether based more on subjective feelings of culture and/or class arrogance or more objectively on superior education, this problem is very difficult to overcome. The only hope lies in intensive training of carefully selected officials which may facilitate a comprehension of the actual functioning of local community leadership and social structure. Better insight may eventually overcome rationally and by experience the prevailing prejudice.

2. Assisted Self-Relocation of Villages and Micro-Regions

The relocation of communities by community effort is in fact an old experience in the Pa Mong region. Some clear evidence is available on aerial photography. In the reservoir area north, in Laos, the French built the first all-weather road in about the middle 1950's through the Nam Song Valley. An aerial photo analysis of the Vang Vieng Valley using the 1959 and 1967 air photos showed that by 1959 about five villages, which had been located at the Nam Song and the upper Nam Lick rivers, were in the process of moving between 1 and 2 kilometers to the new road in order to be located at this new transportation-communication channel. It is important to notice that in all cases the road touched the cultivated land area and the move did not cause excessive distance to the fields. By 1967 these villages had completed the move including their temples. Only the outline of the old village sites could still barely be identified. Each one of these communities had planned, organized, and executed this relocation by itself, without any assistance from either government or private agencies.

Communities in the region are self-sufficient. They have to be able to manage their own affairs to survive in a remote and hostile environment. Villages often relocate for other reasons, such as warfare or due to recurring widespread disease attributed to a particular location. Over half of the villages in the Vang Vieng Valley were established around the turn of this century by communities which moved from north of the Plain de Jars because they were frequently ravished by the Ho Rebellion. In this case communities managed to relocate themselves over several hundred kilometers and establish new prosperous villages on the best possible sites in the valley - all in a manner which even a trained technician could not have improved much. The latest wave of relocating communities appeared in the Vang Vieng Valley in 1964, again from the Plain de Jars where this time they fled the destruction of the current fighting. Again the communities under their own leadership managed to start new communities on village sites given to them by district officials. Within 1 to 2 years they were functioning as productive communities without any government official so much as measuring out or distributing dwelling sites among the families.

The above is mentioned merely to demonstrate the ability of communities in the Pa Mong region to handle relocation by themselves if, and this is the most important qualification, if they are sufficiently motivated to do so. Motivation always comes from taking advantage of perceived benefits which make the effort worthwhile: the benefit of escaping warfare is clear; however, to move a village from a beautiful, clear mountain stream to a dusty road over 2 kilometers, taking 10 years was also thought worthwhile by five villages, simply for the benefit of being at a new more beneficial communication channel.

The situation in the Pa Mong Reservoir will be somewhat different in that the communities will be driven out by ascending waters caused by their own government. However, there are potentially so many benefits to be derived from the reservoir and the power generated that most communities may find enough reasons to move simply for these benefits if they are made available to them at the shoreline. The most crucial qualification is the continuation of means of livelihood, primarily the land they lose by inundation. If this land can be replaced above the reservoir, the biggest obstacles to self-relocation will be removed. If in addition new roads can be built along the shoreline, connecting the new settlement sites with all-weather access to both water and road transportation, communities may even enthusiastically welcome this opportunity for gaining access to the outside world and new goods and resources.

This proposed relocation strategy will require the implementation system, whether government or project, to have its agents play mostly the role of advisers and minimize the role of supervisors. But more resources, both in finances and materials as well as equipment, will be needed the larger and higher developed the village is. Relocated towns, such as Chiang Khan, will actually need teams of advisers and town planners. As much as possible, however, any equipment or material resources required should be channeled through the local private proprietorship. Everywhere most present facilities have been built not by government agencies, but by the people and local businessmen themselves. This knowledge structure constitutes a tremendous potential for growth, if the relatively huge resources necessary for relocation are channeled through it. Bureaucratic red tape would be minimized while training and growth of structure could proceed along present natural channels, which would remain functioning and with much of the gained momentum continuing after the relocation work is completed. Most importantly, forces of motivation to do good work and do it efficiently are built into such a strategy. The always present negative forces of government red tape, inefficiency, and lack of motivation would be largely reduced.

Most communities will need some relocation assistance, though again in a hierarchical fashion. The micro-regional structure is presently, perhaps in an elementary form, but nevertheless potentially capable of rendering substantial relocation assistance to its communities. The many small villages which will need relocation have much simpler facilities and properties to be moved, but they have also less capacity to do the moving fast enough and will need some assistance from central villages or towns. The micro-regional structure can be greatly strengthened by channeling relocation resources through it. Such a strategy can turn the relocation problem into an opportunity to upgrade the region towards the modern market town system. It could do so at a fraction of the costs suffered in keeping a dissatisfied region contained and pacified.

Government or project personnel involved in this strategy obviously will have to be a very different type than traditionally used. The attitude and competence of this personnel will have to be much better than have so far been considered. Relocation staff will have to be divided into two types: one, the 'relocation planning assistants,' and, two, the 'inspectors,' who are to make sure that material and financial resources are utilized as approved. However, the approval of utilization of resources should depend on the relocation advisers and the community leadership and not on the inspectors.

A perhaps utopian ideal would be to pay extra benefits to planning agents for satisfactory work, satisfactory, that is, to the community population. Such "motivation generators" could be made in the form of bonuses to be paid to agents by the project authority dependent upon approval by vote of the assisted community after the completion of relocation. Such a bonus, which need not be large, would generate a better balance of interests and powers and make all participants, population or officials, try to do a better and more efficient job.

Whatever the system to be adopted, a crucial requirement will be the selection and training of either type of official, adviser or inspector. Whatever the possible savings and benefits may be from this strategy, no real savings or shortcuts will be possible in this training requirement. Ideally, relocation personnel, regardless of their origin in public or private agencies, should be trained and organized by extraordinary organizations which are not subject to the regulations and habits of the existing public agencies. Advisers should be placed under the project authority. Inspectors should be made and remain a special branch of government structure for as long as relocations projects require it. Again, we are aware that these are ideal solutions to be sought and that their achievement will also involve other reasons and reasoning.

3. Planning for an Opportunity in Basin Development.

The similarity of geographic central place theory to the more general socio-structural theory makes already developed applications of the former relevant to the latter. Recently two comprehensive efforts to adapt central place theory to practice in regional planning have been published: (1) Arthur Mosher, "Creating a Progressive Rural Structure," and (2) E. A. J. Johnson, "The Organization of Space in Developing Countries." Both see the establishment of a complete hierarchical system of market towns as essential to the development of the LDC's (Less Developed Countries). Both suggest that "construction" of such towns must be based on the selection of places which are already somewhat central in groups of settlements. Mosher proposes to start with the centers of the existing administrative division, the district town. He explains that modernization (commercialization) of traditional subsistent rural society must begin by covering cultivated land areas with a dense system of land-to-market roads. The basic micro-regional unit is seen as the farming district. Starting from the district center roads are progressively pushed into the cultivated land areas. For efficiency purposes this road system is ideally to be a 1-mile square grid system on fertile land, less dense otherwise. In both investment and usage new agricultural technology and commercial services for agricultural inputs and outputs must immediately follow the progression of the road system into the village land areas.

In Appendix D, page D-7, the hexagonal system identified by Skinner has been overlayed by a square grid road system. It shows that theoretically the efficiency criteria for either system are not violated by this combination except for one-third of every hexagon area. In two triangles of a hexagon the square grid will not run toward the main roads in the direction of the market center but diagonal to it. A modification of the continuous square grid system to correct this deficiency appears simple enough. At least in the abstract version the applied proposal of Mosher is compatible with the

systems model identified by Skinner. In practice both may have to be modified substantially especially if, for instance, the colonization drift suggested on map 13 is extensive. However, Mosher wrote a manual for the minor official at the frontiers of development, the countless districts and sub-districts in developing areas, and extensive simplification was necessary.

Johnson in the conceptually most significant book on the application of central place theory, "The Organization of Space in Developing Countries," is aiming more at central planners. He recognizes more variables and is more comprehensive and flexible in the development of a strategy for the creation of a modernized central place hierarchy. In the following summary of his recommendation and Appendix F, the reader will hear many echoes of structural-symbolic theory.

Like Mosher, Johnson finds the creation of "properly dispersed agro-urban central places" essential to development. He proposes to select the most promising central places by criteria of existing relatively higher diversity and civic spirit. He finds that in the natural development process "spontaneity" of central market development is either too slow or in most cases actually paralyzed in present-day developing countries. A mixture of public and private initiative to create and assist promising growth points is necessary. He concludes that low and intermediary level market towns have always been the consequence of such intervening actions even in presently developed countries.

Public planning and subvention can create the "investment climate" in properly chosen "growth points" which will generate "a cumulative and multiplying type of capital formation" by which the private sector will assure the development of a full-fledged market town serving its market area of villages. According to Johnson, geographers and economists can identify the best potential growth points by various criteria, for he points out that any geographic space settled by people contains some well-located villages such as a strategic road crossing or a river-road junction where the population also exhibits a better than average energy and drive, where there is evidence of a rising civic spirit and a better than average quality of leadership. Such villages also may have an agglomeration of merchandising and other services; they may have the beginning of a functional occupational pyramid. All of this focuses on the diversity which is essential to the "functioning central place as a social unit." The identification of these places is certainly possible by scalogram analysis as we have shown in this study.

According to Johnson, it is also the job of the regional planner to find and encourage change agents who are "town planners," the innovators who are willing to take risks, who can conceive of changes and investments worth taking risks for. He finds "town fillers" to be those who primarily imitate and put into practice things they have seen others perform successfully, but who are able to do so only in a favorable investment climate.

Given the limited resources compared with the vast areas of under-developed regions, the problem is not only one of finding enough growth points, but choosing the right region as well. Here productive capacity, both present and potential, constitutes a primary criterion for selection. Like Mosher, Johnson suggests saturating the most promising regions in terms of generating a complete system of agro-urban centers. But, in order not to increase the disparity with less developed and less endowed regions, he

proposes selecting here only a few pilot centers chosen at random. It is here where we are able to supplement Professor Johnson. The random selection is not only potentially wasteful, it is also contradictory to the logical application of the process and pattern of central places so much emphasized in the rest of his book. Random selection of central places is unnecessary with the measuring tools that we have demonstrated in this study. The same process which mades advanced villages appear best suited for the development of central market towns in more endowed areas is also operative in least developed regions and the same principles of selection apply - if one could use them in an efficient and objective way.

We demonstrate in this study that the scalogram methodology can identify levels in the diversity of villages relative to each other in any group of settlements regardless of how remote or low in development they are. Though the area covered in this study is in only two countries, studies in other countries and world regions* indicate that some villages will always display a relatively higher diversity than those surrounding them, and it is these villages which are the budding future market towns in a region. Going one step further, a scalogram analysis of central villages, though not done in this study, can easily identify the most outstanding central villages in a region, and a small number can be chosen from these to become "pilot investment clusters."**

Johnson gives a brief description of an attempt at central place applications in the planning for the resettlement of the population displaced by the Volta Lake.

> After careful resources and land-use studies, and after repeated solicitation of the views of the affected farmers, the Volta River Authority proposed that the fifty-two townships should have central places of four sizes: "central towns" with populations ranging from 8,000 to 10,000; "service centers", 5,000 to 8,000; satellite villages, 5,000 or less; and below these, village clusters.....
>
> To be sure, the hierarchical model was not slavishly adhered to; rather, as an observer has neatly said, "the model gave a theoretical framework against which proposals [for sites] were weighted." Some towns were enlargements of existing towns, others were built de novo; but when the resettlement operation had been

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*See bibliography.

**A highly relevant case study in the Mekong Basin would be of the little known Village Cluster Program in Laos between 1964 and 1968 which attempted to follow exactly the strategy prescribed by Johnson. Initiated by AID and executed in conjunction with the Laos Government that program initially scored some demonstrable successes while the relatively peaceful period following the 1962 Laos Armistice permitted it. With a change in mission administration and the increasing spillover of the Vietnam war into Laos, the cluster program was finally abandoned.

completed, instead of the previous 739 villages there were 52 "new" townships ranging in size from 14 to 816 houses. Since the average new township population has been estimated to be 1,320 persons, almost 69,000 out of the 80,000 displaced persons must have elected to accept supervised resettlement.

The "standard house" with two rooms and with "cooking sitting" porches had to be modified; consequently the one-room nuclear home became the typical structure. By 1961 over 11,000 houses had been erected in forty-four settlements, and 275 miles of new roads gave the new towns access to the national highway system. By 1965 all fifty-two settlements had been completed each with septic latrines and water supply; with primary and middle schools, community centers, civic buildings, and churches; with market yards equipped with selling platforms, granaries and warehouses. To permit fuller use of the agronomic resources of the fifty-two townships, three experimental farms were established where field tests in plant breeding could be made for maize, sorghum, cowpeas, tobacco, and yams, and where experiments for the purpose of improving livestock strains could be carried on. A mechanical cultivation service was also provided by the establishment of eight "machine tractor stations" of the Soviet type, equipped with several hundred tractors and with the appropriate cultivating tools.

It remains to be seen how successful this rather drastic restructuring of the living and working patterns of 70,000 people will be, whether the settlers will adapt themselves to larger social aggregates, or whether the townships will soon subdivide into traditional village communities. It will be interesting to see whether the settlers consider that the advantages of scale can produce benefits that will seem worth preserving. However meritorious it may appear to adopt some device or tactic that promises to transform a rural society quickly and to overcome the poverty, squalor, and illiteracy of the peasants (particularly a plan that appears to make it possible for subsistence farmers to modernize their agricultural technique, thereby benefiting not merely the farm families but the entire national economy), however desirable all these changes may appear, success will ultimately depend on the attitudes of the farmers, their families, and their leaders. (Johnson, op. cit., p. 348-9)

As we have seen, the earlier failures and problems of this plan have been due more to inabilities to implement this plan caused by lack of resources and overplanning than because of inherent conceptional faults. The Pa Mong Project presents an even better opportunity for large-scale planned regional development through the application of the principles outlined by Johnson and Mosher, especially if modified by the insight gained by structural analysis as demonstrated in this study.

Too often in the past relocation has been seen and handled as an annoying problem. Most certainly this seems implied in the feasibility study on the Pa Mong. As David Lilienthal pointed out, "Reservoir relocation presents an opportunity for basin development." The Lake Volta project planners certainly recognized it as such, and the fact that the opportunity was missed initially is much bemoaned by the present administrators.

The "far-reaching" Pa Mong Reservoir does present a unique opportunity for regional development in this section of the Mekong Basin. That the region is a worthwhile area for development should be proven by the fact that both the Thai Government and foreign aid donors have invested millions of dollars in the region through the large-scale roadbuilding programs and other corollary development activities. Comparatively much larger sums of capital and other resources will have to be expended in the region because of reservoir-caused relocation. Whether the expenditures for moving the population, roads, fields, and other improvements can be made to pay much higher benefits will depend entirely on whether they are planned and implemented within any overall regional development scheme. The details of such a plan are far beyond the scope of this paper. Here the plea is merely made to take the opportunity into consideration.

4. Implementing Structure: A Carefully Planned and Integrated Mixture of Community, Project, and Government Divisions of Labor and Interests.

One can expect that the best possible implementation can be achieved if it can be so structured that the interests, resources, and motivations of all concerned parties are utilized to the utmost. We can identify three parties involved in the relocation part of the Pa Mong Project: a. the communities; b. the project authority; and c. the host-national governments. The optimal participation share of each of the three in the implementation can be made clearer by taking inventory of what the resources and interests of each of the parties are.

a. The Communities

(1) Potentially most affected by the Pa Mong Reservoir, both negatively and positively, are the communities. They are therefore the most interested in making the best of the necessary relocation. Positive effects can be realized and negative effects reduced the more these communities can be made to do the moving themselves and to do as much of the planning of change and necessary restructuring as possible. At least their active, voluntary, and positive participation in these tasks must be obtained. As shown, self-relocation of villages for sufficient reasons is part of the cultural heritage in the Pa Mong subregions. The empirical evidence to this fact is available on aerial photography on the Vang Vieng and Moung Kassy districts in Laos. Village leadership structure is predisposed and capable of managing the relocation of their villages.

(2) The resources necessary for relocation can be made a great stimulus to generate voluntary participation by channeling them through the community leadership. Such channeling will also release resources in each community which otherwise would be lost. These resources lie in the potential innovativeness and solidarity effort which are generated by striving towards some recognized benefits. They can be realized by granting the village

leadership the authority for effecting the move as a whole and working out the details of a plan and its implementation while in touch with their people. They should be allowed and assisted to choose new relocation sites and implement the move subject to advisory guidance and allocation of resources and benefits for such a move. The necessary financing and materials should be put at the disposal of the village leadership.

(3) Self-relocation should begin by involving village leaders in the planning of the new micro-regions through site selection and continue on through the acquisition of rights-of-way on lands, the settlement pattern planning at new sites, the planning of communal institutions, the development of new lands, the cultivation of new crops and acceptance of new agricultural techniques, as well as the actual financing and supervising of moving each individual family. To do all this properly the village leadership will need assistance in the form of technical advice on planning; it will need approval procedures on its plans and it will need accounting inspection by qualified public agents.

(4) Other specific details of implementation should be channeled through the local management and business proprietors as much as possible and available. Moreover every effort should be made to upgrade and develop these private capabilities. Villages should clearly be given to understand the potential new sources of gain and profit to be realized by the move, such as: water transportation, fishing, pumped irrigation water, sufficient cultivatable land for intensified cultivation, new agricultural crops and inputs for higher production, better market access by the improved transportation facilities on land and water. At the same time care must be taken to assure that costs to displaced communities which are unavoidable are clearly understood by everyone and that unjustified expectation of benefits are not generated. Assistance and benefits which generate project costs need be provided only according to level of development of a village before displacement.

(5) In the process of assisted self-relocation the community leadership as well as many individuals in the communities will gain tremendously in knowledge and experience. The community and regional structures for knowledge processing will grow equally. A substantial net development growth, which will continue to pay benefits for a long time, will have been achieved. This strategy could achieve an optimum solution of relocation, satisfactory both to the relocated population and to a basin development plan.

b. <u>The Project Authority</u>

(1) We assume that the project of the Pa Mong Dam Reservoir and all correlated parts, especially relocation, will be implemented under a special organization for project implementation which may be called the Project Authority. We had concluded above and found considerable consensus elsewhere that the costly and complex relocation part of a dam project, starting with feasibility investigations and on through financing and implementation, has to be part of the project as a whole.

(2) In this case the Project Authority should have all the resources in capital technology and trained personnel which are necessary for settlement relocation. The Project Authority will also have the major interest as an economic undertaking, to get the most utility for the resources

to be expended. The Project Authority should directly supply the communities with the resources they need for their own relocation undertaking. It is also the Project Authority which should be in charge of any relocation and development or replacement activities which are outside the scope of individual communities, such as road construction, land development irrigation and the development of what ever other utilities are to be provided.

(3) To the most possible extent the Project Authority should subcontract individual tasks to local contractors found in the communities and towns in and around the reservoir. It should even expend effort to generate such contractors and help existing ones expand by intensive training programs for necessary skills and occupations. The Project Authority thus will not only construct physical structures but, at relatively small additional costs, will also construct knowledge processing social structures which in the long run may turn out to be much more beneficial then the physical dam and its power generating plant.

c. The Government

(1) The main interest for the involved government is that a and b above do their best in the interest of the country as a whole. It's major function is to be supervisory, for which it has both the jurisdiction and power. Government, through its bueaucracy on the other hand is the most ill fitted agency for detailed implementation of construction plans, be they physical or social in nature. The involvement of the government bureaucracy in construction affairs which is both, outside its major interests and outside its usual competences, must be kept to the utmost minimum.

(2) Even as a supervisor in the interest of fair play and law and order the danger constantly exists that its agents in the field will succumb to the relentless pressure of corruption. Government field inspectors under this scheme would be subjected to bribery by both the communities and the Project Authority. In fact officials will be in the position to enforce the payment "of special dues" for a smoother processing and a reduction of red tape in giving approvals and doing other functions remaining in their domain.

(3) This is not meant to be viewed too negatively. At least this would be positive corruption, payment for services performed by otherwise underpaid civil servants. The matching of the major interests of the three parties with sufficient resources, powers and rewards to realise them is definitely to be preferred to a monopolistic concentration of all powers into one party. The proposed separation will result in a better balancing of powers and motivations will produce a more optimal operation and allocation of resources in the long run. It will also minimize missappropriation and inefficiency costs which always result from monopolistic power, whether public or private.

(4) Such an arrangement would also make sense in terms of the natural levels of knowledge processing structure and its communication channels. By realistically facing all operative forces, a balanced structural system can be devised which minimizes negative and optimizes positive action. The results in essence may, according to E.A.J. Johnson, be the "the vigorous development which has in the majority of cases been the consequence of variable mixes of private enterprise and governmental subvention or assistance." (Johnson op. cit. p. 379).

B. Shoreline Resettlement is the Apparent Optimum Solution

1. For villages able to move within their present land area and for villages moving within their present micro-region.

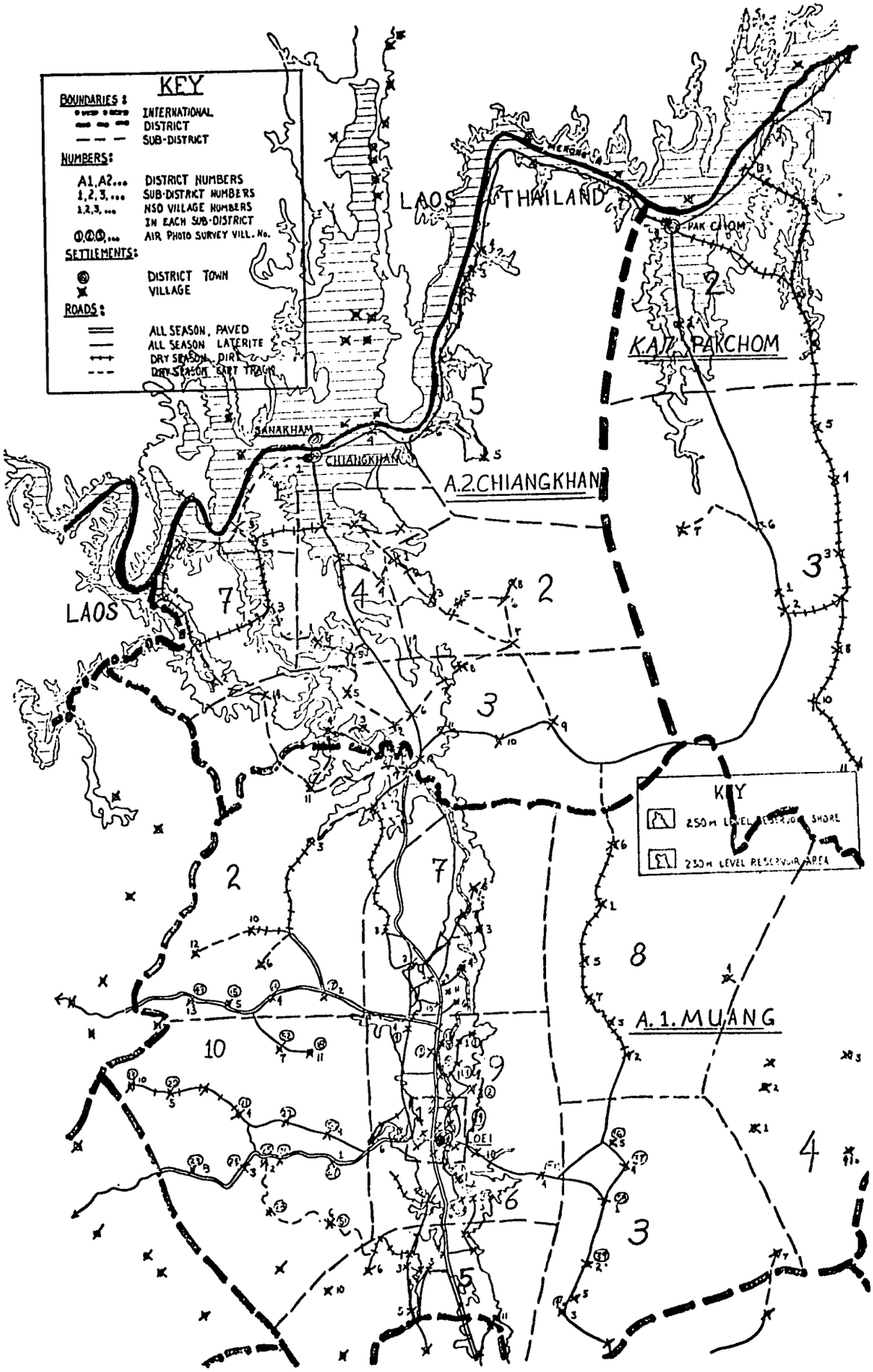
We have generally outlined the micro-regional structure and its contents in the sub-regions of the Pa Mong Area. We now have to investigate how the reservoir will intrude into these structural systems and identify the major problems,opportunities and constraints for relocation policy and planning. On Maps 2 thru 11 in earlier sections, the two levels of the reservoir, 230-meters and 250-meters, have been superimposed in red. (Only Maps 2 and 8 are presented here, the other maps are in previous sections.) Though the matching has not been perfect and the location of villages in the reservoir or at the shoreline can not be taken too literally, one can see the general picture of reservoir intrustion and the necessary adjustment of micro-regions around it. The following observations can be made:

(1) One can see how the reservoir in most of the valleys will take out the very highest developed micro-regions in each of the sub-regions analysed. One can also see the truncated remaining micro systems outside the reservoir. What often remains are at best remote minor central villages and their satellite communities and at worst single communities without central villages at all.

(2) Another factor is that the reservoir takes out mostly utilized land areas with its shoreline frequently surrounded by unutilized lands which in some mountainous areas may have only a limited potential for cultivation. On the other hand if one checks the reservoir outline on topographic maps it becomes apparent that the reservoir will also open up many still uninhabited valleys which show relatively large flat areas, potentially cultivatable. These areas, regardless of present ownership, must be preserved for the relocation of villages since otherwise they will be colonized rapidly by settlers from outside the Pa Mong Region as soon as access to them is provided by the reservoir.

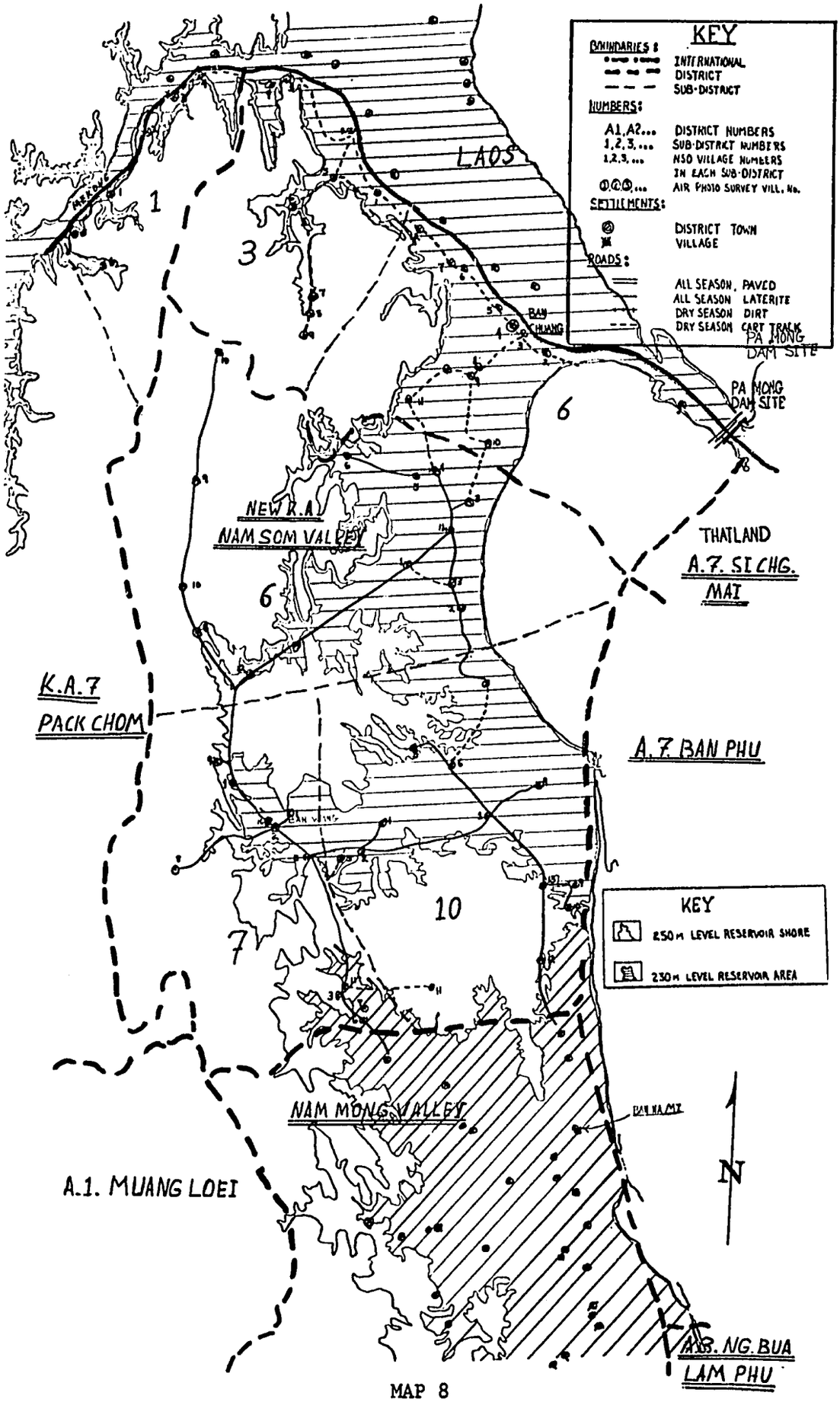
(3) The shoreline of at least 10,000 kilometers in the mostly narrow but many-branched Pa Mong Reservoir cut through the majority of village areas and micro-regions to be inunated This means that for most of the villages a relocation site at the nearest shoreline with a suitable topography for the settlement site and for sufficient cultivated lands should be feasible within or near their presently Utilized Land Area (ULA). Villages moving within their own land area could effect this move by themselves if given sufficient time of about 5 to 10 years. They could within that period "creep" to the new location, developing and using much of their own resources and ingenuity in the process. It would appear that most of the villages within three kilometers distance from the shoreline would fall into this catagory of "relocation creepers". According to Table 2-C this would amount to about 80 percent of all the settlements in the reservoir area. How many of these settlements will not find suitable relocation sites on the nearest shoreline and would have to move (jump) to more distant sites can not be determined at this time from the data available.

(4) The resettlement of villages either to far from the shoreline (more than 3 kilometers) or whose nearest suitable relocation site is more than 3 kilometers and therefore outside their present village territory



MAP 2

Regions 5 and 6: Roads, Distr., Sub-Distr. and Village Numbers.



MAP 8

Region 7: Roads, Distr., Sub-Distr. and Village Numbers.

will in most cases have to jump across presently occupied areas to find suitable relocation sites along the reservoir. Such "relocation jumpers", perhaps 20 to 30 percent of all settlements involved, will need considerably more assistance in the relocation process beginning with site selection and transportation and continuing on to general adjustment into new micro-regional systems. It is primarily for these settlements that unoccupied major valleys opened by the reservoir must be preserved. Many of the "jumping" villages will be in groups i.e. will be whole micro-regions.

(5) Such "jumping" micro-regions will need the most comprehensive assistance in relocation planning and implementation. The assistance for them still should be channeled through the most competent local structures in the sub-regions, which invariable will be the district towns.

(6) The district towns will also be more heavily involved in providing assistance to the relocation of at least the major central villages and micro-regions to be inunated. Most of these CVs will be able simply to move to the nearest shoreline (creepers) but whether they will be able to remain central villages at the new location will be eventually determined by the physical and social factors which together favor certain locations in the development of central places and which are somewhat independent from the capacities and aspirations of the people in these communities. Special attention must be given to these centrality-adjustment-problems in the planning and organization for relocation.

(7) There appear to be four physical factors which will be important in the evolution of a micro-regional network around the reservoir shoreline. These factors are: (a) a constant distance function between central villages; (b) the most feasible road network within the given topography throughout the reservoir area in general and between central villages in particular; (c) the reservoir shoreline cutting through topographic determinants of communication channels; and (d) the natural resources, mostly cultivable land above and below the shoreline. The intersections of these four factors will determine the new favored locations for central places. These favored location would be identified and the site selection for central villages should as much as possible incorporate these favored locations.

(8) The concept of the physically and socially favored location for central places is important in the development of new micro-regional systems and the consequent adjustment necessary by relocated settlements for two important reasons. The central villages which are not located at favored locations may find their centrality severally reduced to the point where they will lose their central position in the micro-region. As we have pointed out the loss of access to processing structure invariable results in a more severe reaction of (defensive) social solidarity then does the mere frustration of aspirations or access to processed new knowledge. On the other hand some villages may get located at favored locations which are totally unprepared for the additional knowledge structure channeling through them. Considerable blockage to the development of new communication channels may occur because such villages simply do not have the competence to process additional knowledge or acquire the necessary knowledge processing structure rapidly enough.

(9) In the long run, lesser villages placed at most favored central place locations will become central villages and former central villages placed outside these locations will lose their status and compentence. During this adjustment time the friction will cause considerable inefficiencies and waste which may be avoidable with forsight and planning. The determination of "most favored central place locations" along the shoreline will depend on very detailed data yet to be obtained and on considerable research on the interaction of the four factors mentioned (and maybe others) which still has to be done.

(10) As emphasised by Mosher and Johnson, roads are the single most important initial factor in micro-regional development. The relocation of inunated roads must therefore be made in accordance with the Basin Relocation and Development Plan and not simply a replacement above and parallel to inunated roads as proposed in the USBR feasability study. The magnitude of roads relocation will be much larger than estimated in the USBR study because of the investment undertaken by the Thai and Laos governments and foreign aid through the road building program in the region over the past five years. Final planning for road relocation should be withheld until all settlement relocation sites have been determined by the other factors of reservoir adjustment; the shoreline, cultivable lands near it, and most favored central place locations along it.

(11) Many lands at ideal relocation sites along the shoreline are already occupied and privately owned. These lands must be included in the acquisition of rights of way by the project under the same authority and policy which allows acquisition of the lands to be inunated. Such acquired land will then have to be redistributed as the placement and compensation to the population to be relocated demands, for either residence or cultivation. Any additionally required lands will have to be developed by the Project Authority. It appears that the replacement of land will on the whole be cheaper than the payment of compensation at present market value. The cadastral survey in Thailand shows cultivated land values to range between 20 dollars a hectare in the Nam Mong Valley and $3,000 a hectar in the Loei Valley. The average land value at $610 per hectare would be substantially above the $350 per hectare necessary to clear, grade and terrace suitable lands with an average 2 to 3 percent slope (or a range of 0 to 5 percent slope). (See Appendix I of the USBR Study).

(12) A cursory inspection of topography maps especially of the 1:20,000-scale show that there should be more than enough land area with a slope of 0-5 percent within a reasonable distance from the shoreline (up to 3 kilometers). The task of developing these lands and financing must be the responsibility of the project authority especially since "in principle it has been agreed" in the USBR report "that this task must be done for the irrigation areas if irrigation development is at all to be feasible". For the sake of feasibility and fairness, the same principle must then be applied for the relocated population. The use of reservoir water for irrigation by pumping may reach significant proportions only during the rainy season when the crest volume of the Mekong will supply more then enough water for both irrigation and turbines. During the dry season the draw-down of the reservoir may make pump irrigation above reservoir prohibitive.

2. Shoreline Resettlement is Essential for Drawdown Agriculture and Fishing.

Drawdown agriculture, the cultivation of lands inunated by the reservoir during the extended annual dry season seems to have been overlooked by most reservoir planners and feasible studies until it was initiated by some innovative and opportunity consicious shore settlers, for instance at Lake Volta. Since the late 1960's research has been started by some reservoir authorities to determine what crops could best be grown under conditions of reservoir drawdown. The two brief accounts on Lake Volta and Lake Nasser below describe the presently accumulated state of knowledge on this type of agriculture: from Kalitze op. cit.:

"Draw-Down Agriculture

An important development in agriculture associated with the Lake which has already started is farming on the land exposed by fluctuations in the Lake levels. This development has started on the initiative of the local lakeside dwellers. But research work has been initiated mainly on the soils and cropping patterns.

The annual fluctuation in the level of the Lake varies between 6 to 14 ft. (2 to 4 m) It has been estimated that at 10 feet, some 200,000 acres would be exposed around the 3,000 miles (4,800 Km) of the lake boundary, with an average of about 200 yards which could be used for farming. The soils in the draw-down area are mostly sandy and well drained. The eastern and southern banks are steep and expose only a narrow area. On the other hand wider stretches occur on the northern banks where population density is low. The northern bank of the Arram and the western bank of the main lake also expose moderately wide area.

At present, only a small portion of the draw-down area, those adjacent to the areas of high density are cropped mainly with vegtables such as tomatoes, okra, peppers and garden eggs, and maize. Some problems encountered include draught conditions and insects.

Crop trials are being carried out to determine the cropping system to be encouraged in the area. It is thought that in the area immediately above the maximum flood level where the water table is high, main crops of cassava, and possible cotton, could be planted in October and November season, with garden crops of groundnuts, okra, pepper, garden eggs as secondary crops. In the areas exposed up to February, groundnuts and tomatoes could be grown as main crops with okra, pepper, garden eggs, maize and sweet potatoes as secondary crops. For areas exposed late February to April ending, rice, maize and sorghum could be grown.

Apart from above, rice can also be grown and it has been estimated that at current low yields of 800 lbs. per acre, at least 30% of the country's rice imports can be produced."

and from: P.C. Raheja op. cit. "Lake Nasser: A Case Study". UNSF-FAO Lake Nasser Development Centre Project, Asswan:

"Shore Agriculture

There is no farming community at present existing around the lake. Over 86 per cent of the fishermen were originally farming the land in their native villages. But they have not so far taken to farming as new settlements have not yet been set up. It is after surveying the soils in Khors, Wadis and peneplains between the levels of 160 and 190 m that schemes for development of lake shore agriculture would materialise. In the meanwhile experimental work was taken up in 1969 and 1970 for selection of crops suitable for cultivation. In both the years, due to lack of facilities, the work was undertaken in late March. Of the crops sown most successful was water melon. The other crops which showed promise are Sorghum, Cucumber, Cucumis peop, maize and snake Cucumber. All the crops showed very good germination on the residual soil moisture of the receding water front. The growth was satisfactory for one month. Thereafter the crops needed frequent irrigations. With limited amount of irrigation available the crops of water melon and Sorghum matured. Due to high mean temperatures of 34° - 36° C. in the period May - June other crops dried up permaturely. Thus it was concluded that summer crops must be started from January - February The response to levels of nitrogen was shown in growth and development of fruits in water melon and Sorghum crops."

In 1970 preliminary data on cost of cultivation of these crops was compiled."

An excerpt of a paper summarizing the problems and experiences otherwise encountered with draw-down agriculture have been presentated by D.R. Sikka at the above mentioned convention on Man-Made Lakes in 1971: Only the excerpt of his paper have become available which are reproduced here: D. R. Sikka: "Planning and Allotment Procedures for Marginal Agriculture in Reservoirs for Optimum Use."

"In reservoirs, large areas come under submergence as soon as construction of dams is completed. The Irrigation and Power Development needs "stage approach", thus regulation of water releases on initial and full development, would materially effect the position. It is therefore, necessary to make use of the available agricultural lands even after completion of projects, even though they might have been acquired from their owners.

In a predominantly agricultural country, where people's economy is entirely dependent on cultivation, a very careful watch is to be kept while finalizing the areas to be acquired by the State for the operation and control of water supplies and the marginal lands could also be developed between average and the maximum flood levels, lasting for short durations. Permanent and temporary acquisitions of the lands under a phased programme could be resorted to with appropriate procedures for leasing and letting out to the Society either with or without auction.

While evaluating the capital investment, the benefit cost ratio, in such man-made lakes, it would be apparent that the impact of land acquisition, compensation, loss of production, advantages of marginal agriculture and their returns on changing cropping patterns versus the initial loss suffered by the Society are kept in view.

At what rates, terms and conditions such marginal lands should be allotted and to whom, have to be detailed out by the administration to avoid frustration amongst those displaced landless people, who have not been given alternative, 'equal return' land. The assessment and recovery rules in such cases also require fine definition as sometimes about 25% of the total acquired area gets opened up. The difficulties in accurate assessment get further multiplied due to: silting of the field's boundaries after formation of lakes as such, the question of a uniform land rent/water rate on modified blocks after taking into account submergence/fertility factors."

The Pa Mong Reservoir seems to contain a huge potential for draw-down agriculture. The fluctuation between the annual normal and draw-down levels is large, being 10-meters on the average. In many areas of the reservoir branches, a 10-meter fall of the reservoir level will expose relatively large areas of formerly cultivated or cultivatable land.

As can be seen on aerial photo #1, the Mekong Region has considerable knowledge on the techniques of what is in essence a kind of draw-down agriculture which is now practiced all along the Mekong.

Draw-down agriculture along the Mekong takes place in two location types: one, on a smaller scale is done by terracing the sometimes steep but fertile banks of the Mekong River. This is done by practically every settlement along the Mekong River from Burma to its mouth in Vietnam. Crops grown here are mostly vegetables for home consumption. The other location type is on the rather large silt and sand banks such as the one also shown in aerial photo #1, which are exposed in the dry season each year. These large flat areas become available usually for at least 3 to 4 months every year. Crops grown on a large scale are sometimes vegetables but more often watermelons and tobacco. With the knowledge and experience existing in the Pa Mong Region these practices should easily spread throughtout the Pa Mong Areas suitable for this type of agriculture, especially if assisted by extension training and provision of inputs.

In areas last exposed by the draw-down and first flooded again, where the time period of exposure is too short to raise and harvest any kind of crop, green manures could be grown which would attract fish during the flooded stage of the reservoir. In addition, permanent fish farming of these areas could be instituted by building permanent, high fences along the lowest drawn-down shoreline with built in fish traps. The fish traps, growing in the fence enclosed reservoir areas, would be caught automatically at final stages of draw-down and be harvested very easily. These areas would have to be stocked with rapidily growing fish which mature to marketable size within 10 or 11 months. The inital food for these "fish cropping areas" could come from the inunated green manure crops, while the final feeding may be possible from crops grown on the first exposed lands of the draw-down cycle.

It appears that draw-down agriculture and fish cropping can potentially be most intensive and complementary. This potential has obviously far reaching implications for shoreline resettlement and reservoir land development. Research on the potentials along the Mekong Reservoir should be initiated as early as possible before any relocation planning has to start.

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APPENDIX A

Standards for Relocation

Abstracts from papers on Resettlement Guidelines presented at the International Symposium on Man-Made Lakes, Knoxville, Tennessee May 3-7, 1971

RESETTLEMENT

Dr. Charles A. P. Takes

In the paper the following theses will be elaborated:

1. Social justic demands that people who are compelled to leave their lands and homesteads in a reservoir area should

   a) not only be compensated for loss of material property, but also be enabled to earn an adequate new living,

   b) benefit equally with other inhabitants of the project area from the improvements brought about by physical construction (flood control, irrigation, generation of power, etc.). This means that the orthodox principle that people should be compensated in such a way that they are "no worse off than before" is far too passive and lacking in dynamism.

2. To ensure maximum welfare benefits from dam projects, the costs of satisfactory resettlement and other rehabilitation measures should be planned and budgeted for simultaneously with those of physical construction and should be integrated in total project cost.

3. The integration of resettlement costs in the total project budget will facilitate the recruitment of expertise from international and other outside resources; it will also facilitate the recruitment of capital from such resources, should the economy of the country be unable to bear the cost of satisfactory planning and execution of rehabilitation measures.

4. Where farmers are to be evacuated from reservoir areas, resettlement on suitable cultivable lands will, in general, be the most appropriate way of providing them with an adequate new livelihood. Full attention should also be paid, however, to evacuees with other occupations and to those farmers who may wish to be rehabilitated in a different way. In the latter cases measures should be taken to ensure that cash compensation paid for loss of production means will be used only for productive purposes.

THE MIGRATION OF POPULATION AND ECONOMY REORGANIZATION DUE TO RESERVOIR CONSTRUCTION IN THE USSR

A.B. Avakyan, V.A. Sharapov

The development of economy in the Soviet Union has caused a necessity of streamflow regulation. The construction and operation of reservoirs in economically developed regions where river valleys are as a rule densely populated and well developed exert influence on the nature and economy of riverside areas within both the backwater and downstream zones of hydraulic structures.

Settlements may be in different zones of direct and indirect reservoir influences. Simultaneously with the direct effects of reservoirs on the area of settlements, the economy of regions and individual industrial and agricultural enterprises is also affected: economic ties, transport conditions, sanitary situation, particularly, change that also influences settlements and population.

The regional planning scheme is the basis of projecting measures for settlement transfer. It covers prospects of economy development, rational distribution of urban and rural settlements and perspective sites for new settlements, industrial enterprises and other utilities, transport links, etc. with taking into consideration the natural and economic conditions of the region, which change as a result of reservoir construction.

The selection of sites for settlements and planning of resettlement measures are made proceeding from the following principles: (a) new settlements are placed where most favorable natural and economic conditions exist and at the shortest possible distances from the area of old residence; (b) houses tend to be removed to existing settlements in order to make utmost use of the municipal, public and industrial utilities, transport and other facilities as well as in order to enlarge settlements; (c) the lay-out of new settlements, residential and municipal construction are based on modern sanitary and architectural standards; (d) all costs of transfer and reconstruction of buildings are included into the hydraulic structure construction cost estimate. In addition, the migrants are paid for their belongings, transportation, temporary renting, etc.

Reservoir construction is a major factor of population migration and leads to a considerable change in the geography of population over vast areas causing more rational distribution and enlargement of settlements, improvement of transport links, municipal services, architectural look, etc.

GUIDELINES FOR RESETTLEMENT AND REHABILITATION OF UPROOTED AGRICULTURAL POPULATIONS ON FORMATION OF LAKES

D. R. Sikka

Rehabilitation and resettlement of displaced persons from the areas and villages coming under the submergence of lakes is a very intricate and a 'human' problem, only the degree of severity is at variance, both in highly developed areas whether industrial or agricultural and in case of highways, railroads and other establishments all would require relocation, although even after adopting cardinal principle of the greatest good to the largest number, would need sacrifices on the part of section of the population with large scale, financial implications at times.

Separation from its established surroundings and resettlement needs careful and tactful handling. Insistence of law and authority would not be enough. Socio-technical education might be advantageous along with understanding, sympathy and compassion. The problem is likely to be more complicated in case of inter-state rivers.

Number of projects have been constructed in this country and the paper could try to assess and work out the details of problems by the brief case study. Besides Socio-studies, necessary facilities like preferential allotment of shops, professional adjustments, trades and employment, changing of cropping patterns, setting up special industries, construction of new colonies with all modern amenities, establishment of work centers and modern industrial units, and so on, it would be necessary to work out a national policy for this important administrative measure, which involves numerous problems at every time, a project is constructed and lakes created.

When actual tiller of the land becomes landless, no amount of cash and kind compensation might satisfy his hunger for getting land for land and that might involve a transportation of the society and environments as a whole, a strong policy for carrying out rehabilitation and resettlement of displaced persons from the river valley projects, it will have to consider the need of minimum submergence and consequent minimum dislocation and for that, it would be compulsory to technically assess and finalize irrigation and power loads and demands along with supplementing the same for the residual by underground water resources. A set pattern for transformation of forest and waste lands for agricultural lands in a preplanned way would also be necessary for these areas where agriculture is the backbone of the Society. The procedures to compensate and allot the various alternative facilities to the displaced persons will have to be streamlined and results ensured that their economic conditions were better than prevalent before.

Various legislative measures would also be required for the realization of these objectives.

APPENDIX B

Excerpts on Resettlement and Relocation from:
Pa Mong Stage One Feasibility Report

by

United States Department
of the Interior
Bureau of Reclamation

(Page numbers are those in the USBR Report)

O. LANDS AND RIGHTS, CLEARING AND RELOCATIONS

Pa Mong Project features will require the acquisition of lands in Thailand and Laos for construction of dams, reservoirs, canals, laterals, drains, and other project facilities. About 293,600 hectares of land will be cleared within the reservoir areas, and about 16,400 hectares of project land will receive some type of clearing treatment preparatory to irrigation. Existing physical features will be relocated to allow construction of project facilities, and people living within the reservoir area will be relocated and resettled.

Under Thailand's Immovable Property Expropriation Act, B.E. 2497 (1954), it is possible to expropriate titled and/or other occupied lands when no transfer has otherwise been agreed upon for purposes benefiting the State. This act requires that compensation be made to owners for damages incurred during implementation of temporary surveys on the lands or for permanent acquisition of lands and other immovable properties such as trees, buildings, and structures. It is understood, although the specific law, act or code remains unidentified, that land and properties can be similarly acquired for the State's use in Laos under provisions of Royal Decree.

The construction of Pa Mong, Nam Mong, and Nam Lik Dams and formation of the combined reservoirs to an elevation of 250 meters, which is the top of the joint use pool, will require the acquisition of an estimated 409,700 hectares of land within the reservoir take-line elevation of 253 meters. The 253 elevation take-line will provide 1.5 meters of surcharge, plus 1.5 meters of freeboard. The maximum water surface elevation will be 251.5 meters. The combined reservoir site is relatively remote with the exception of Loei Valley in Thailand which has substantial population and private development. Other privately held lands are found in relatively small villages located along both sides of the Mekong River throughout its reach within the potential reservoir area. Although no specific data are available, RLG and RTG forest-reserve lands comprise the major category of landholdings in the reservoir area with an estimated 206,200 hectares in Laos and 203,500 hectares in Thailand.

The potential Stage I Area includes 11,420 and 31,580 hectares of irrigable land in Laos and Thailand, respectively. These lands lie immediately downstream from the Pa Mong damsite on both sides of the Mekong River, in relatively highly developed agricultural areas. Rights-of-way required for construction of distribution canals, laterals, ditches, and drains will result in an estimated 9 percent loss in productive land in the Stage I Area. An estimated 21,000 Lao and 86,000 Thai live within the Stage I project service area. The proposed irrigation service area contains about 8,000 hectares of irrigable uncultivated land and about 35,000 hectares of irrigable cultivated land. Based upon studies in Thailand, it is estimated that nearly all of the Stage I land is held privately. Forest reserve lands represent a very minor portion of all land within the irrigation service area.

The entire reservoir area population consists of about 19,900 families in Laos and 24,550 families in Thailand, all of whom will have to be resettled or relocated. It was originally assumed that most of the displaced families would have an opportunity to be resettled on new project lands. Subsequent investigations have revealed that essentially all the irrigable land is occupied. The RTG has assumed responsibility for investigating resettlement requirements for the Pa Mong Project in Thailand and has prepared a report[1] covering various phases of the problem. No specific resettlement sites have been designated.

The Lao portion of the resettlement problem has not been studied formally; however, a letter report thereon entitled, *Pa Mong Project–Reservoir Cadastral Survey in Laos,* was prepared by a Working Group, RLG/Mekong Secretariat July 27, 1969. These reports provided the basis for project resettlement cost estimates.

In order to reduce operational debris removal requirements within the Pa Mong Reservoir and to provide fisheries, wildlife, and recreational enchancement, it will be necessary to clear the reservoir's forested areas. An estimated total area of 293,600 hectares in Laos and Thailand will have to be cleared. Native tropical vegetation types and densities include bamboo and brush, low, open forest, mixed-open forest, and closed-canopy forest varities. Topography ranges from relatively accessible and smooth or gently undulating surfaces to extremely high slopes and rough surfaces. Reservoir clearing will include cutting and burning of native vegetation but not grubbing of stumps and roots.

Clearing of irrigable lands within the project area will be accomplished to provide new lands for agriculture and to improve operation on existing partially cleared lands. It is estimated that about 16,400 hectares of irrigable land within the Stage I Area will require some type of clearing. Vegetation types and densities will be similar to those within the reservoir area, but the area topography is relatively level and smooth.

Project construction requirements will include relocation of important hard-surfaced roadways that transect the Pa Mong-Nam Mong-Nam Lik Reservoir areas. Construction of access roads to site locations of major project reservoir features such as Pa Mong, Nam Mong and Nam Lik damsites will be required as well. Project features will include about 200 kilometers of hard-surfaced road relocations and about 90 kilometers of hard-surfaced access roadways.

[1] *Project Settlement and Estimation of Expenditure for Establishment of the Pa Mong Project Settlement,* dated December 30, 1968, prepared by the Settlement Programming and Planning Division, Department of Public Welfare, Ministry of Interior.

I. RESETTLEMENT

1. DISPLACEMENT EFFECT

Development of the Pa Mong Project will displace a large number of families, estimated at 24,550 for Thailand and 19,905 for Laos, because of inundation of lands by the reservoir, rights-of-way acquisition, and other project activities. This potential displacement of people was recognized early in the investigation and was outlined as Support Program Item 5-F in the Pa Mong Project, Phase I Report, 1966. It was originally assumed that most of the displaced persons would have an opportunity to resettle on project lands. However, it was found during subsequent investigations that essentially all the irrigable land has been taken. New settlement sites have not yet been located. Location, however, should not affect project cost estimates inasmuch as the settlement sites will be situated on government-owned property and will not require further project expenditures for rights-of-way.

Thailand has assumed the responsibility of investigating this item and the RTG agency concerned has prepared a report[9] covering various phases of the problem. A formal report on resettlement has not been prepared for the Lao portion of the project; however, a letter report on landownership[10] was received from which estimates have been made.

2. PLANNING RESPONSIBILITY–THAILAND (COROLLARY REPORTS)

A brief analysis and summary of these reports is presented, herein, which also includes additional information obtained from the authors. These reports are included in Appendix VII, Corollary Studies.

The resettlement aspect of a water resources development program that deals specifically with handling of persons displaced from an area to be flooded by a reservoir impoundment is not new to Thailand. There are a number of reservoirs of substantial size already built in Thailand and a number of smaller scale tank impoundments. Laos has had less experience with the problems of displacement of groups of people and resettling such groups, although the matter of resettling people to be displaced by the waters stored behind Nam Ngum Dam must be settled soon.

In Thailand, the Ministry of Interior, through its Public Welfare Department, has the responsibility of planning for the resettlement operations. This responsibility involves the initiation of surveys to identify the size and complexity of the resettlement problem, the selection and assignment of areas for resettlement under direction of the Cabinet Committee, the preparation of plans for the resettlement areas, the preparation of budgets, and supervision of actual resettlement operations.

3. PLANNING RESPONSIBILITY–LAOS

In Laos, the Department of Relocation and Resettlement, Ministry of Social Welfare, has responsibilities for resettlement activities. In recent times the settlement of refugees from areas of security hazard has been a priority requirement.

4. PLANNING CRITERIA–THAILAND

The usual Thai budget for a resettlement operation is based upon field studies for a specific resettlement site. For the Pa Mong Project estimate no specific sites were studied; therefore, an assumption was made that there would be three sites in each of three provinces–Udon, Nong Khai, and Ubon. For the entire Pa Mong Project resettlement operation in Thailand, the Department of Public Welfare estimated that they would require about 196,000 hectares of land. The average area allotted for a village is 200 hectares, which encompasses community facilities, homesteads, and agricultural lands. Community facilities consist of roads, a water supply system, wats (temples), schools, and administrative buildings.

The average area to be allotted for each family for settlement purposes amounts to about 25 rai. Three rai are to be cleared initially by government forces, of which two rai will be for homesite purposes and one rai for immediate use for planting of subsistence crops. Under usual circumstances the balance of the 22 rai would be cleared by the farmer and his family as time and energy permitted. However, for our analysis to be conservative, an item of cost has been included for clearing of all 25 rai in each of the settlers' tracts. It is interesting to note that the average size of present farmholdings in the Northeast is very close to that proposed for the farm units in the resettlement areas.

The Thai resettlement area budget includes salaries and wages for Welfare Department workers and supervisors, equipment for the building of roads, moving of materials used in the construction of community facilities and the needed lumber and building materials, spare parts for equipment, etc. Costs were also included for land upon which community facilities may be constructed. A portable sawmill will be included in the equipment list to permit settler utilization of trees cut in the clearing operation for housing materials.

Compensation will be given to owners for the land and moveable property which lie within the proposed impoundment area. Displaced people will be given land in resettlement areas if they wish to reside in these prepared locations. If they do not choose to take advantage of this opportunity they will not be given

[9] "Project Settlement and Estimation of Expenditures for Establishment of the Pa Mong Project Settlement," December 30, 1968, Settlement Programing and Planning Division, Department of Public Welfare, RTG Ministry of Interior.

[10] "Pa Mong Project–Reservoir Cadastral Survey in Laos," letter report prepared by Working Group, RLG/Mekong Secretariat, 7/27/69.

money in lieu of land in the resettlement areas. Estimates of costs are based upon the assumption that all people will wish units in the resettlement areas. Actual participation in the resettlement ventures by people displaced by reservoir impoundments in Thailand range from 30 to as high as 80 percent. Cost estimates prepared by the RTG Department of Public Welfare for Pa Mong Project are overstated if resettlement participation is less than 100 percent.

5. ADDITIONAL CONSIDERATIONS

Specific items were added to the submitted budget in order to cover other economic costs involved in resettlement efforts and directly attributable to the costs of the Pa Mong Project. These include: (1) A cost for moving people and their property from the reservoir area to a new resettlement homesite. This item was estimated by National Energy Authority on the basis of their past experience to be equal to 15 percent of the established value of such property excluding orchards, (2) A cost for clearing of the settler's land in excess of the 2-rai homestead site. This envisions that clearing for the agricultural lands will be accomplished by the use of appropriate machinery but that stumps and roots will not be grubbed out as will be done in the project irrigation area. An estimate of $30 per hectare was used for this item, (3) A cost for a temporary living allowance for a 90-day period which will permit purchase of a limited amount of rice or other food items during the initial period before vegetable and other annual crops could be harvested. This allowance amounts to approximately $0.50 per family per day or approximately $45 for each family. This allowance will be equivalent to that now being allowed by the Department of Public Welfare for certain types of resettlement assistance in the southern part of Thailand. Previous to this recent change, policy did not permit temporary assistance to persons being resettled.

Based upon the existing criteria used by the RTG in their resettlement operations, and including the three items mentioned immediately above, an estimate of costs was prepared for resettlement of the families in the Thailand portion of the Pa Mong/Nam Mong Reservoir system. This estimate is shown in Table IX-5. A value of $11,420,000 was used to cover Thailand's portion of costs involved in the resettlement of persons displaced by Pa Mong Reservoir impoundments.

6. PLANNING CRITERIA–LAOS

Since no formal report on resettlement has been prepared for the Laos portion of the Pa Mong Reservoir, an estimate of the number of families who will be involved in resettlement activities was based upon the letter report of July 27, 1969, referred to in footnote 10 of this chapter. Cost estimates for the Laos portion of the resettlement program were prepared from data regarding the Thailand studies. Costs for Laos using the Thai data amounted to $7,584,000 and are also shown in Table IX-5.

7. TOTAL RESETTLEMENT COSTS

Total project costs for resettling of people displaced by Pa Mong and its associated reservoirs are estimated to be $19,000,000. The elements included and their costs are summarized also in Table IX-5.

8. DESIRABLE PLANNING OBJECTIVES

The responsibilities assumed by governments with respect to assistance given to the resettlement of families displaced by reservoir impoundments vary widely. The ability to respond to these acknowledged needs and responsibilities depends upon ready availability of funds for this purpose. Thailand recognizes the need and has made policy and administrative efforts to facilitate the readjustment of families so displaced. There is an understandable gap between goals and accomplishments, but positive steps have been made to meet the needs. The basic objective is to assist the displaced families to become reestablished in the shortest possible period and to situate these families in such a manner that they can quickly become self-sustaining, productive members of the Thai economy. A similar humanitarian objective is assumed to be existent in the policy decisions of the RLG.

A broad statement of desirable principles and policies governing resettlement activities within the Lower Mekong Basin has been prepared by a Working Group established by the Mekong Secretariat.[11] Representatives of the Royal Governments of Laos and Thailand participated as consultants in the preparation of this statement. Attainment of all the objectives stated in this paper will be difficult to achieve. However, many of these goals will be realized, in whole or in part, during the process of development of water resource projects in the Lower Mekong Basin.

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[11] "Statement on Principles and Policies for Resettlement and Settlement in the Lower Mekong Basin," August 1968, prepared by an Interagency Working Group established by the Executive Agent of the Mekong Committee, March 1968.

Table IX-5

RESETTLEMENT COSTS FOR PA MONG, NAM MONG (THAILAND), PA MONG, NAM LIK (LAOS)

Item	Laos	Thailand	Total	Percent
Total area to be blocked out for resettlement purposes (hectares)[1]	159,293	196,464	355,757	–
Number of families to be moved[2]	19,905	24,550	44,455	
Settlers' clearing cost (dollars)[3]	2,197,512	2,710,320	4,907,832	25.83
Moving costs (dollars)[1]	551,850	2,746,831	3,298,681	17.36
Temporary living allowance (dollars)[1]	870,904	1,074,137	1,945,041	10.23
Administrative costs (dollars)[1]	3,963,683	4,888,639	8,852,322	46.58
TOTAL COSTS (dollars)	7,583,949	11,419,927	19,003,876	100.00
Rounded	7,584,000	11,420,000	19,000,000	

[1] For Thailand – Based on Department of Public Welfare Study.
Laos – Based on Thailand data.
[2] For Thailand – Based on Department of Public Welfare Study.
Laos – Based on Mekong Secretariat Study Group data.
[3] $30 per hectare.

IX–17

M. CADASTRAL SURVEY, RESERVOIR AREAS, THAILAND AND LAOS

The estimate of right-of-way costs for Pa Mong Reservoir involved the determination of the cost or economic value of all lands, buildings and structures, man-made improvements, including villages and towns and agricultural properties which will be physically located within the impoundment area of the reservoir. The reservoir area was initially based upon an assumed elevation of 250 meters and rights-of-way costs were estimated at this elevation, at which the reservoir will have an area of 3,846 square kilometers. At elevation 253 meters, which involves surcharge storage for peak inflow, wave action, erosion, etc., the area of the reservoir will be 4,097 square kilometers, according to preliminary topographic maps.

The incremental area between these two elevations, approximately 25,000 hectares, was assumed to be forest lands. The cost or economic value of this area has been estimated as nonagricultural and nonurban forest land, the value of which has been computed on the basis of capitalization of potential net annual income from lumber production. The area of land involved in the reservoir rights-of-way estimates at elevation 253 meters is shown below:

Country	Area in square kilometers	Area in hectares
Thailand	2,035	203,500
Laos	2,062	206,200
TOTAL	4,097	409,700

The study of the Pa Mong Reservoir in Thailand, including the Nam Mong portion, was undertaken by the RTG National Energy Authority under Item 24, Reservoir Cadastral Survey, outlined in Chapter 13, Volume 1, of the Phase I Pa Mong Report.[15] A companion study under the Support Program in Laos was performed by the Mekong Secretariat in cooperation with the RLG.[16] Neither study included the value of the predominantly government-owned forest areas as a direct rights-of-way cost. The potential annual production of forest lands was capitalized to arrive at an economic value, and these values were included as induced costs in Chapter IV, Economic Justification, Appendix VI. A brief discussion of the separate rights-of-way costs for Thailand and Laos follows.

1. THAILAND

Initial plans to do extensive fieldwork to assist in establishing land and improvement values met with difficulties because the areas involved are politically sensitive. Some portions of these areas lacked suitable road accessibility and in others there were security problems. It was found expedient to use an alternative approach which involved limited fieldwork, study of aerial photographs, and use of land and property values from secondary data available from the National Statistical Office. Provincial and amphoe offices were visited to review land and property files and to discuss property and land values with responsible officers. Quantitative information was first obtained on government-owned lands, primarily forest lands, except for land used for agricultural production within experiment stations. Similar quantitative information was obtained on privately owned lands, both agricultural and nonagricultural. Nonagricultural lands included those used for commercial purposes, including factory sites and processing establishments.

[15] Pa Mong Reservoir Cadastral Survey, Technical Division, National Energy Authority, Ministry of National Development, Thailand, July 1969.

[16] Pa Mong Project, Reservoir Cadastral Survey, Laos, prepared by a Working Group, Mekong Secretariat, Bangkok, June 1969.

Quantitative data were also accumulated for both government and nongovernment land and property within perimeters of villages, towns and other administrative centers, use of which would be largely residential or commercial. Details of the methodology and the procedures used in this analysis are contained in the cited RTG study

Using the methods and procedures outlined in the RTG study, the value of land was based upon the latest values assigned by the Land Department for purposes of establishing a base for tax assessment. The value of improvements was established by a survey which included three large towns in the reservoir area, all villages containing over 200 families, and about 50 percent of the smaller villages selected on a random-sample basis. These data were tabulated and a relationship established between size of village and improvement values. Using this general method for estimating, the following monetary values were computed:

PA MONG AND NAM MONG RESERVOIRS
AT ELEVATION 253 METERS

Item	Area (Rai)	Economic value Baht	Economic value $
Pa Mong (Thailand)			
Land	148,250	415,500,000	
Property	–	362,300,000	
Subtotal		฿ 777,800,000	$ 37,812,000
Nam Mong			
Land	53,357	16,100,000	
Property	–	37,600,000	
	201,607	฿ 53,700,000	$ 2,611,000
Rounded Total	32,300 (Hectares)	฿ 831,500,000	$ 40,423,000

2. LAOS

The method of establishing rights-of-way values for the Laos portion of Pa Mong Reservoir involved use of aerial-photog aph interpretation and was largely based upon secondary sources of data. Values of land were essentially based upon the comparative value of similar lands in Thailand. Value of schools and religious structures were obtained from the Ministry of Education, RLG. Other types of structures and improvements were based upon comparable Thai property values. The major portion of the Laos land which will be inundated by the Pa Mong-Nam Lik impoundment was found to be in forest lands which are considered to be Crown property. The area of land developed for agricultural production is relatively small. The nature of the terrain, lack of road networks traversing the reservoir area, and instability of the area in terms of security precluded initiating a study of the detail and scope of the one accomplished in Thailand. The table below summarizes the rights-of-way values established for the Laos portion of the Pa Mong-Nam Lik Reservoir impoundment at elevation 253 meters.

3. SUMMARY OF RESERVOIR RIGHTS-OF-WAY COST (LAND, PROPERTY AND IMPROVEMENTS):

Thailand	$ 40,423,000
Laos	$ 14,257,000
Total	$ 54,680,000

Item	Area (Rai)	Economic value (Baht)	Economic value $
Pa Mong-Nam Lik			
Land	79,779	131,475,950	6,392,000
Property	–	161,777,000	7,864,700
Total	79,779	฿ 293,252,950	$ 14,256,700
Rounded	12,765 (Hectares)		$ 14,257,000

H. RELOCATION OF DISPLACED FARMERS AND NEW SETTLEMENT OPPORTUNITIES

Of major importance and concern in development of the Pa Mong Project is the displacement of approximately 45,000 families—25,000 in Thailand and 20,000 in Laos—from inundation of lands by the reservoir and acquisition of other project rights-of-way. Investigations have revealed that nearly all of the project irrigable land is already under private ownership, leaving practically no project lands that could be utilized for resettlement purposes or for new settlement opportunities.

Displaced persons, however, will be compensated for their land and property within the potential reservoir impoundment area, and will be given land and other assistance if they wish to reside in new, but as yet undetermined, resettlement areas. Thailand recognizes the need to resettle displaced families and has provided agencies and arrangements to facilitate readjustment of the families that would be relocated. Similar arrangements exist in Laos.

I. SOCIAL IMPACTS OR EFFECTS FROM PROJECT DEVELOPMENT

The project will have social effects on a great many people and institutions. The lives and livelihoods of farmers, businessmen, professional men, laborers, and people engaged in transportation, trade, finance, public services, and utilities will all be affected socially. Farmers will need to work in the fields in all 12 months of the year instead of the traditional 6 months. This will reduce their time for other activities including recreation. Existing social structures will be disrupted somewhat during construction of project distribution facilities and the on-farm development facilities. This will require temporary readjustments. Village life will change with respect to the operation and maintenance of the irrigation facilities. Farmers will find organization necessary to assist each other in the common goal of maintaining their irrigation facilities. This type of community cooperation has not often been required in the past. A greater degree of individual leadership will be required to operate and maintain the irrigation facilities. Extra schooling will eventually be required as the need for more advanced technology develops. Greater amounts of agricultural extension training will also be required to assist the farm operators in improving farm management practices.

Increased activity resulting directly and indirectly from the project will create an increase in the demand for agricultural products; agriculturally oriented industrial products; nonagricultural products; and for products or services from mining, manufacturing, power generation, and service industries such as transportation, trade, finance, and public utilities.

1. POLITICAL STABILITY

The project will have an important social effect on political stability in both Thailand and Laos. A beneficial effect on political stability will result from the banding together of communities for the operation and maintenance of the irrigation facilities—cooperation in a common cause. Communications will be more effective through established organizations. Greater allegiance to the national interests can develop through these organizations. A successful resettlement program will contribute greatly to local political stability.

An editorial statement in the "Bangkok Bank Monthly Review," September 1969, about defense and internal security also applies to the potential Pa Mong Project:

> "A more positive approach to rural security would be through economic and social measures. A higher standard of military and political security can be obtained in the countryside by striving for a higher degree of economic and social security for the farmers."

Much of this security can result from the change or shift from near-subsistence farming to a more intensive, double-cropping system producing more crops for sale on the commercial market and thereby increasing cash farm income and national benefits. Further political stability will result from increased consumption of commercial goods and services, which will provide greater profits to the industrial sector of the economy.

2. ENHANCEMENT-OF-VALUE CONCEPTS

Social impacts will accrue with the enhancement of personal and real property values. This will tend to fulfill a common individual desire for wealth, prestige, and influence with other villagers. Personal goals in life will be more attainable through the capacity to utilize value concepts relative to production of additional wealth. Values of business will increase due to increased incomes.

3. IMPROVEMENT OF LIVING CONDITIONS

Substantially improved living conditions should result from the development of the Pa Mong Project Stage I Area. Homes should be enlarged and improved, and more and better food will be available. Availability of good, potable domestic water will be a definite asset to community living. Health and sanitation conditions will improve. More family income will be available with which to acquire the necessities or luxuries of life. Sales of radios, televisions, motorcycles, and laborsaving farm or household equipment will increase greatly.

E. PROJECT FEASIBILITY AND JUSTIFICATION

Benefit-cost ratios, internal rates of return, and project payout studies are indicative rather than conclusive in making decisions on water resource projects and programs of economic development. Many important aspects of such decisions are not subject to monetary analysis. The social and economic setting, problems and needs of the area, present and potential conditions of resource use, the wide range of multiple purposes, economic impacts, and social considerations described in previous chapters of this report all have a bearing on project justification and feasibility.

In particular, analysis of Stage I of the Pa Mong Project as an isolated operation is a partial analysis because the full services which the project can provide in the project area have not been taken into account, and its operation as part of an integrated system of developments in the Lower Mekong River Basin is not yet indentifiable. The findings of this report are therefore subject to refinement when results become available from the further studies listed in the section on Conclusions.

APPENDIX C

S C A L E 1

MAXIMAL GUTTMAN SCALING WITH SCALE STATISTICS

by

Barton Sensenig 3rd
Programmer

&

Harold E. Voelkner
Analyst

October 1971

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INTRODUCTION

The Guttman Scaling program was written by Barton Sensining, Department of Sociology, Cornell University, according to the specification given by the analyst and project director, H. E. Voelkner, Washington, D. C., for an applied research project on regional analysis and reservoir settlements relocation for the proposed Pa Mong Dam Project in the Mekong Basin. (1) (Contract AID/EA-147 (Regional) PIO/T 498-220-3-1004). The scaling routines were adapted from a much simpler program written by Gary Simon for the IBM 1620 at the University of the Philippines College of Agriculture at Los Banos.

This Guttman Scaling program was specifically designed for scalogram analysis within the framework of socio-structural (structural-symbolic) theory as postulated by Professor Frank W. Young and Dr. Ruth Young at Cornell University.(2) The program generally follows the scaling rules first defined by Louis Guttman (3) as applied by Gary Simon in the base program. However, some modifications (usually optional in the program) and additional rules have been incorporated to facilitate certain theoretical interpretations or to analyse special sets of data. Some of these modifications, such as measuring scalability based on step averages or combining data from two different times into one scale, were developed and theoretically justified by graduate students of Professor Young at Cornell University. The Shadow Scale, percent deviations per range step, the re-ordering of items and cases within steps to reduce deviation dispersion, the scale line maximizing the scale score in case of ties and the use of the larger sum of non-modals for computing the scalability coeffient in cases of long and narrow scales, have been added by the analyst. The programer developed the dispersion coefficient which is a normalised summation of distances of deviations from the scale line and which serves as an additional coefficient in determining the best possible scale.

The central variable in socio-structural theory is structural differentiation. Both the presence and change of differentiation can be measured by Guttman Scales. Generally the data used represent the presence or absence of strictly qualitative

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(1) See final report: H.E. Voelkner et.al. "Social Factors in Reservoir - Settlements Relocation: An Adaptation of Scalgram Analysis Using Aerial Photography and Ground Survey Data - Applied to the Mekong Basin Pa Mong Project", Agency for International Development,U.S. Department of State, 1972.

(2) A book on the theory is shortly to be published by the Young's.

(3) See Louis Guttman: "Cornell Technique for Scale Construction" in R.W.O'Brian, etal. "Readings in General Sociology" Hughton Mifflin Co. Cambridge, 1951 and several other papers by the author on the subject. The best description of the method however can be found in textbooks on statistical methods for social science such as M.J. Hagood and D.O. Price, "Statististics for Sociologists". New York: Henry Holt Co. 1952.

More recently a possible improved method of development scaling which permits atrophy of attributes has been suggested by R. K. Leik and M. Matthew "A Scale for Developmental Processes" in American Sociological Review 1968 Vol. 33 pp. 62-75.

aspects (variations) of knowledge processing structure as defined in socio-structural theory. Guttman scaling itself is imply a technique to rearrange binary data, according to certain rules, to bring out an inherent particular pattern in the data to the degree it is present. This pattern, which the scale identifies and measures, is the systematic accumulation of diversity or differentiation. The pattern appears to be a phenomenon of qualities in nature in the same way that a normal distribution is a phenomenon of quantities in nature.

The implications of the cumulative scale pattern are potentially highly significant. Most of todays statistical theory is based on the discovery of the normal distribution principle(4) yet the principle and construction of a normal curve with applicable data is extremely simple. The same can be said about the principles and construction of a small Guttman Scale from the right data. The danger of this simplicity however, is that it easily detracts from the powerful implications the scale projects by identifying a particular new pattern in natural order including social order. At this point, based mostly on the still limited emperical results, one can venture the prediction that the cumulative scale principle will turn out to be as fundametally important to qualitative or non-metric statistics as the normal distribution curve has been to quantitative statistics.

The Guttman scaling technique is very easily used mannually with less than 30 cases, (for instance villages or countries) and items (attributes) but the larger the matrix becomes the more complex and time consuming it is to manipulate by hand. The project had to process data on up to 450 cases (villages) with 2-300 attributes. An essential part of this project was therefore the development of a computer program which: a. could handle large numbers of cases and attributes to produce the inherent scales in a comparatively short time and b. include into the scales the maximum possible number of attributes. It was only because of the successful development of this computer program that the large amount of data could be processed and analized for the project.

This program has been turned over for distribution to the Comparative Modernization Research Methods Project under the Center for International Studies at Cornell University, Ithaca, New York 14850.

(4) Peter Gould "Is Statistix Inferens the Geographical Name for a Wild Goose?" Economic Geography, June Supplement 1970 p. 442.

WHAT THE PROGRAM DOES

Purpose

SCALE1 produces the largest Guttman scale with an acceptable scalability coeficient (usually .65). This "maximal" approach in which as many items as possible are retained in the scale is appropriate for analysis of item distribution and sequencing. It is contrasted with "minimal" scaling which seeks the least number of items that will adequately differentiate cases (one item per step). The latter approach is used, for example, in the construction of questionnaire scales. Maximal scales are always readily reducible to minimal scales.

The program accepts numerical data of any format (permitting "no data" entries) and converts it to a standard binary form in accordance with the user's specifications. It then attempts to scale the entire matrix of input data and continues by successively dropping the poorest scaling items until it obtains an acceptable scalability coeficient. Only items, not cases, are dropped. The final scale is accompanied by a large number of descriptive statistics.

Definitions

ITEM: An input variable, characteristic or quality converted to standard binary format (0=absent, 1=present, 9=no data) for each case.

CASE: An individual unit of analysis (respondent, village, province, etc.) represented by its corresponding data set.

SCALE: The Guttman Scale represented as an I X C matrix where I=items not dropped and C=cases. (See Figure 1.)

SCALE LINE: The boundary representing the ideal separation of ones and zeros in the Guttman scale. (See Figure 1.)

SCALE SCORE: For a case, the number of items below the scale line. For an item, the number of cases to the right of the scale line..

STEP: A step in the scale line representing the items for which the line is straight vertically and the cases for which the line is straight horizontally. (See figure 1.)

DEVIATION: A departure from a perfect Guttman Scale with complete separation of ones and zeros. A 0-deviation is a zero occurring below the scale line and a 1-deviation is a one occurring above the scale line. (See Figure 1.)

NON-MODAL: If a vector (item or case) contains more zeros than ones, ones are non-modal. If it contains more ones than zeros, zeros are non-modal. The number of non-modals in the scale can be counted along items (item non-modals) or along cases (case non-modals).

SCALABILITY: A measure of how close the actual scale comes to being a perfect Guttman Scale (S=1). It is usually measured by Menzel's Coeficient of Scalability ($0 \leq S \leq 1$):

$S = 1 - D/N$ where: D=total deviations in the scale
N=the minimum of item non-modals or case non-modals.

The program permits an alternative measure referred to as "Stepwise Average Scalability" in which each step of the scale is represented by one average case or item with the average number of deviations and non-modals before the above equation is applied. This can be justified since all items or cases within a step are equivalent with respect to the scale, and sometimes results in a higher coeficient, but its use is not generally recommended since it is not a standard statistic and requires special footnoting and justification when it is used.

Equivalent scalability statistics, Item Scalability (S_i) and Case Scalability (S_j), have been defined for individual rows and columns of the scale:

$S_i = 1 - D_i/N_i$ where: D_i=deviations in the item
N_i=non-modals in the item.
$S_j = 1 - D_j/N_j$ where: D_j=deviations in the case
N_j=non-modals in the case.

DISPERSION: A measure of the scatter of deviations about the scale line. The Coeficient of Dispersion ($0 \leq D \leq 1$) reflects both the number of deviations and their distances from the scale line. D=0 means no deviations and D=1 means maximum deviations (deviations=non-modals) positioned as far as possible from the scale line.

$$D = \frac{\sum_{k=1}^{d} x_k + y_k}{\sum_{k=1}^{N} m_k}$$

where: d=total deviations in the scale
x_k=cells between deviation k & the scale line horizontally
y_k=cells between deviation k & the scale line vertically
n=the minimum of item non-modals or case non-modals
m_k=the maximum of (x_k+y_k) for the kth deviation (see Figure 2).

The Coeficient of Dispersion was developed specifically for this program. It is used to select the best scale when there is a tie in Scalability Coeficient, since the positioning of deviations close to the scale line is preferred. Equivalent dispersion statistics, Item Dispersion (D_i) and Case Dispersion (D_j), have been defined for individual rows and columns of the scale:

$$D_i = \frac{\sum_{k=1}^{d_i} x_k}{\sum_{k=1}^{m_i} C - k}$$

where: d_i = deviations in the item
n_i = non-modals in the item
C = number of cases.

$$D_j = \frac{\sum_{k=1}^{d_j} y_k}{\sum_{k=1}^{m_j} I - k}$$

where: d_j = deviations in the case
n_j = non-modals in the case
I = number of items in the scale.

DEVIATION RANGES: Deviation ranges are an alternative measure of the scatter of deviations about the scale line. The nth range is defined as the cells lying between two lines drawn parallel to the scale line, one n cells above and n cells to the left and the other n cells below and n cells to the right. The program prints the number and percent of 0-deviations, 1-deviations, and total deviations falling in each range. It is thus possible to define confidence limits including any desired percentage of the deviations. We have utilized the deviations within the 60% limit as indicators of propensity for change over time, ignoring the remainder as likely to reflect either errors in measurement or individual peculiarities of cases.

Figure 1

SAMPLE SCALE

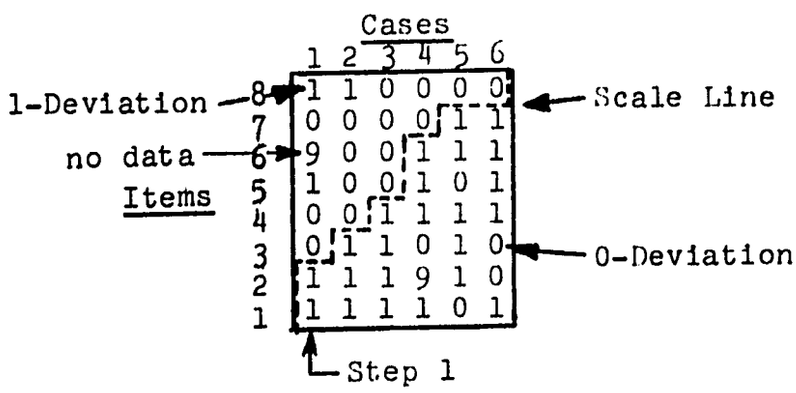
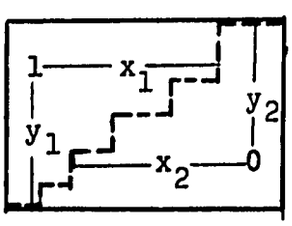


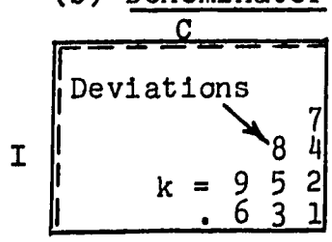
Figure 2

DISPERSION

(a) Numerator



(b) Denominator



k	m_k
1	I+C-2
2-3	I+C-3
4-6	I+C-4
7-10	I+C-5
etc.	etc.

Maximum dispersion is an inverted scale with deviations equal to non-modals.

Assumptions

The basic theoretical assumption underlying Guttman Scaling is that the items can be ordered along a single dimension. We assume here that the user is familiar with Guttman Scaling. The basic assumption underlying the program design is that SCALE1 should be compatible with the widest possible range of different computers. It has, thus, been written so as to be usable on any machine which can handle basic Fortran IV and provide sufficient core storage. For this reason, it uses a full word of storage for each cell of the scale even though a few bits would suffice. More efficient usage of storage is possible by modifying the program for specific machines. For the IBM 360 series cells can be defined as bytes, increasing efficiency by a factor of 4. For the Univac 1108 the program can be converted to Fortran V (using the FLD function) increasing efficiency by a factor of 6. (See Appendix IV:"Programmer's Notes" for details.)

Requirements

The program requires a machine which can handle basic Fortran IV. As compiled it requires 50 K words of storage and will permit up to 150 Items and 110 Cases. Instructions for recompiling the program to alter storage requirements or maximum Items and Cases are provided in Appendix IV:"Programmer's Notes".

Costs

The program is extremely rapid and inexpensive. Small scales have taken as little as three seconds on a Univac 1108. Larger scales average around 20 seconds. Only with maximum items and cases when an error was made so that all items were dropped has the time required exceeded one minute. It is impossible to predict accurately the time required for any particular run since this depends on the number of items dropped.

Input

The program will accept any numerical data in any format. Input can be either continuous numerical variables or data coded into categories. Several different items can be constructed from a single input variable, for example by setting different cutting points. Data can be read either from cards or from card-image tape. Details of the organization of input and the control cards required are presented in Section 2:"How to Use the Program".

Output

The program prints the following output: (1) a listing of the control cards, (2) the input matrix of items after conversion to standard binary format, (3) a summary of computations indicating

items dropped, (4) the final Guttman Scale produced, with dropped items shown above the scale, (5) a series of Item Statistics for each item, (6) a series of Case Statistics for each Case, (7) a set of overall Scale Statistics, and (8) a set of Deviation Ranges. The input matrix and Item, Case & Scale Statistics can be punched if desired. Definitions of the specific statistics and punched output formats are presented below. A sample output is presented in Appendix I.

Input Matrix

The input matrix is the matrix of Items X Cases after conversion of data variables to standard binary format (0=absent, 1=present, 9=no data). It is printed with up to 50 cases on each page and the format is designed so that pages can be arranged next to each other to present an uninterrupted scale with identifying information surrounding it on all four sides.

If the input matrix is punched, each card or set of cards represents a case and columns represent items. Up to 50 items are punched on each card. Items and cases are punched out in the order in which they are read in, according to the following format:

Columns	Contents
1-4	JOB IDENTIFICATION NUMBER: From JOB card.
5	DECK: "0" Identifies input matrix deck.
7-10	CASE ID NUMBER: From CASE cards.
12-13	CARD NUMBER: "01" = Items 1- 50 "02" = Items 51-100 "03" = Items 101-150
15-64	ITEMS: Each column represents an item as 0=absent, 1=present, or 9=no data.

Summary of Computations

The exact statistical distribution of deviations for Guttman Scales has (to our knowledge) never been calculated. It is, thus, impossible to guarantee that any scale is the best possible. The program makes three tries and selects the best of these. It selects the one with the highest Scalability Coeficient, and if there is a tie for Scalability, the one with the lowest Dispersion. If the Scalability Coeficient is less than the criterion value (usually .65) the program continues by dropping the poorest scaling items and trying again. The program prints the number of items in the scale, the Scalability Coeficient, and the Dispersion Coeficient for each try and indicates which try is selected as best.

In the Summary of Computations the program also lists the ID number and name of the items which are dropped as well as the reason for which each one is dropped. Items can be dropped for three reasons: (1) zero scale score, (2) more deviations than scale score, and (3) most deviations and deviations per non-modals. Items with zero scale score or more deviations than scale score are

always dropped as soon as they are encountered even if the scalability coeficient is greater than the criterion value, for they are considered non-scaling items. After the first pass the program also drops the poorest scaling items. Initially, until the Scalability Coeficient comes within .10 of the criterion value, the program is permitted to drop up to five poorest scaling items. This is for the sake of economy. After this the program drops only the single poorest item on each pass.

It is possible that the program will be unable to obtain a scale on a given try. A limit of ten cycles through the basic loop of the main routine is built into the program for each try. If no scale is obtained the program will print "NO SCALE AFTER LIMIT OF CYCLES" in place of the scalability and dispersion statistics. If no scale is obtained on three successive attempts the program also prints "NO SCALE AFTER THREE ATTEMPTS". In either case the program continues as before ignoring the unsuccessful attempts. In practice, these messages have never occurred in extensive usage of the program.

At the bottom of the Summary of Computations the program prints TOTAL CYCLES which is the cumulative number of passes through the basic loop of the main program over all tries. It is intended as a rough measure of how hard the program worked to obtain the result. (For further details on computational procedures see the section on "Program Logic" below.)

The Scale

The Scale is printed like the Input Matrix with up to 50 Cases across each page in such a manner that pages can be arranged next to each other to present an uninterrupted scale with identifying information surrounding it on all four sides. The Scale Line is not printed, but can be readily drawn in accordance with the Scale Score statistics. Dropped items are printed immediately above the scale, separated only by a dotted line. They are ordered by their best possible scale score, and within steps by the frequency (number) of ones. This arrangement facilitates examination of the relationships between dropped items and the Scale.

Item and Case Statistics

Item and Case Statistics are analogous, usually with the roles of Items and Cases simply reversed. They are printed with the NAME (Up to 28 characters, from the Item or Case Cards) followed by the ID number and statistics shown below in their punched format. If punching is requested, the statistics are punched twice in two different versions, first with the percentages for frequencies and deviations accumulated (as printed) and second with unaccumulated percentages. Accumulated percentages are used to indicate percentile rankings on the statistics. Dropped items are given percentages greater than 100% which indicate their distance from the scale. The Item Statistics printout can be placed alongside the Scale to obtain complete labelling with Item Name. Appendix I indicates the printout format.

ITEM AND CASE STATISTICS
(Punched Format)

Columns	Contents
1-4	JOB ID NUMBER: From JOB card.
5	DECK: "1" = Item Statistics "2" = Case Statistics
6	VERSION: "1" = Cumulative percentages for Frequencies & Deviations (as printed). "2" = Non-accumulated percentages for Frequencies & Deviations.
7-11	ID: Case or Item ID number from CASE & ITEM cards.
12-14	RANK: N: Rank order number left-right & bottom-top.
15-17	P: Rank as % of items in scale or cases.
18-20	SCALE SCORE: N: Items below or cases to right of line.
21-23	P: % of cases or items in scale.
24-26	SCALE STEP: N: Step # in which item or case falls.
27-29	P: % of total number of steps in scale.
	FREQUENCIES:
30-32	Ones - N: 1s in item or case - dropped items counted.
33-35	P: 1s up thru item or thru case left-right/ total 1s in scale.* Version 2 non-cumulative.
36-38	Zeros- N: 0s in item or case - dropped items counted.
39-41	P: 0s up thru item or thru case left-right/ total 0s in scale.* Version 2 non-cumulative.
42-44	Nines- N: 9s in item or case - dropped items counted.
45-47	P: 9s up thru item or thru case left-right/ total 9s in scale.* Version 2 non-cumulative.
	DEVIATIONS:
48-50	Ones - N: No. of 1-deviations in item or case.
51-53	P: 1-devs up thru item or thru case left-right/ total 1-deviations. Version 2 non-cumulative.
54-56	Zeros- N: No. of 0-deviations in item or case.
57-59	P: 0-devs up thru item or thru case left-right/ total 0-deviations. Version 2 non-cumulative.
60-62	Total- N: Total no. of deviations in item or case.
63-65	P: Devs up thru item or thru case left-right/ total deviations. Version 2 non-cumulative.
66-68	NON-MODALS: N: No. of non-modals in item or case.
69-71	P: % of total item non-modals for items or % of total case non-modals for cases.
72-74	SCALABILITY: Item Scalability or Case Scalability.
75-77	DISPERSION: Item Dispersion or Case Dispersion.

*Usage has proved these statistics inappropriate for Cases. Since the numerator includes dropped items the denominator should also include dropped items.

Scale Statistics

Scale statistics are totals and summary statistics for the Scale as a whole. They include the bases for the Item & Case Statistics. They are printed on a separate page (see Appendix I) and can be punched out on three cards according to the following format. "SCALE SCORE: In" is the number of cells below the scale line and "SCALE SCORE: Out" is the number of cells above the line.

Columns	Card 1	Card 2	Card 3
1-4	JOB ID NO.	JOB ID NO.	JOB ID NO.
5	DECK: "3"	DECK: "3"	DECK: "3"
6	CARD: "1"	CARD: "2"	CARD: "3"
8-13	ITEMS: Total	NON-MODALS: Item	FREQ: ones - N
14-19	ITEMS IN SCALE	NON-MODALS: Case	FREQ: ones - %
20-25	CASES	NON-MODALS: Min.	FREQ: zeros- N
26-31	SCALABILITY	SCALE SCORE:In-N	FREQ: zeros- %
32-37	DISPERSION	SCALE SCORE:In-%	FREQ: nines- N
38-43	DEVS: ones - N	SCALE SCORE:Out-N	FREQ: nines- %
44-49	DEVS: ones - %	SCALE SCORE:Out-%	
50-55	DEVS: zeros- N	SCALE STEPS	
56-61	DEVS: zeros- %	STEPS/ITEM	
62-67	DEVS: total- N	STEPS/CASE	

Program Logic

Under "Summary of Computations" we outlined how the program selects the best of three tries at a scale and drops poorest scaling items until the Scalability Coeficient reaches the criterion value. It remains to specify the manner in which it produces each try. The following procedure was copied from an IBM 1620 program entitled "Scal-o-gram Analysis" written by Gary Simon of the University of Philippines College of Agriculture in Los Baños and has produced excellent results in extensive usage.

1) Order Items by Frequency of ones with the maximum at the bottom. Order Cases by Frequency of ones with the maximum at the right.
2) For each Item find the position for the line which minimizes deviations. In case of a tie, select the left-most position.* Reorder Items by the line positions with left-most lines to the bottom. In case of a tie, order by "1-deviations - 0-deviations" with 1-deviations moving the item towards the bottom.*
3) Repeat Step 2 for Cases. In case of a tie for line position select the top-most position.* Reorder cases with lowest line positions to the left. If two Cases have the same line position order by "1-deviations - 0-deviations" with 1-deviations moving the Case to the right.* While this is done, Item line positions set in Step 2 are not moved.
4) Count one cycle. Test whether the lines for Items and Cases join together to form a staircase. If not, return to Step 2. If they do join, proceed to Step 5.
5) Calculate and print Scalability and Dispersion for this successful try. If this is the first or second try, reverse the order of the Cases and return to Step 2. If it is the third try, select the best try and test the Scalability Coeficient against the criterion. If it does not meet the criterion drop the poorest scaling items. If it meets the criterion, this is the final scale.

*These are alterations from Simon's program. There is considerable debate as to how to handle ties. We use the technique of always maximizing Scale Step.

HOW TO USE THE PROGRAM

There are seven types of control cards for SCALE1. These control cards are all mandatory and cannot be omitted. They are all identified by a keyword in columns 1-4 except for the Format card. The arrangement of a typical input deck is outlined below:

1) (System Cards)
2) JOB CARD: Identifies the job.
3) SET CARD: Sets parameters and switches.
4) ITEM CARDS: One card per item provides identification and specifies conversion. Ordered as items are read.
5) CASE CARDS: One card per case provides identification. Ordered as cases are read.
6) FORMAT CARD: Standard I-type Fortran format describes the input data. Uses columns 1-72 of up to 8 cards.
7) DATA CARD: Indicates input data follows.
8) (Input Data)
9) (If more than one job is to be stacked in the run, #2 - #8 are repeated here for each job.)
10) END CARD: Indicates end of run and stops the program.
11) (End of File System Card.)

JOB CARD

Columns	Contents
1-4	KEYWORD: "JOB "
5-8	JOB ID NUMBER: Any 4-digit alphameric job ID. It will appear on all output & will be the only ID on punched output.
9-80	JOB NAME: Any job name up to 72 characters. It will appear on all printed output.

SET CARD

Columns	Contents
1-4	KEYWORD: "SET "
5-7	NUMBER OF ITEMS (1-150)
9-11	NUMBER OF CASES (1-110)
13	INPUT SWITCH 1=Standard Binary Input (punched by SCALE1). 2=Numerical Input Data.
14	OUTPUT SWITCH 0=No punching; print only. 1=Punch binary input matrix only. 2=Punch statistics only. 3=Punch both input matrix & statistics.
15	NUMBER OF FORMAT CARDS (1-8)
17	NON-MODAL SWITCH 0=Minimum Non-modals (Menzel's Coeficient) 1=Item Non-modals 2=Case Non-modals Can force use of item or case non-modals in calculating Scalability. Used in referring sub-scales to larger scales. Normally 0 or blank.

SET CARD (Cont.)

Columns	Contents
18	SCALABILITY SWITCH 0=Menzel's Scalability Coeficient (normal setting). 1=Stepwise Average Scalability (see pg. 2).
19	INPUT TAPE (1-9) Logical number of input tape. If blank, input is read from cards.
21-23	SCALABILITY CRITERION (0.01-1.00) Permits varying criterion for accepting a scale. If blank, program assumes 0.65. Decimal point assumed to the right of column 21.

```
  Col's:  1...5...10...15...20...25...30
EXAMPLE:  SET 132 065 201
```

(Since columns 17-23 are blank, the program assigns "normal" settings - Menzel's Coeficient, Card Input & .65 criterion.)

ITEM CARDS

Columns	Contents
1-4	KEYWORD: "ITEM"
5-9	ITEM NUMBER 5-6: Card - No. of card in which item is punched. 7-8: Column - Rightmost column of item field. 9 : Version - (0-9) "0" if only one version of this variable. If several items are constructed from one variable they are numbered 1-9 and the Item Cards must follow each other sequentially.
11-38	ITEM NAME: Any 28 character alphameric item name.
40	TYPE OF CONVERSION* 0=Any non-zero number is assigned "1" (present); only a zero is assigned "0" (absent). 1=Unordered Categories: only the criterion value (col's 42-45) is assigned "1"; all other values are assigned "0". 2=Decreasing Categories or Numbers: Any non-zero number up to and including the criterion value is assigned "1"; zero & values greater than the criterion are assigned "0". 3=Increasing Categories or Numbers: Any number greater than or equal to the criterion is assigned "1"; numbers less than the criterion including zero are assigned "0".
42-45	CRITERION:*This is the criterion referred to above.
47-50	"NO DATA" VALUE:* The value punched here will be converted to a "9" (no data) regardless of the type of conversion specified above. If this field is 0 or blank the program assumes there is no missing data. (Thus, "0" cannot be used to indicate missing data.)

*These conversion specifications are ignored if input is in standard binary format.

EXAMPLE: The following data are punched on card 1 of the input:

Col 11: Buildings	Col 12: Accessibility	Col 13-16: Population
1=Elementary school	0=No road	
2=Secondary school	1=All-weather road	
3=Temple	2=Jeep track	9999=No data
9=No data	3=Ox-cart trail	
	4=No data	

The following ITEM Cards would be appropriate:

```
Col's:  1...5...10...15...20...25...30...35...40...45...50
        ITEM01111 ELEMENTARY SCHOOL            1    1    9
        ITEM01112 SECONDARY SCHOOL             1    2    9
        ITEM01113 TEMPLE                       1    3    9
        ITEM01120 ACCESSIBLE BY MOTOR VEHICLE  2    2    4
        ITEM01160 POPULATION OVER 1000         3 1001 9999
```

CASE CARDS

Columns	Contents
1-4	KEYWORD: "CASE"
6-9	CASE ID NUMBER: (Up to 4 digits)
11-38	CASE NAME: Any 28 character alphameric case name.

FORMAT CARD

A standard I-type Fortran Format describing the input data. It begins with an open parenthesis in column 1 and ends with a closed parenthesis. The format is punched in columns 1-72 of up to 8 cards.

DATA CARD

Columns	Contents
1-4	KEYWORD: "DATA" (Indicates data follows.)

END CARD

Columns	Contents
1-4	KEYWORD: "END_" (End of Run. Stops program.)

Input Data

Input data cards immediately follow the DATA Card. Input can also be read from a separate tape if the logical number of the tape is specified in column 19 of the SET Card. Data can be in any order so long as cards within each case are in the same order and the ordering of Item and Case Cards agrees with the ordering of the input data deck. In practice it is most efficient to order cases serially by case ID number and cards within each case serially by card number.

Error Message

The program writes the single message "CONTROL CARD ERROR. JOB TERMINATED" for any error it discovers in the control cards. This message is printed immediately following the listing of the

card in which the error was discovered. The program checks the Keyword in columns 1-4 of the control cards. If this is mispunched it will result in an error message. It also checks the control cards against the specifications in the SET card as follows:

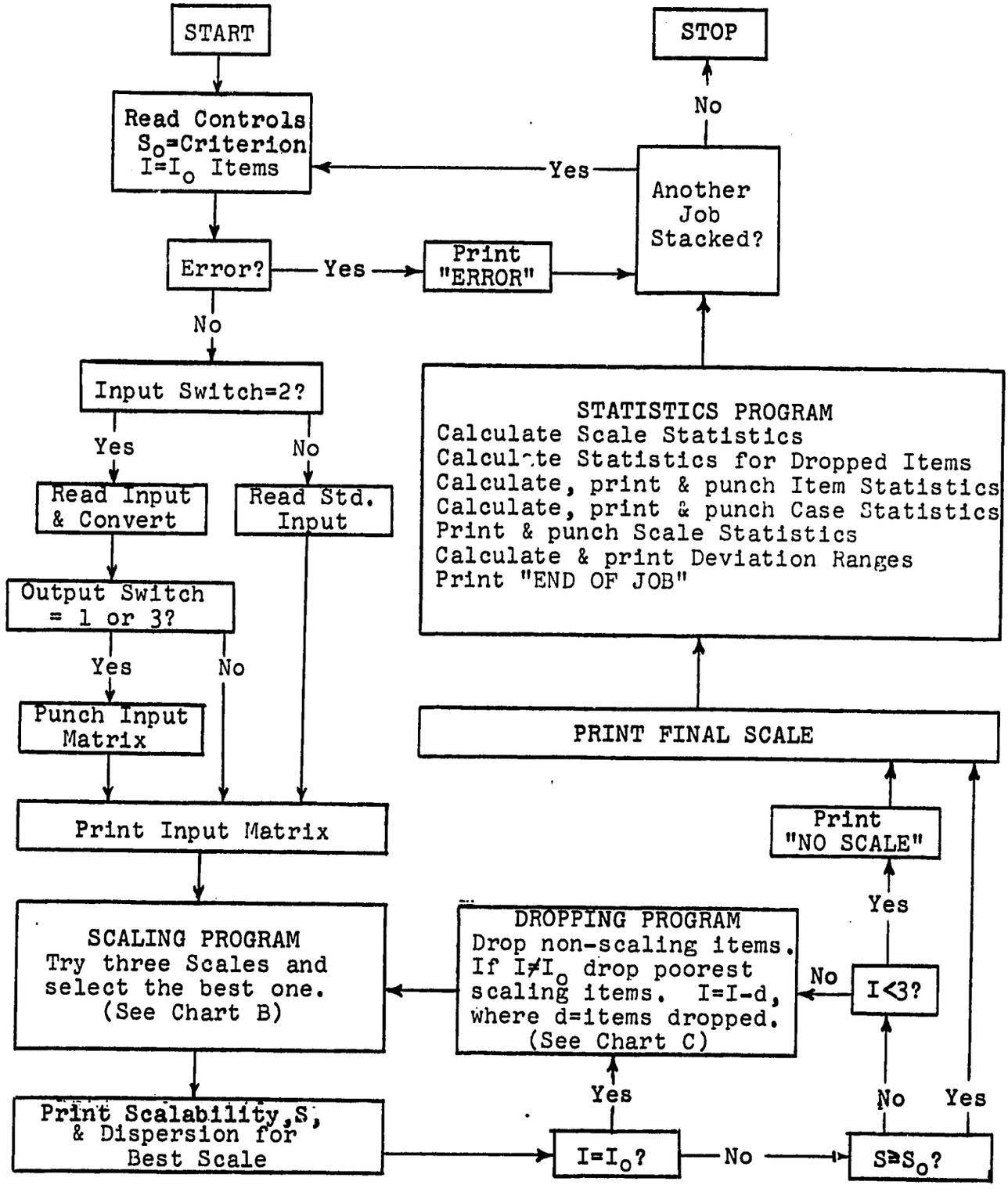
1) If there are too few ITEM cards the first CASE card will be treated as an error because an ITEM card is expected.
2) If there are too many ITEM cards the first ITEM card beyond the number specified in the SET card will be treated as an error because a CASE card is expected.
3) If there are too few CASE cards the FORMAT card will be treated as an error because a CASE card is expected.
4) If there are too many CASE cards the first CASE card beyond the number specified in the SET card will be treated as a format card. This leads to the last FORMAT card being treated as an error because a DATA card is expected.

Extreme care must be exercised in ensuring that the FORMAT accurrately describes the data to be read since the program cannot check this. Whenever a control card error is detected that job is terminated. If several jobs have been stacked in one run, the program proceeds to the next job. Otherwise, it stops.

Appendix II

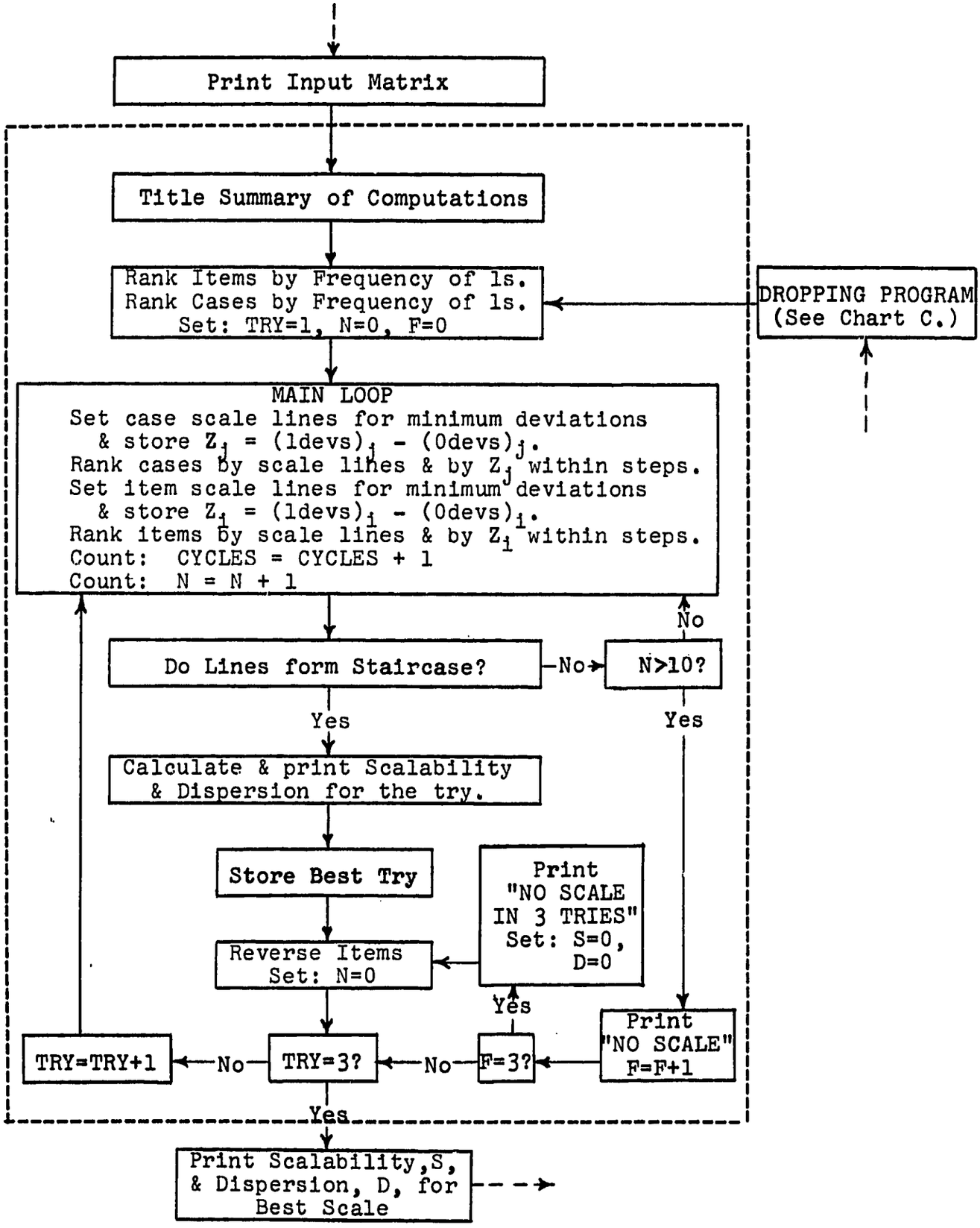
FLOW CHART OF SCALE1

A. Overview



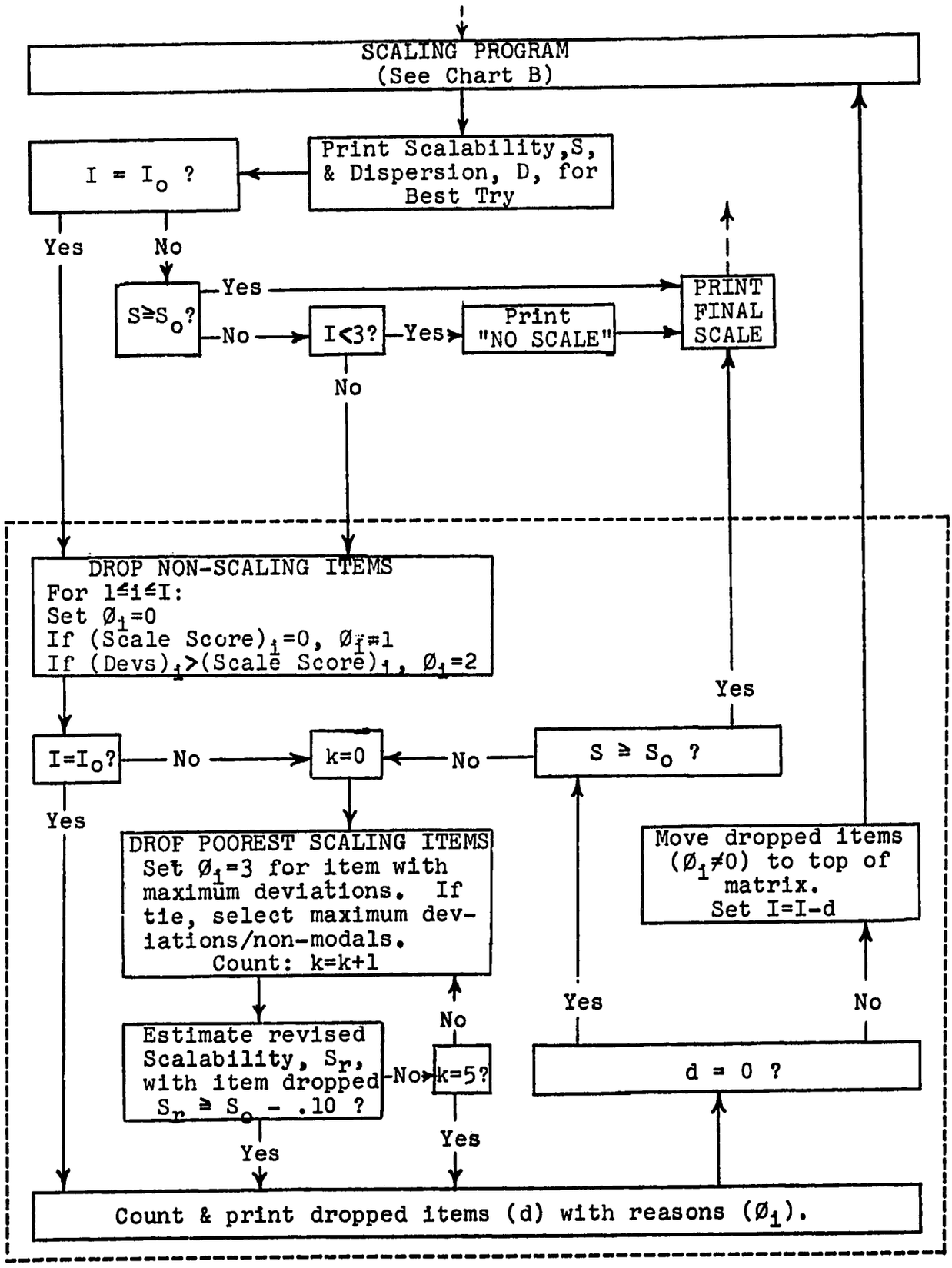
Flow Chart B

SCALING PROGRAM



Flow Chart C

DROPPING PROGRAM



Appendix IV

PROGRAMMER'S NOTES

To Adapt SCALE1 for a Specific Installation

1) The program deck is punched in 026 Keypunch mode (for the Univac 1108) and must be converted to 029 Keypunch mode for IBM 360 machines.
2) The program prints on all 66 lines of the page. For some systems this requires inserting a subroutine call following the definitions (e.g. CALL PGSIZE(1,66) for EXEC II.)
3) The program is set to read cards from unit 5, print output on unit 6, and punch output on unit 3. These units must be adapted to the specific installation.
4) Instructions for altering core requirements and Item and Case limits are given below.
5) Hints on altering the program for more efficient use of storage are given below.

To Alter Core Requirements & Item & Case Limits

1) Change all "110"s under "Alterable Dimensions" to new case dimension.
2) Change all "150"s under "Alterable Dimensions" to new item dimension.
3) Replace COMMON cards in RANK & STAT subroutines with duplicates of the new cards punched above.
4) Dimension INDEX in RANK subroutine at the maximum of the number of Items or Cases plus two.
5) Dimension NRANK2 in RANK subroutine at the maximum of the number of Items or Cases.

For Efficient Storage on IBM 360s

1) Define the MATRIX with cells of 1 byte and a logical-integer buffer as follows:

```
DATA ICELL/0/
LØGICAL*1 MATRIX(100,160), LCELL(4)
EQUIVALENCE (ICELL,LCELL(4))
```

2) Replace all references to the matrix with logical-integer conversions such as the following example which sums cells:

```
LCELL(4) = MATRIX(I,J)
ISUM = ISUM + ICELL
```

3) Write integer-logical conversion into the input routine.

For Efficient Storage on Univac 1108s

1) Store the matrix in six-bit strings using the FLD function.
2) Define a function called MATRIX(I,J) which will pull out the desired cell whenever it is referred to.

Revisions Suggested by Usage

1) Most errors are in faulty FORMAT cards. The program could be revised to write its own format from the ITEM cards.
2) CASE NAMES have proved unimportant in our work. CASE cards could be dropped altogether and the CASE ID NO. read from the data cards.

3) Error checking of the sequencing of input data cards should be built in.
4) The program should be altered to permit reading the data in once and then performing a series of different sub-scales on the data.
5) Provisions for rewinding the data tape should be built in.
6) Provisions for selecting cases from a tape as well as items should be built in.
7) It would facilitate checking of conversion if the program printed the original variables before conversion as well as the converted input matrix.
8) The Output Switch should permit more specific specification of the statistics to be punched to eliminate unwanted cards.
9) Non-cumulative percentages for Frequencies and Deviations should be based on number of cases for items. For cases the Frequencies should be based on total items (including those dropped) and Deviations should be based on number of items in the scale.
10) For cumulative percentages Case Statistics on Frequencies should be based on total Frequencies counting dropped items.
11) Item Statistics should be punched for dropped items as well as for items in the scale.
12) The capability for combining items and cases should be built into the conversion routine.
13) The Scale Statistics printout should include (1) number of initial items, (2) number of final items, and (3) number of cycles.
14) Another type of conversion should be added which assigns "0" to any number up to the criterion (including the punch 0) and "1" to numbers greater than or equal to the criterion.
15) Provision should be added for allowing the punch "0" to represent "no data".
16) The ratios STEPS/ITEM and STEPS/CASE under Scale Statistics should be inverted.
17) NON-MODALS: Items and NON-MODALS: Cases need to be defined more carefully and possibly the labels should be reversed.
18) CASE ID NUMBER should be expanded to permit 6 or 8 digit numbers.
19) New Statistics need to be developed regarding the analysis of deviations as indicators of potential for change. The deviation ranges prove of limited use because they are cut off by the edges of the scale. Along these lines, one could attempt to construct a "shadow scale" from the dropped items and supply statistics for it.

APPENDIX D

Skinner's Model of Chinese Market Town Systems

Selected Excerpts from: G. William Skinner
"Marketing and Social Structure in
Rural China" Part IV
Journal of Asian Studies Vol. 24. 1964

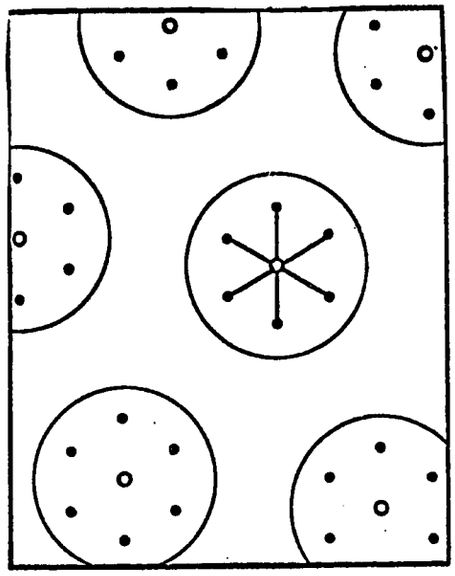


FIGURE 5.1. One ring of villages surrounds each dispersed market town.

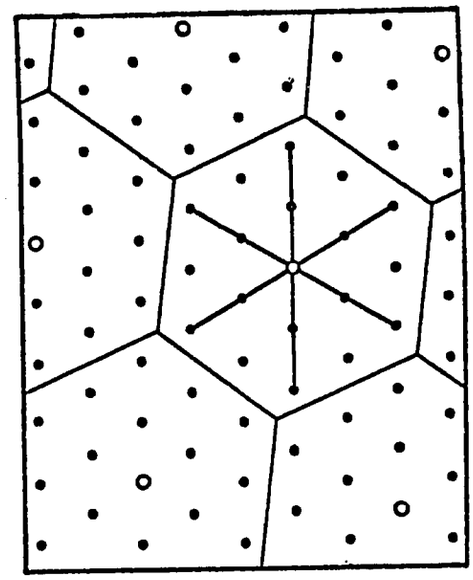
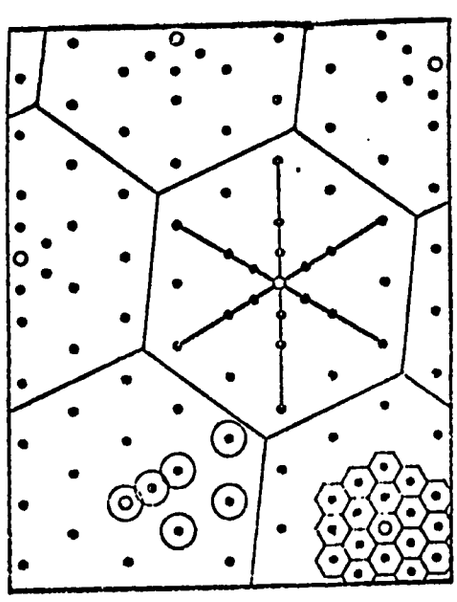


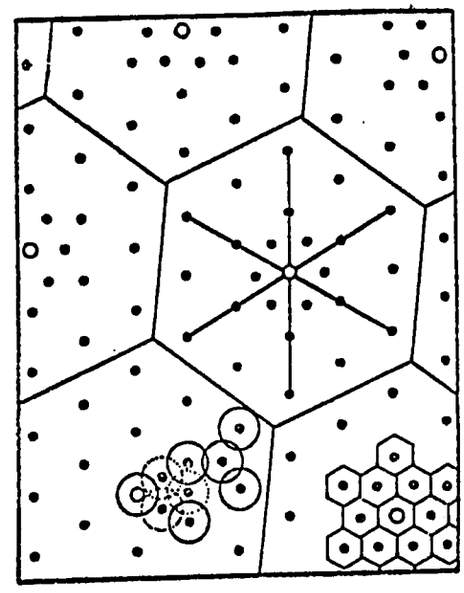
FIGURE 5.2. The landscape fills out with villages; two rings surround each market town.

KEY:

Solid dots	:	Villages
Small open circles	:	Standard market towns
Solid-lined hexagons	:	Standard marketing areas
Lines connecting settlements	:	Original system of paths



Model A



Model B

FIGURE 5.3. An inner ring of villages forms around each market. (Small circles relate to the problem of village siting; see text.) Small hexagons represent the extent of village lands after the formation of the new inner ring.

The intensification model begins with a simple distribution of dispersed village clusters, each surrounding a small rural market, as shown in Figure 5.1. This diagram represents in schematic form the situation in an area where settlement (or resettlement following rural devastation) is recent. Marketing systems are small - their hubs may be though of as minor markets rather than standard market towns - and marketing areas tend to be circular since they have not yet expanded to the point of potential overlap. In Figure 5.2, new villages have been established, filling out the landscape on the module set by the older villages. The six paths radiating from the market town are extended to the outer ring of villages. Marketing areas have expanded and been pressed into hexagonal shape. The landscape is in stable equilibrium with the space filled.

At this stage, further intensification normally occurs through the segmentation of the older villages, i.e., those depicted in Figure 5.1. In what general part of the marketing area the new settlements are established is inconsequential for this model, although in Figure 5.3 it is assumed that the first new settlements will be made in the advantageously situated area between the Original villages and the market. Two patterns of siting are possible (see Figure 5.3). In Model A, each new settlement is established on one of the main paths connecting an old village to the market. In Model B, each new settlement is established equidistant from the market and two old villages, at a site not served by the original paths. Each new village is equidistant from two of the original settlements in Model A and from three in Model B.

On the face of it, one would expect the first pattern of village siting (Model A) to be followed in circumstances where laying out new paths is difficult and where the proportion of the total marketing area needed to support one village is relatively small. By contrast, new settlements are likely to be established in accordance with Model B where the proportion of the total marketing area needed to provide agricultural land for one village is relatively large, so that villages established on the already existent paths are not viable, and where the layout of new paths (to connect the new villages to market) is not an arduous task. If the circles at the lower left of the two diagramed models (Fig. 5.3) represent the amount of land, expressed as a proportion of the marketing area, needed to support a village of optimal size, then it is clear that the larger circles of Model B inhibit villabe growth on the path between an old village and the market (note the dotted circles) and encourage the growth of new villages equidistant from three already existing settlements. The small hexagons at the lower right of the two diagrams represent the proportion of the total marketing area which is optimal for village lands in each situation.

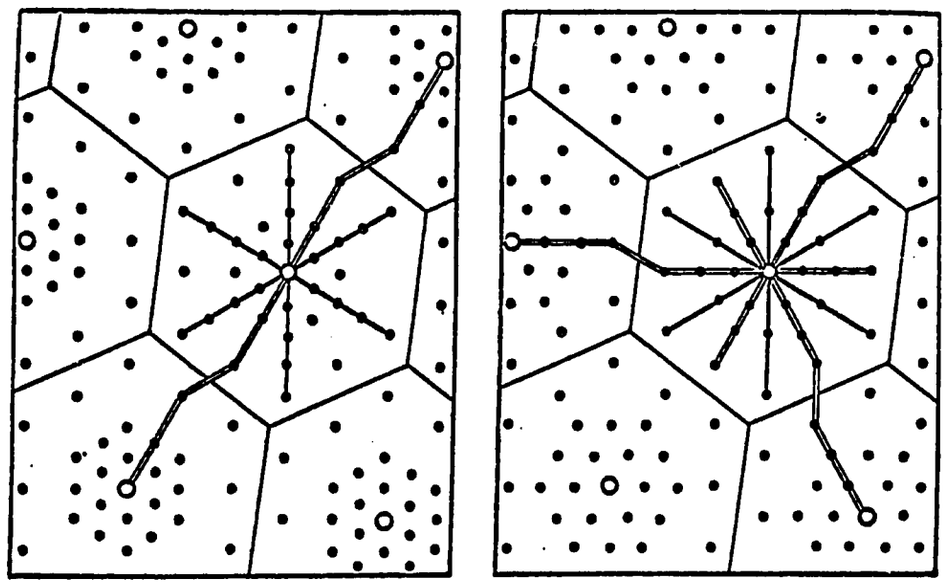
In fact though it may seem paradoxical on first glance at Figure 5.3, Model-A distributions are fostered by relatively unfavorable terrain, in particular where hilly or mountainous topography limits arable land to a low proportion of the total area. By contrast, villages tend to be sited in accordance with Model B in landscapes where a high proportion of the land is arable, most notably on alluvial and coastal plains.

The reason for the difference in settlement patterning must be sought, I believe, in the interrelation between transport cost and agricultural productivity...

pp. 196-8

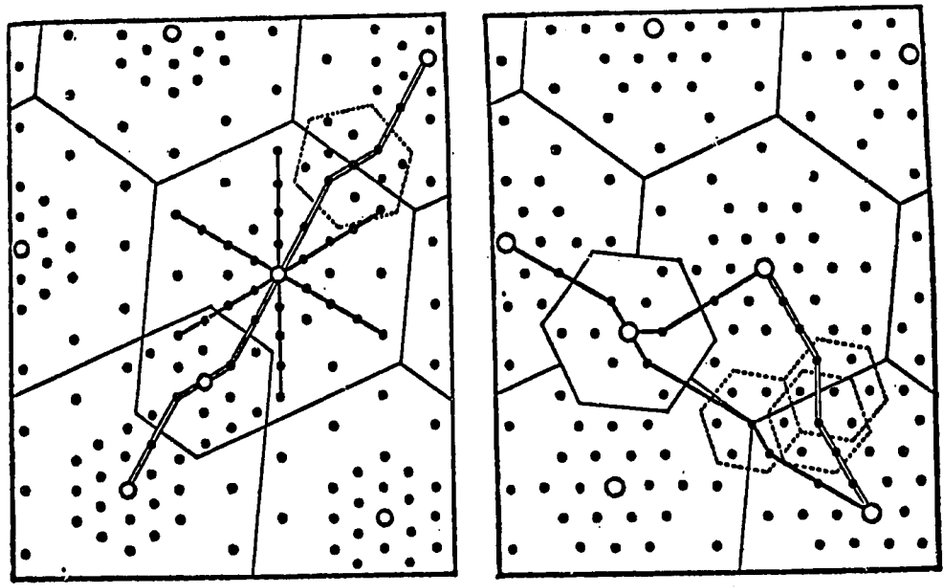
"To summarize the agrument: In the plains which induce Model-B distributions, villages are originally situated close to the markets and to one another, and because of a favorable transport-productivity equation, they grow large before new satellite villages are formed. The later must therefore be sited so as to maximize the potential village lands of the new settlement - namely at the point equidistant from three original settlements, even though this means breaking a new path. In the hilly or mountainous landscapes which induce Model-A distributions, however, villages are originally situated relatively far from the market and from one another, and because of an unfavorable transport-productivity equation, new satellite villages are formed before the original villages grow large. Consequently, sites on the paths connecting the original settlements are viable for new villages - with respect to available agricultural lands - and preferable because they minimize the transport problem which stems from the unfavorable terrain....

p. 200



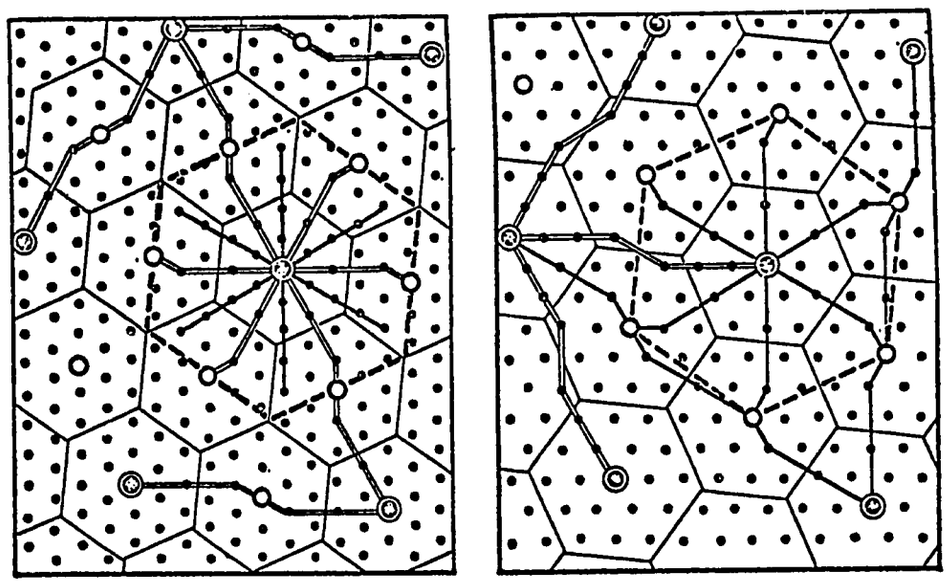
Model A Model B

FIGURE 5.4. Additional villages are established and intermarket roads are built. KEY to lines connecting settlements:
Solid : Original system of paths and the roads developed therefrom
Double : Second system of roads



Model A Model B

FIGURE 5.5. The distribution of villages becomes still more dense and new markets begin to be founded. One viable minor market and one new standard market town are shown on each diagram. The original system of roads is extended in Model B. (Only parts of the road systems are shown.) KEY: Dotted hexagons : Minor marketing areas.



Model A Model B

FIGURE 5.6. New standard market towns are established at all potential sites, and villages completely fill in the landscape on the intensified module. The original market towns become higher-level market towns, and what had been standard marketing areas become intermediate marketing areas (of which only one is shown on each diagram).
KEY: Heavy encircled dots : Higher-level market towns
Heavy dashed hexagons : Intermediate marketing areas

"To return to the sequence of intensification, in Figure 5.4 new villages continue to be established on the two different modules already set in Figure 5.3. In Model A, settlements are established on the original paths until they resemble strands of pearls, and when intermarket roads are eventually built they pass through relatively few settlements. In Model B, by contrast, the continued establishment of villages equidistant from three already existing settlements soon means that the second set of paths surpasses the first in importance, and it is these which are developed and extended to become intermarket roads. Both Models now show two complete rings of closely spaced villages surrounding each market.

When settlement is further intensified on the landscape, as in Figure 5.5, minor markets are established to serve villages near the rim of the original standard marketing areas. In Model A these will be situated on the intermarket road at the point equidistant from two of the original market towns. Not only does the module of intensification call for a settlement at precisely that point; not only does situating the new market on the already existing intermarket road obviate a second set of intermarket roads in an area where one of the givens is difficulty with transport; but also, and above all, a minor market so sited can grow into a standard market with a full complement of eighteen dependent villages without encroaching on the full two rings of villages required to support the original standard market. By contrast, the intensification module of Model B provides for no settlement site on the intermarket road at the point equidistant between the two markets, and any minor market which might be established near the road (note two of the dotted hexagons) could grow into a viable standard market only if inroads were made on the outer ring of villages which one of the original markets requires for its own standard marketing area. However, minor markets established at the corners of the original marketing areas (note the third dotted hexagon) equidistant from three of the original markets, at sites provided for by the Model-B intensification module - and only those minor markets - are able to grow into viable standard markets, each with a potentially full complement of eighteen dependent villages. Markets established at these points are served by extensions of the first set of paths to have been laid down within the original standard marketing areas. When these are further extended (and road building is relatively simple in the Model-B situation) they become an important new set of intermarket roads. New standard markets, of which one each is shown for Model A and Model B in Figure 5.5, are eventually established at other potential sites around each of the original markets....

pp. 201-2

"It should perhaps be made explicit that each of the factors relevant to the difference in village siting at the stage depicted in Figure 5.3 is also relevant to the difference in market siting at the stage depicted in Figure 5.5. Just as a new village in Model B must seek out a site equidistant from three already existing settlements in order to have sufficient agricultural lands not already cultivated by the older villages, so a new market in Model B must seek out a site equidistant from three already existing markets in order to have a sufficient complement of dependent villages not needed for support of the older markets. Just as a new village in Model A favors a site on the original intervillage paths, so a new market in Model A favors a site on the original intermarket roads. These locations are viable in the case of Model-A villages because the necessary complement of agricultural land is available without encroaching on the lands cultivated by the original villages; and they

are viable in the case of Model-A markets because the more extreme pattern of village intensification permits a full complement of eighteen villages for the standard marketing systems of all markets, new and old.

It should now be clear why it is that markets approach Model B in their distribution 1) the more closely the terrain resembles a flat isotropic plain, and 2) the greater the productivity of the land per unit of total area. In the case of China one must also add a third circumstance which favors Model-B distributions: propinquity to urban centers. This factor affects the transport-productivity equation in two ways. In the first place, each city in China enhances land fertility in its immediate environs through its lavish production of nightsoil, which is contributed daily to the surrounding farmland. And, secondly, road systems tend to be better developed in the vicinity of cities, partly out of commercial necessity - they are the hub of great trading areas - and partly because cities are likely to be prefectural or provincial capitals and hence well served by imperial roads (or, in post-imperial times, by kung-lu, "public highways").

Thus it is that Model B occurs most generally in the plains around local and regional cities while Model A appears to be nearly universal in areas of mountainous terrain remote from urban centers.....

pp. 203-4

"Let me now summarize the essential differences between the final intensified version (see Figure 5.6) of the two spatial models. Each standard market is dependent on two higher-level markets in distributions of the Model-A type but on three in Model-B distributions. Each intermediate marketing area is equivalent to four standard marketing areas in the case of Model A (the higher-level market's own standard marketing area plus one-half of the marketing area of each of the six dependent standard markets), but to only three standard marketing areas in the case of Model B (the higher-level market's own standard marketing area plus one-third of the marketing area of each of the six dependent standard markets).

It follows that an intermediate marketing area is more inclusive of villages in the case of Model A than of Model B: in the former case ideally seventy-two villages are incorporated, in the latter only fifty-four. Since settlements tend to be more sparsely distributed in mountainous environments of the Model-A type, the size of Model-A intermediate marketing areas is also greater in terms of absolute units of area. For instance, the two complete intermediate marketing systems depict in Figure 2(Model A) average 235 square kilometers in area, while the two complete intermediate marketing systems shown in Figure 3 (Model B) average 105 square kilometers. The contrastive models also lead us to expect that the disparity in absolute size between the two types of intermediate marketing systems will be greater in terms of area than of population, for while the number of villages per intermediate marketing system is smaller in Model B than in Model A, each village is on the average more populous in the former case.

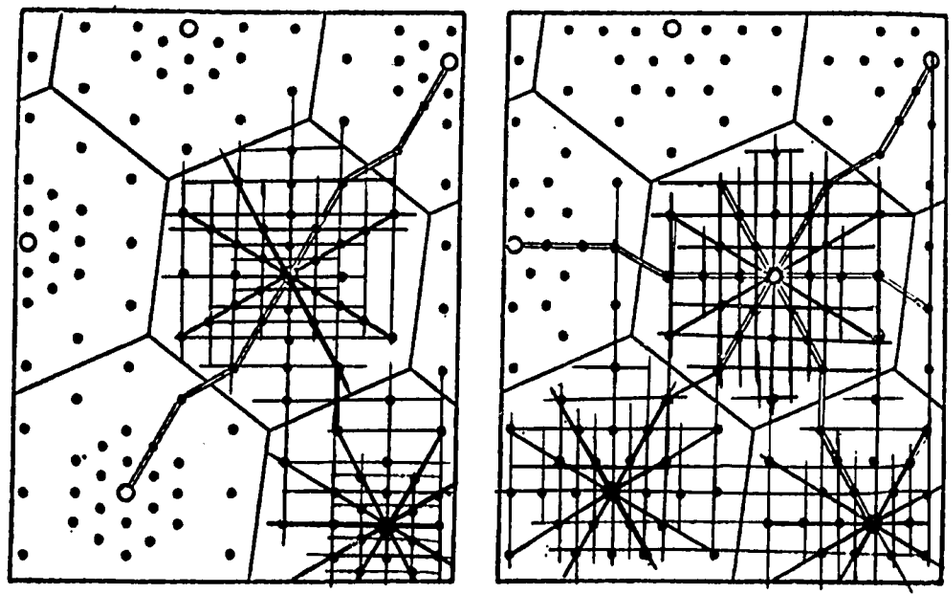
Finally, as might be expected in the mountains, Model-A development results in a comparatively simple network of roads (see Figure 5.6). Roads connecting intermediate markets pass through one standard market, and this same system of roads serves to connect intermediate markets to all higher-level central places. In the case of Model B, however, there are two sets of roads which connect through higher-level markets; one set passes through no standard markets, the other

two. The first set serves the standard marketing system and the central marketing system; the second set serves the intermediate marketing system and the city trading system.

It will be noted that both models show eighteen villages per standard marketing system at the conclusion of the intensification cycle, as at its onset. However, in absolute area and in population, standard marketing systems differ consistently in the two models: those in Model-A structures tend to be larger in area and smaller in population than are those in Model-B structures.

Let us now put aside the differences between the two models and consider the general features of the intensification cycle predicted by both. Village-to-market ratios being low (six in Figure 5.1), increase gradually to eighteen (Figure 5.2), then on to 24-30 range (Figure 5.3), and to the 30-36 range (Figure 5.4), at which point minor markets begin to form. Ratios may rise to the 40's, or even 50's in the case of Model A, before the first of the new standard markets emerge (Figure 5.5). As new standard markets are established, the village-to-market ratio drops - precipitously when most of the new markets are founded within a short time of one another. When the whole set of new markets is established before new villages have completely filled out the landscape, the ratio drops below eighteen and then gradually increases to the average of the equilibrium model.

pp. 205-6



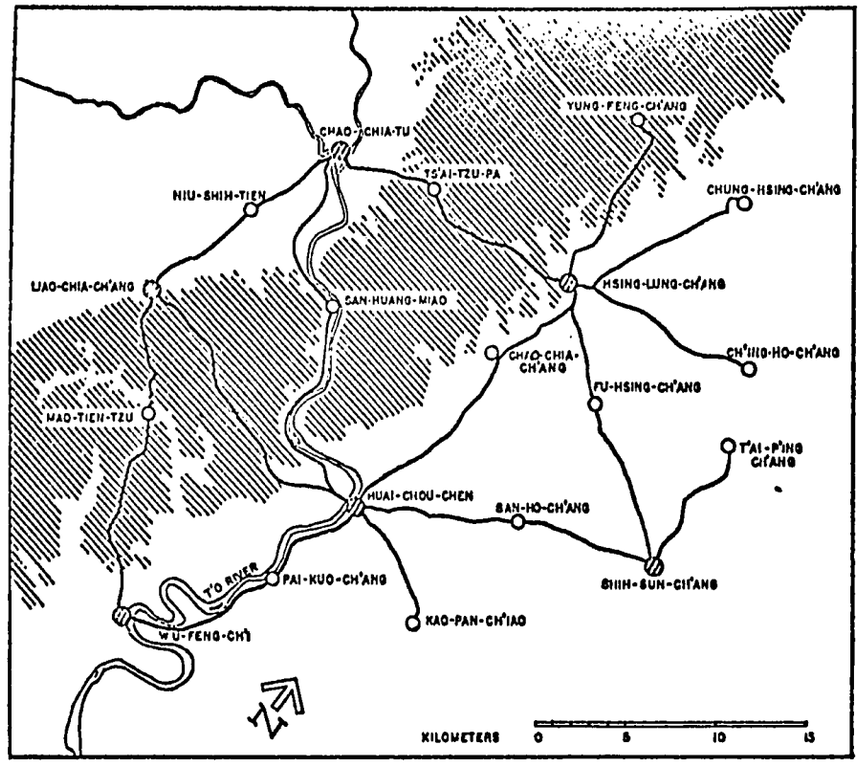
Model A Model B

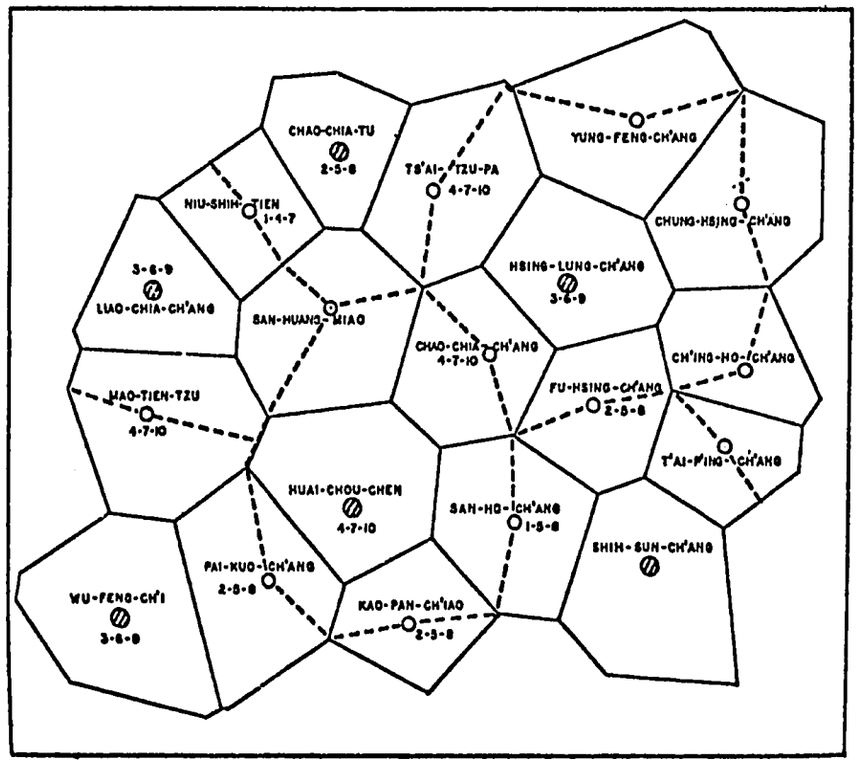
Mosher's Farm-to-Market-Roads grid systems superimposed on the hexagonal market town areas. (See text p. 134)

TABLE 1. AVERAGE AREA AND POPULATION OF STANDARD MARKETING COMMUNITIES, AS FUNCTION OF POPULATION DENSITY, 1948 ESTIMATES FOR AGRICULTURAL CHINA

	Density: Persons per sq. km.	Average Population	Average area in sq. km.	Ave. distance traveled by most disadvantaged villager (km.)	Average distance (km.) between market towns
	10	1850	185	8.44	14.6
	20	3160	158	7.80	13.5
	30	4080	136	7.24	12.5
	40	4800	120	6.80	11.8
	50	5300	106	6.39	11.1
	60	5790	96.5	6.09	10.6
	70	6160	88.0	5.72	9.91
	80	6500	81.3	5.59	9.69
	90	6750	75.0	5.37	9.31
	100	6980	69.8	5.18	8.98
	125	7460	59.7	4.79	8.31
	150	7870	52.5	4.50	7.79
	175	8050	46.0	4.11	7.12
	200	8240	41.2	3.98	6.90
	225	8350	37.1	3.78	6.55
	250	8570	34.3	3.63	6.30
	275	8720	31.7	3.49	6.05
	300	8850	29.5	3.37	5.84
	325	8870	27.3	3.24	5.62
	350	8790	25.1	3.11	5.39
	375	8660	23.1	2.98	5.17
	400	8640	21.6	2.88	5.00
	450	8100	18.0	2.63	4.56
	500	7850	15.7	2.46	4.26
	550	7320	13.3	2.26	3.92
	600	7140	11.9	2.14	3.71
	650	6760	10.4	2.00	3.47
	700	6370	9.1	1.87	3.24
Average for Agric. China:	111	7140	64.4		
The modal case:	150	7870	52.5	4.50	7.79

p. 34





Examples of the reduction of actual market town patterns to theoretic, diagrammatic forms of Model A and B.

pp. 22-29

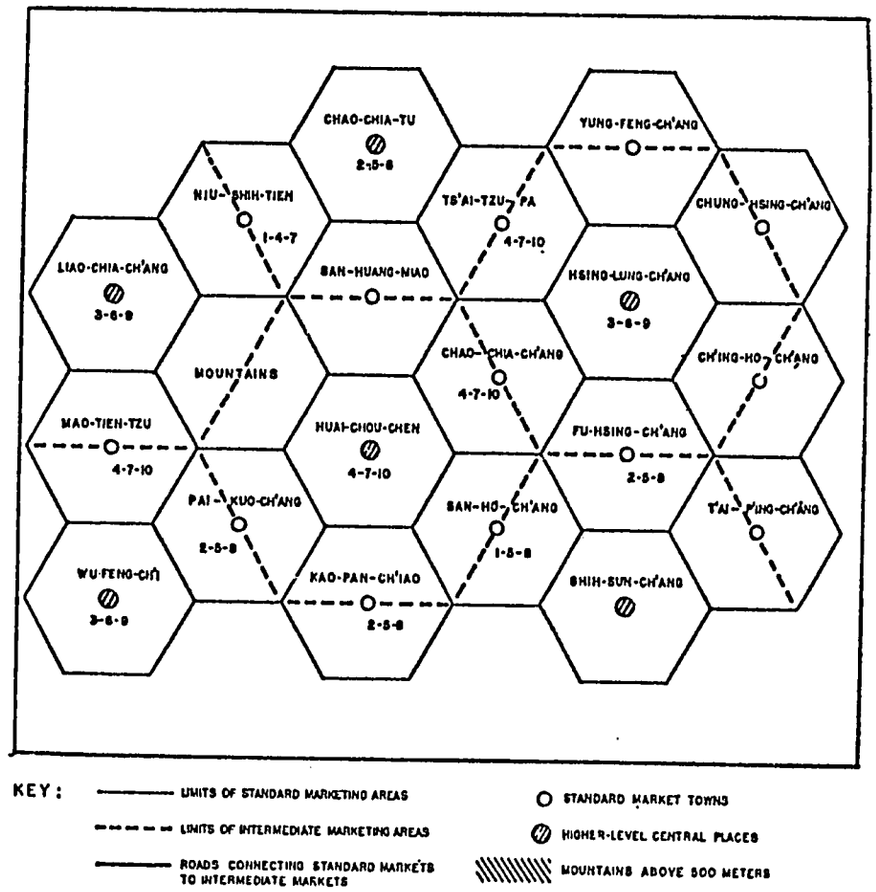


FIGURE 2. A portion of the economic landscape in Szechwan approximating Model A in the distribution of market towns.

2.1: The 19 market towns depicted lie between 35 and 90 km. northeast of Chengtu. Five markets (Yung-feng-ch'ang, Chung-hsing-ch'ang, Ch'ing-ho-ch'ang, T'ai-p'ing-ch'ang, and Shih-sun-ch'ang) are in Chung-chiang *hsien*, the other 14 in Chin-t'ang *hsien*. The mountains shown are part of the Lung-ch'üan range. The only roads mapped are those which connect standard to higher-level market towns.

2.2: First abstraction of the same landscape showing theoretic standard and intermediate marketing areas.

2.3: The same reduced to diagrammatic form. Compare with Model A as diagrammed in Figure 1.

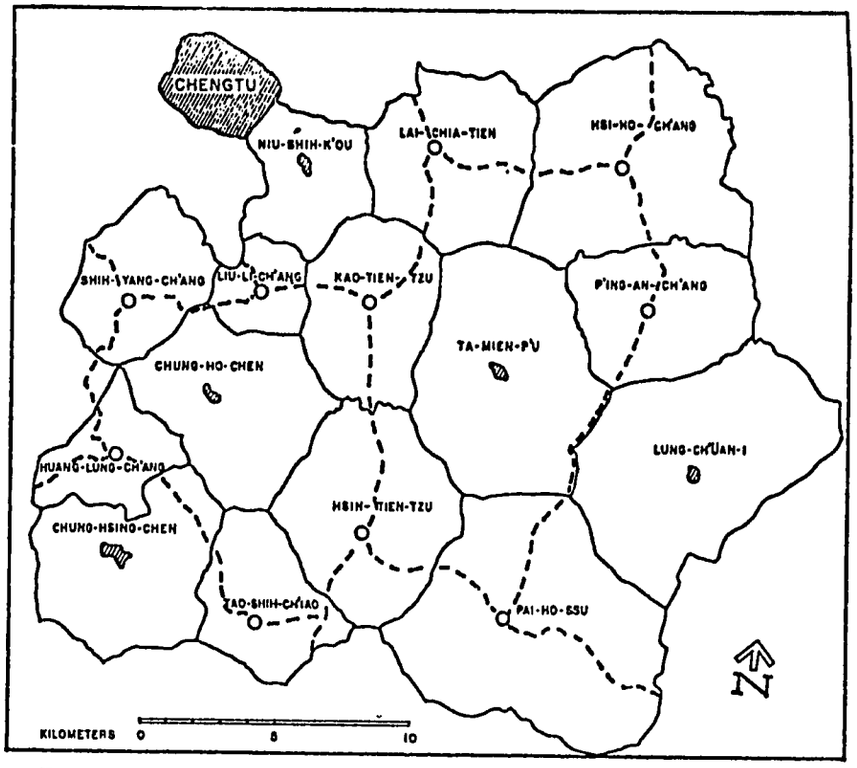
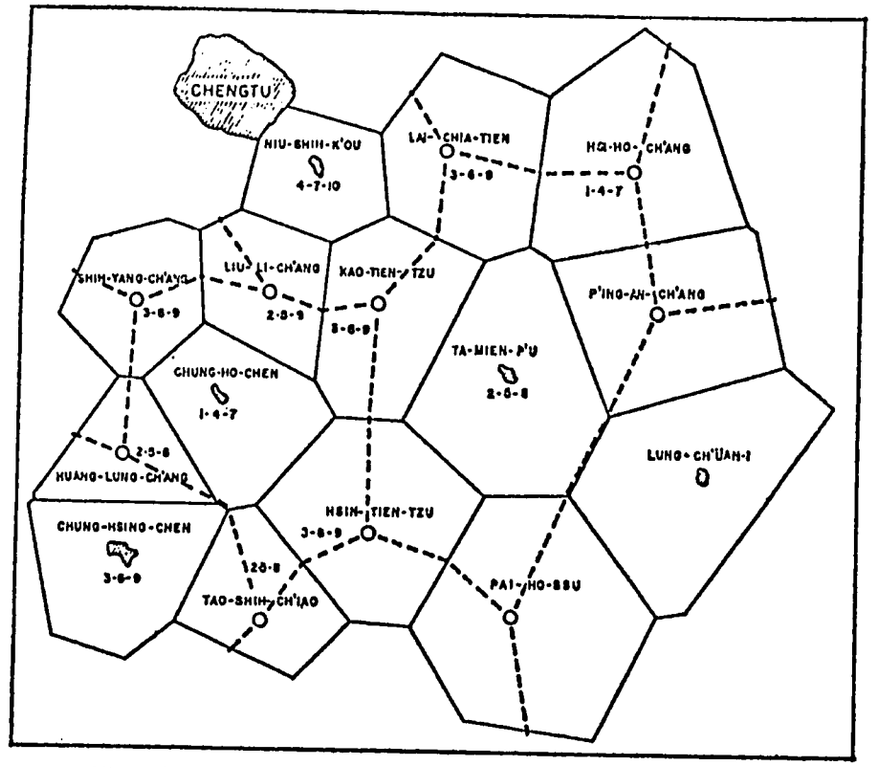
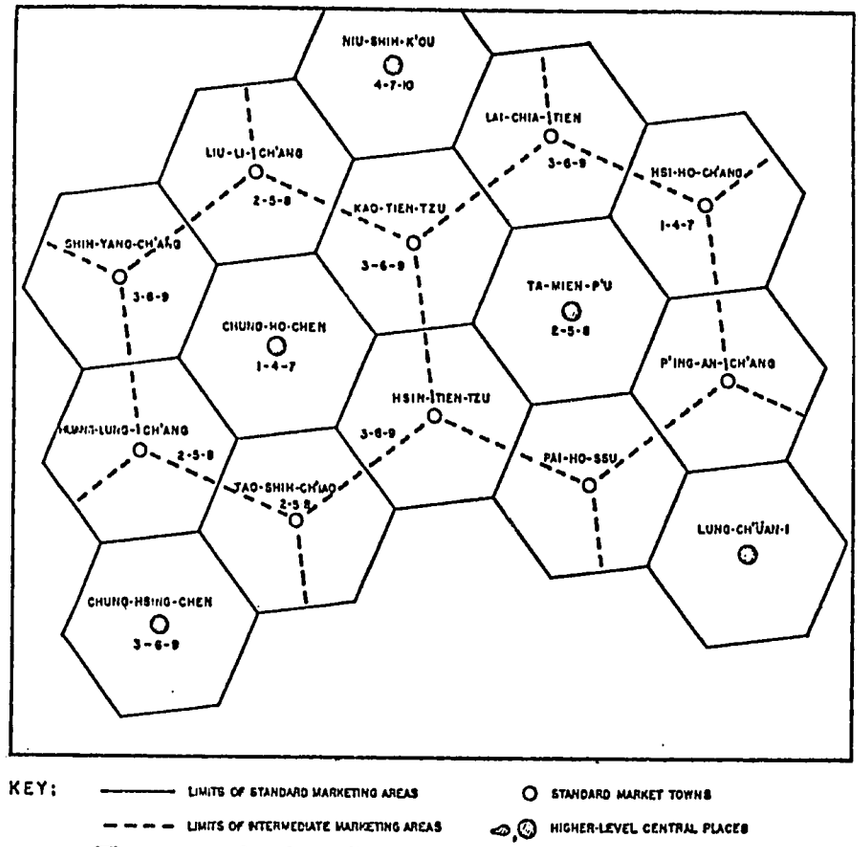


FIGURE 3. A portion of the economic landscape in Szechwan approximating Model B in the distribution of market towns.

3.1: The 15 market towns depicted lie to the southeast of Chengtu within a radius of 25 km. Three markets (P'ing-an-ch'ang, Lung-ch'üan-i, and Pai-ho-ssu) are in Chien-yang *hsien*, the other 12 in Hua-yang *hsien*. The terrain varies from flat to hilly; Lung-ch'üan-i is situated at the western foothills of the Lung-ch'üan mountain range. Marketing-area boundaries are only approximate.



3.2: First abstraction of the same landscape showing theoretic standard and intermediate marketing areas.



KEY: LIMITS OF STANDARD MARKETING AREAS — LIMITS OF INTERMEDIATE MARKETING AREAS — STANDARD MARKET TOWNS — HIGHER-LEVEL CENTRAL PLACES

3.3: The same reduced to diagrammatic form. Compare with Model B as diagrammed in Figure 1.

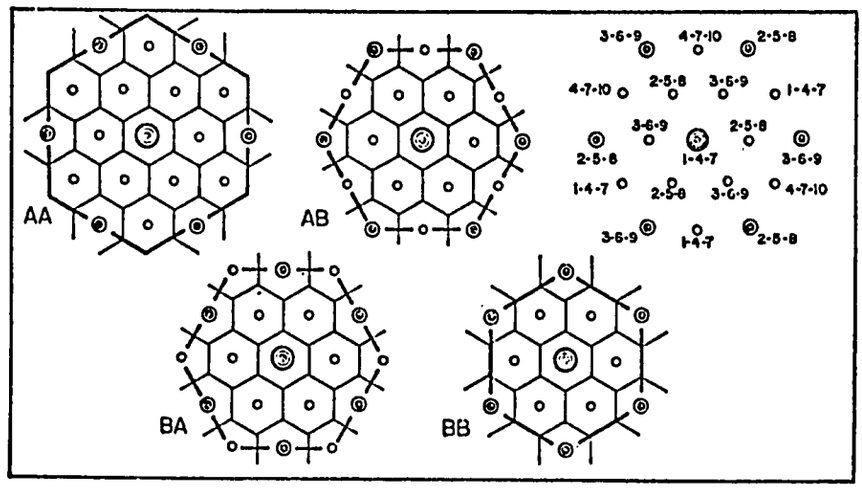


FIGURE 4. Four spatial models of central marketing systems. At the center of each model is, of course, a central market town. Open dots represent standard market towns, while the heavier dots around the rim of each system represent intermediate market towns. Villages are not shown When markets at all levels are distributed consistently according to Model A or Model B, the result is systems as shown in AA or BB, respectively. Systems like AB and BA involve a mixture of the two model distributions.

Markets of an AB system are shown upper right with the addition of regular 3-per-*hsün* market-day schedules.

APPENDIX E

Development Contour Mapping by Computer

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Development Contour Mapping by Computer

Most topographic map making today is based on aerial photography whether for the original production of maps for an area or simply updating older maps. It should be easy to make the production of micro-regional development maps a constant adjunct to the production of topographic maps. This could be done fast and inexpensively since the development isolpeth contours can be drawn by computer. For this study a computer program for the drawing of isopelth contours became available to late to produce most of the maps to be produced and most had to be interpolated and drawn by hand.

An operational computer program and equipment was eventually made available at the US Army Topography Command (formerly Army Map Service) were three maps, the air data scale (Map 4A), the census scale (Map 4B) on Loei and the air data scale on Vang Vieng (Map 11) were drawn for demonstration purposes. This facility as well as the computer program presents problems. Accessibility at the installation is restricted. The technique of drawing contours is better suited for geological data because contours are drawn by interpolating triangle areas which results in very rigid, linear contours. More accessible and applicable are for instance the facilities of IBM which has a contouring program available which is based on a more applicable method of interpolation. IBM also has the necessary contour drawing equipment for rent or sale.

Another method and facility (again found to late for this study) was developed at the computer center of the University of California at Berkely. This method interpolated contours from random points and can also translate the two dimensional contour diagram drawn on maps into a three dimensional side view diagram. There are certainly other facilities and methods available elsewhere. What this simply amounts to is the fact that production of micro-regional development maps based on scalogram analysis can be cone very routinely and inexpensively with the automated technology existing today.

To give some idea as to what the costs of equipment should be, without implying that this is either the best or least expensive equipment, the letter from IBM has been reproduced below.

International Business Machines Corporation

4733 Bethesda Avenue
Bethesda, Maryland 20014
301/656-0817

September 29, 1971

Pamong-Mekong Resettlement Research Project
East Asia Bureau
Regional Development Division
Department of State
Washington, D. C.

ATTENTION: Mr. Harold E. Voelkner

Gentlemen:

The IBM application program that we discussed, and I am confident would meet a demanding requirement, is the Numerical Surface Techniques and Contour Maps Plotting Program. The program is written and designed to be used on an IBM 1130 Computer System and is available at no charge from IBM.

The program uses a data set concept for disk storage of intermediate results. This offers the user a great deal of convenience in establishing solutions for a variety of problems.

A non-linear contouring technique produces maps which closely resemble those produced by hand. Options are provided for rapid linear contouring of intermediate maps and contouring of a series of maps without operator intervention.

This system provides the user with a number of techniques which may be carried out singly or in various combinations. Programs that are included in the set are:

Utility Programs
Numerical Approximation over a Uniform Grid
Interpolation to a Finer Grid
Smoothing
Surface Fitting with Orthogonal Polynomials
Equation Evaluation over a Uniform Grid
Grid-to-Grid Operations
Numerical Integration
Contouring
Map Annotation

Details of the system are described in IBM manuals H20-0357 and H20-0356 that were delivered to you. Additional copies may be obtained from IBM.

For information purposes, I will list the minimum system requirements necessary to operate the program.

	Monthly Rental	Purchase
1131 Model 2B Central Processing Unit 8K Words Storage, Console Printer-Keyboard and Single Disk Storage Drive	$ 980	$41,475
Feature #4454 1442 Attachment	35	1,480
Feature #7187 1627 Attachment	15	675
	$1,030	$43,630
1442 Model 6 Card Read Punch	$ 257	$14,140
1627 Model 1 Plotter	Purchase Only	$ 4,560
2315 Model 1 Disk Cartridge	Purchase Only	$ 90
	$1,287	$62,420

Other equipment can be attached to provide more capability such as:

Additional Core Storage to 32K Words
Additional Disk Storage
Line Printers
Magnetic Tape Drives
Communications Capability to Other Systems and on-line Terminals

A Catalog of Programs (C20-1630) is available that demonstrates the versatility of the IBM 1130 Computer System. The catalog lists programs that were written by IBM, IBM Systems Engineers and customers that are available from IBM at no charge. In addition, IBM has Program Products that are available under license agreement.

The recommendations for equipment and programs contained in this letter are estimates based on the data you have furnished us and on our observations. While we believe our estimates to be sound, the degree of success with which equipment and programs can

be applied to data processing is dependent on many factors, many of which are not under IBM's control. Therefore, our estimates as to the results to be obtained from the equipment or programs being supplied must not be regarded as express or implied warranties.

The machines and services indicated herein are offered in accordance with the prices, terms and conditions of the applicable Federal Supply Schedule Contract. The current contract number is GS-00S-04253.

Thank you, and if I can be of further assistance, please call me.

Sincerely,

Carlton L. Murphy
Marketing Representative

CLM:gko

APPENDIX F

Regional Planning for Underdeveloped Rural Regions

Selected exerpts from: E. A. J. Johnson
"The Organization of Space in Developing Countries"
Harvard University Press, Cambridge, Mass, 1970

".....the first objective of regional planning must be a visualization of systematic projections for the progressive development and numerical increase of properly dispersed agro-urban central places.

The lack of towns and small cities must by some means be corrected; the void between the ubiquitous villages and parasitic great cities must be bridged. Obviously, a whole hierarchy of central places cannot be preplanned or quickly built. What can be done, however, is to coagulate programmed investments, both private and public, into new, well-located capital clusters that can become nuclei around which the "powerful forces of spontaneity" can gradually begin to exert their influence. Just as a handful of honeybees, if provided with a fertile queen, can in a short time become a vigorous colony of twenty-five thousand or more worker bees, in much the same way one can visualize a genetic process whereby contrived investment clusters can become the nuclei for almost any desired number of new agro-urban center places in underdeveloped countries. It is here that the process of town building must begin; on this score the Löschean sequence from small to larger central places should be the prescription, because the larger, intermediate central places will have no true function unless the smaller market towns have begun to take form.... "

p. 212

".....a number of planning steps must be systematically taken in each region whose transformation is contemplated. Because there are in every landscape some well-located villages, strategic road crossings, important river-road junctures, or places where the population exhibits better than average energy and drive, such locations can become particularly promising growth points. In these, certain already programmed investments can be coagulated into what I have called "investment cluster". Here regulated markets can experimentally be established to see whether they will create a "field of attraction". If they do, then a road-building or road-improving program and a selective electrification expansion can be undertaken to stimulate some measure of local subpolarization. The process might well be quickened if appropriate coordinating and capital-assembling institutions are established compentent to guide and assist the whole town building program. A distinction will need to be made between"town founders" and "town fillers", although both groups will be equally essential. But these several steps in the planning enchainment, which will be discussed seriatim, are all dependent on the success with which an investment climate can, more or less artifically, be produced so that private investors will voluntarily conjoin tranches of their capital with public-sector capital inputs, thereby setting in motion a cumulative and multiplying type of capital formation. It is quite feasible to create such an investment climate, one that can attract capital from outside a local community and by that example induce wary local propertied people to venture capital in a development program.... "

p. 213

"The choice is not simply one between regions. A decision has to be made whether a "saturation" technique will be followed in a chosen area with enough growth points selected so that something similar to a classical landscape of market hexagons might result; or, conversely, whether growth points should be chosen at random on the assumption that wherever they are they are worthy of development and that their improvement will benefit not only a particular locality but, in some way, the national economy as well. The virtue of the latter procedure is that it might make it possible for the more backward areas

to share modestly in a town-building program (provided they have any eligible growth points ab initio rather than be forced to wait until the less backward regions have first been favored.

".....the best compromise would be to "saturate" portions of one or more of the better regions while randomly chosen growth points are used as "pilot projects" in the more-backward areas..... "

p. 218

NOTE: With the measured identification of Central Villages, random selection which can be highly wastefull, becomes unnecessary.

"In selecting rural sites that have better than average prospects of becoming future agro-urban communities, two locational considerations arise. What should be the characteristics of the region in which such a growth point will be sought, and, secondly, what special features should a particular site within a region possess? Since geographic, agronomic, and ethnographic factors will influence the choice of both region and site, it is not easy to isolate general determinants. But there are some. Because the function of the emergent "rural growth center" is to bring country-dwelling people into a market economy in a more complete and truly functional way, the growth potential of any chosen site will perforce depend on the productive capacity of the region in which it is located for the very obvious reason that in an agrarian economy the future prospects of a market center will depend on its capacity to assemble or process crops that are important not only to the local area but to the entire economy. The first criterion for evaluating a region will therefore be its present crop-producing performance, the second, its potential future productive capacities... "

p. 219

"Regional profiles of resources ought to be made together with projections of what these resources might reasonably be expected to produce under a feasible degree of technical guidance. Once these potentials are estimated, the search for best sites can begin....

"It should not be forgotten, however, that there are social criteria that are sometimes as important as physical factors. Even deep rich soil, suitable terrain, or salubrious climate and adequate rainfall will not suffice unless there is "evidence of a rising civic sprit," of ambition and drive on the part of a majority of the people, a willingness to work, save, and invest. Like all other aspects of progress, the development of rural growth centers will very much depend on the quality of leadership a community can muster and on the ability of leaders to inspire confidence and kindle the enthusism of their fellow-citizens... "

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"Coagulating Investments into Punctiform Clusters

Although the site for a rural growth center could be out in open country at an important road junction or at a riparian location where piers, docks, and loading and unloading facilities could be built, it will ordinarily be found in an existing village or small town where some marketing, merchandizing and service facilities already exist. The planning task is to devise ways and means for improving the facilities that already exist adding new capital installations, providing minimally necessary public services, and establishing

such educational, health, and other institutions as will be necessary to make the center a place that will attract buyers and sellers from a widening hinterland, and thereby hasten the process of areal technical and economic improvement and modernization.

"An investment cluster is a punctiform grouping of business enterprises that can, by the communicative power of its proffered goods and services, stimulate greater agricultural production, improve the quality of farm produce, and induce farmers to augment their marketable surpluses. Unlike a cluster of similar industries (shoe factories in Brockton, Massachusetts, or cotton textile mills in Ahmedabad, India) an investment cluster in a rural growth center will consist of varied and different enterprises, their number and variety articulated largely to the needs of the hinterlands which are to be served. But though dissimilar, the enterprises will nevertheless derive benefits from association and proximity to one another. These advantages of agglomeration are real and fairly predictable... "

p. 223

"A community with a cluster of dissimilar enterprises will have the likelihood of greater stability in output and employment. Thus an industrial estate with small industries operating continuously can be a stablizing counterpoise to a highly seasonal cannery, rice-hulling mill, or slaughterhouse.

"Once astute and careful planners have chosen a site for a rural growth center, the problem is how to materialize these potential "advantages of numbers and association". Obviously, an underdeveloped country cannot patiently wait for the "powerful forces of spontaneity" to set this process in motion, since the unpleasant truth is that these forces have not been "powerful" enough in the past, and unless an investment stimulus is provided by some "change agent", they will not be any more "powerful" in the future. The "operational" task of the planners, whoever they may be - and it should be emphatically pointed out that they need not necessarily be bureaucrats of some central governmental ministry - the really critical responsibility for the planners to find the needed "change agents" I say "find" because the change agents may be local entrepreneurs who can be "induced" to undertake some new venture, they may be outside investor who are "attracted" by certain concessions, or they may be certain institutions that can "extend" their activities to new growth centers. The methods and techniques will vary from country to country, from region to region. Puerto Rican planners have mainly relied on "attracting" foreign entrepreneurs, Israel has "induced" change by means of collective cooperative institutions, while Yugoslavia has allocated investment funds to new "communes". Whatever strategy is employed, the basic task is to get a few key enterprises started at the chosen growth center sites...

This raises at once the question of whether the initial impetus must come wholly from the public sector or whether some interblending of public and private activities may be feasible. This will largely depend on the "investment climate"...

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"Whatever the strategem, some adventurous innovators must be found who will assume the initial risks. Only when they have taken the first steps can one expect more conservative people to make parallel investments or establish enterprises of an ancillary or secondary character."

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"As the annals of economic history are critically reviewed, it becomes increasingly evident that vigorous development has in the majority of cases been the consequence of variable mixes of private enterprise and governmental subvention or assistance....."

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"If a central place (whether it be a rural growth center, a market town, or even a small city) is going to be a genuine integrating force, a "social unit," as Frank Pick once said, must come into existence, one that is "not too large to destroy personal contact" and yet large enough "to afford variety and diversity". Ideally, such a social unit should "involve all classes" and thereby elicit the vital forces and latent creativity that reside in an area's human resources...

The crux of the matter is just this. If an area that is spatially definable by transport perimeters is to become truly "functional," it will need to develop what McCarty has called an 'occupational pyramid'. The base of this pyramid will consist of the several types of primary production that natural resources make possible: farming, mining, fishing, and lumbering these "basic" operations will profoundly influence the superstructure that can be built upon them as social and economic foundations. Processing industries will form an important section of the pyramid, but only if outreaching market and transport facilities exist, so that semimanufactured agricultural, mineral marine, or forest-products can be "exported" from the area...

"Wise policy makers will "seek out a functionally efficient level of synchronization between two spatial patterns of distribution of economic activity and population". "The major trust of regional policy," say Berry and Prakasa Rao, "should be the fight to offset polarization, to eliminate the dichotomy", because it is only by bringing into existence "a complete spatial system of urban centers arranged in a hierarchy from agro-urban towns through several intermediate types to the metropolis that growth and development can be achieved"...

"Geographers and economists have devised tools by which the potentials of any portion of terrestrial space can be quite accurately measured. Not only can the resources, both physical and human, be evaluated but, within a given compass of space, particularly promising "growth points: can be located..."

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We may add at this point that now Sociology or more specifically Social Anthropology has added a tool by which the "integrative social pattern" can be measured and a theory which makes interpretation and prediction more feasable for planning.

PA MONG RESERVOIR LEVEL OPTIMIZATION RE-CALCULATED

Supplement to: Social Factors in Reservoir Settlements Relocation

H. E. VOELKNER

Submitted to:

The Agency for International Development

and

The Mekong Committee

April 1972

PA MONG RESERVOIR LEVEL OPTIMIZATION RE-CALCULATED

Supplement to: Social Factors in Reservoir Settlements Relocation*

A. Introduction

This paper presents an exercise undertaken to determine the effect that probable maximum relocation costs would have on the optimal reservoir level, in terms of costs of electric energy produced. Except for the new relocation cost estimates, the method of computation and the costs are those used by the Bureau of Reclamation in its "Supplement to the Pa Mong Feasibility Stage I Report: Optimization Study and Interest Rate Sensitivity Analysis."

In comparison with the large scale dam projects in Africa (Figure 1), the resettlement costs used by the Bureau of Reclamation in the Stage I Report appear to be exceedingly low.**

This raises the question: What are the realistic potentially maximum costs of relocating the population and replacing the property displaced by the Pa Mong Reservoir at various levels? The potential maximum costs have to be stressed to determine what policies and actions may reduce them, such as inundation by 1980 instead of 1990, thus avoiding a 10 year population growth.

One important qualification must be emphasized at the outset: this optimization exercise does not pretend to be conclusive. The figures used for the more realistic cost adjustment are only estimates derived from valid but circumstantial evidence found in the Bureau of Reclamation Report or otherwise available to this project.. There may be other cost increases not included here or some of the increases presented may turn out to be far off the mark. The purpose of this exercise is mainly: (1) to demonstrate the potential seriousness of the identified omissions in the Bureau of Reclamation computations, and (2) to show the need for correcting these omissions through the required research and investigations which should replace the rough estimates used here with actual facts. Until this is done, a clear decision cannot be made on the appropriate size of the Pa Mong project, or whether there even should be such a project if it is justified by electric power benefits alone.

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* Prepared for the Agency for International Development and the Mekong Committee, 1972.

** It should be noted that the cost data used by the Bureau of Reclamation are claimed to be based upon the maximum possible compensation presently allowed under Thai law. Even so, the costs derived appear to be low by any reasonable standard, which raises the question of their appropriateness in an official cost benefit analysis without at least clearly identifying the differences from the potential actual costs.

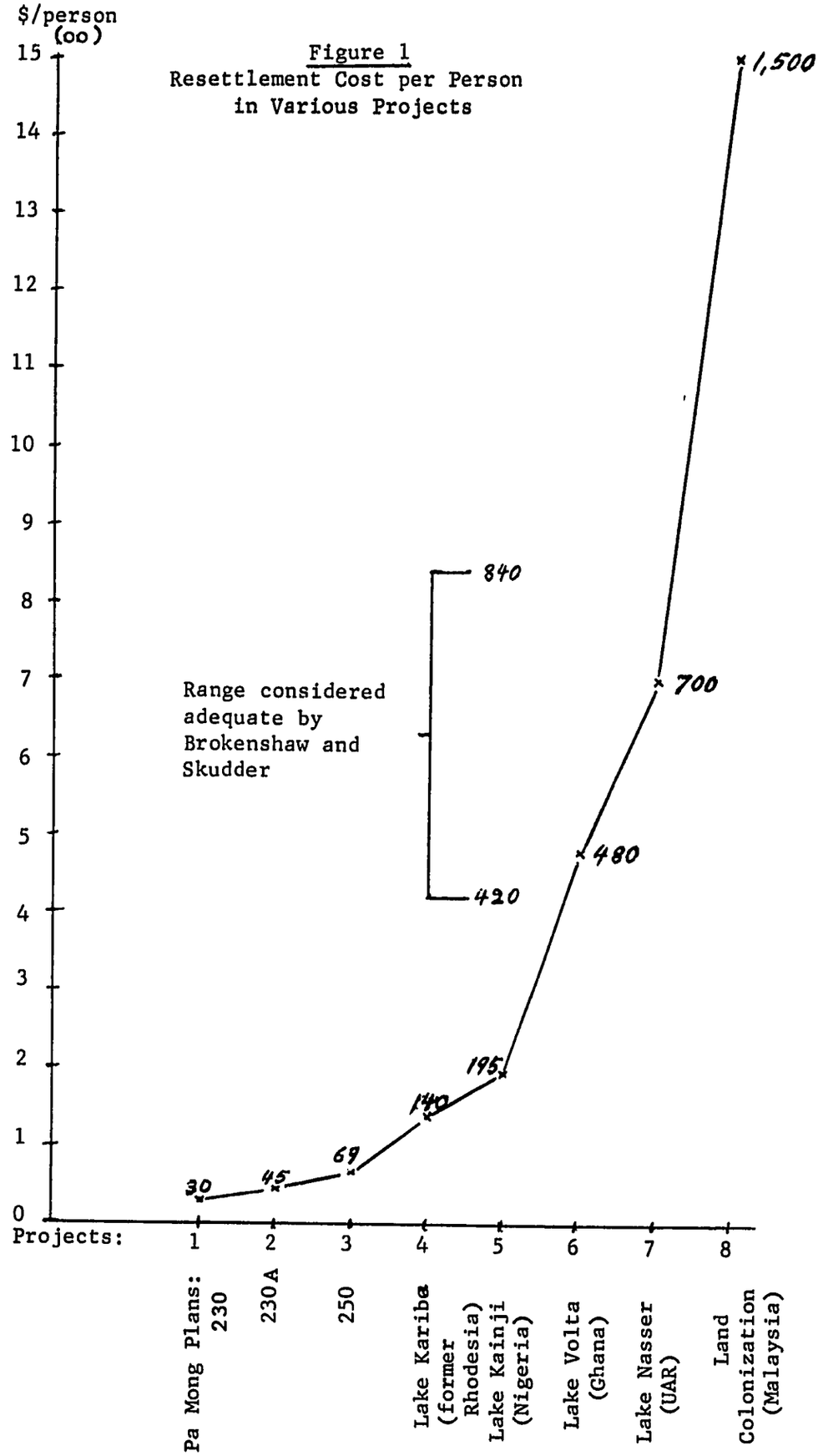


Figure 1
Resettlement Cost per Person in Various Projects

Source: See Table 1 in Main Report

B. Relocation Costs Under-estimates in the Bureau of Reclamation Stage I Report

To determine the availability of tangible evidence on which to base reasonable increases in relocation costs, it was first necessary to search for reasons of these low costs in the Bureau of Reclamation Report and Appendixes. This was no easy task since very few details are given. It became obvious that first the costs relating to relocation and resettlement had to be identified in the Bureau of Reclamation cost presentation. Table 13 from the Bureau of Reclamation Supplement on optimization shows the different cost allocations at each reservoir level investigated.

After reading various sections in the main report and the Appendixes, it appears that only three items in Table 13 relate to relocation and resettlement costs. These are: Land, Resettlement and Roads. (Clearing for resettlement is contained in the resettlement costs.) These three items, if added before adjustments, make up about 9 percent of the total cost at the 230 meters level and about 12 percent of the total cost at the 250 meters level. Each of the three items were studied in terms of how they have been possibly derived and how realistic these figures are in view of the data analyzed for this study.

The most important relationships generating the questions above are the significant differences between the rates of increase of (1) displaced population, (2) value of displaced property, (3) reservoir size, (4) installed power capacity, and (5) engineering costs for different reservoir levels. As shown in Figures 2A and B, variables (1) and (2) increase substantially faster than the other three variables. The higher the level of costs for variables (1) and (2), the more will the economic advantage of larger reservoir sizes be reduced or even reversed. The investigation of the USBR Report, Appendixes and Supplement revealed several areas for substantially increasing relocation costs (variables (1) and (2)).

The following underestimates were identified:

a) The resettlement and relocation costs in the USBR Report and Supplement are for 1968. Though the construction is planned for 1983 to 1995, the USBR computation did not make allowance for population growth up to the time relocation becomes a reality. By now this date has been estimated to be in the late 1980's. For easier computation it is here taken to be 1990. The total costs for relocation have to be based on the total number of people to be relocated at the time it has to take place. Relocation of course can and must start far ahead of the actual flooding of the reservoir area. However, by past experience this has rarely been possible and therefore for maximum costs the absolute final date for relocation should be taken to be 1990.

b) The resettlement cost, found in USBR Correlary Study No. 7 in Appendix VII, was computed according to the standards and regulations made for resettlement of landless poor from urban areas in Thailand. Amounts of assistance and materials allocated per family represent the minimum to permit a family to gain a foothold in the colonization of unoccupied areas.

Table 13

PA MONG PROJECT ALTERNATIVE HYDROPLANS

PLAN	Construction Costs ($1000)				
	230	240	250	260	260-A
Installed capacity	3,200 mw	4,000 mw	4,800 mw	5,600 mw	4,800 mw
Pa Mong Dam and facilities	156,090	171,940	182,820	226,890	226,890
Nam Mong Dam and dikes	16,520	21,140	39,410	75,560	75,560
Nam Lik Dam and dikes	19,850	21,690	21,780	31,870	31,870
Pa Mong Powerplant	325,980	350,880	375,410	401,030	375,410
Substations, switchyards, and transmission lines	216,790	274,620	275,620	344,760	275,620
Land	35,500	47,200	54,680	60,000	60,000
Clearing	17,900	28,000	40,900	49,500	49,500
Resettlement	5,100	13,000	19,000	21,700	21,700
Roads	38,200	42,600	47,400	48,800	48,800
Camp and service facilities	30,000	30,000	30,000	30,000	30,000
Total Cost	861,930	1,001,070	1,087,020	1,290,110	1,195,350

*From US Bureau of Reclamation; "Pa Mong Stage One Feasability Report; Supplement Optimization and Interest Rate Sensitivity Analysis", 1970, p. 5.

Figure 2-A

PA MONG RESERVOIR AND POWER CAPACITIES, ENGINEERING COSTS AND NUMBER FAMILIES DISPLACED FOR ALTERNATIVE RESERVOIR SIZES.

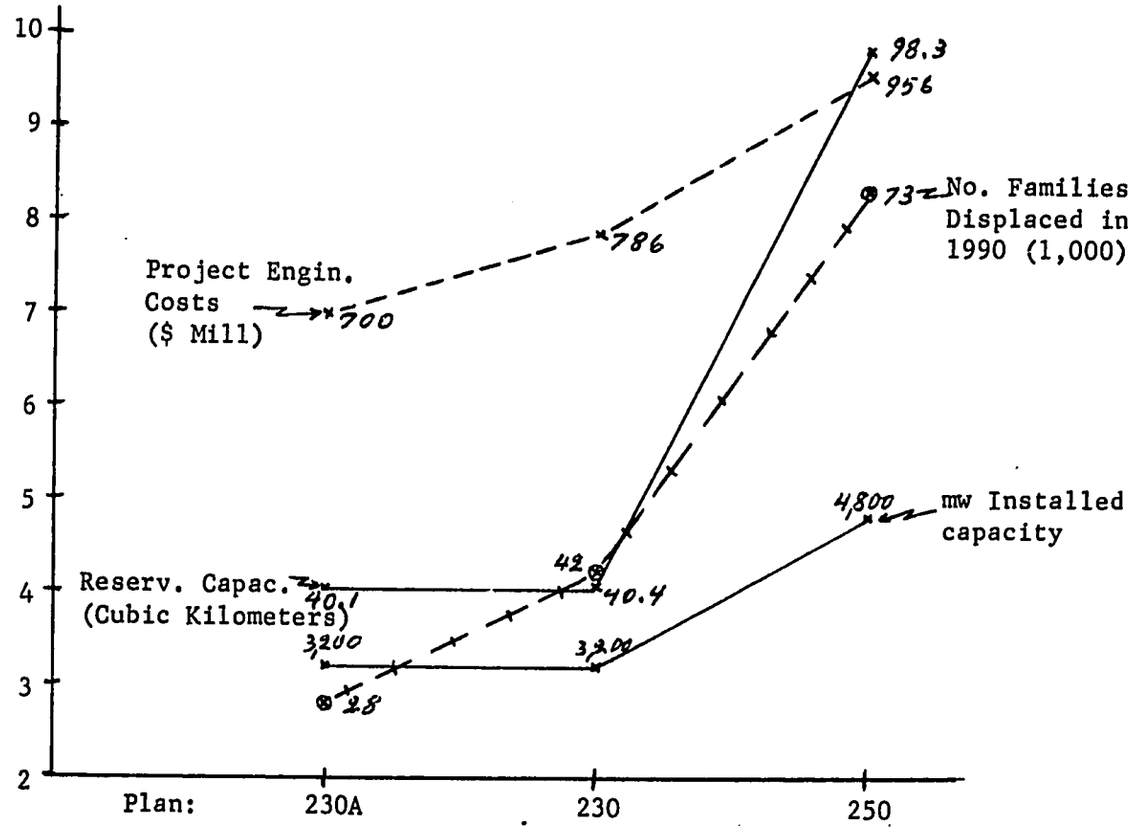
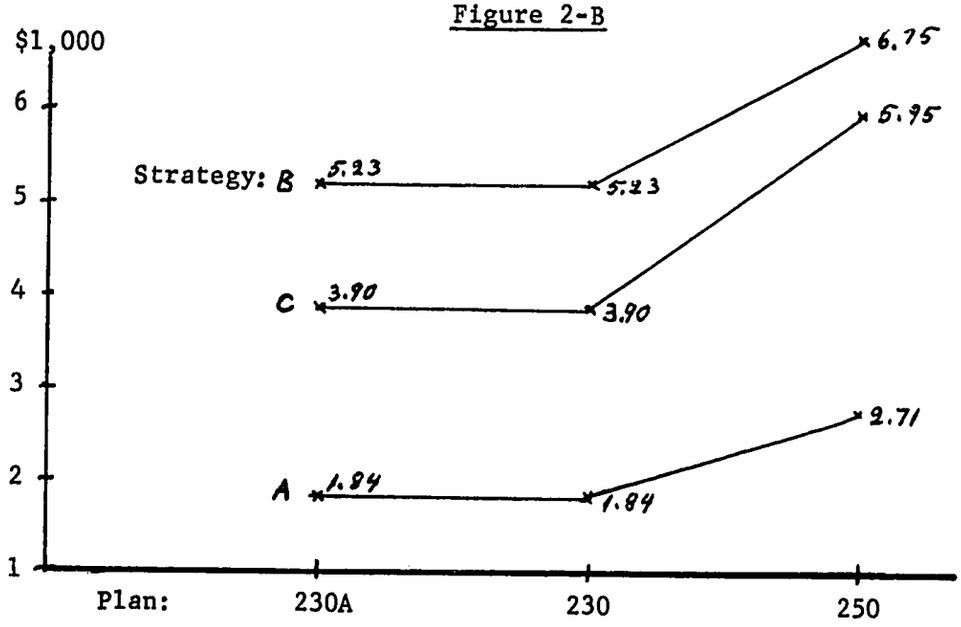


Figure 2-B



Total Relocation Costs per Family Displaced in 1990 for Alternative Reservoir Sizes

Of course, almost anything given to such people is more than they have had before and for that purpose these standards and policies may be adequate and applicable. At Pa Mong, however, we are dealing with people who invariably have property; some of them are sophisticated people with highly valuable properties, especially in the towns and large villages in the Loei Valley (for more detail see Main Report). Most importantly all these people will lose their property by government action, presumably for the benefit of the people of Thailand or Laos, of which they are a part. They are not landless poor and therefore the standards and regulations made for land colonization can not be applicable. In fact, an application of these policies would constitute a severe social injustice which would surely lead to the generally recognized results of political action. There are universal elements of social justice and this is one of them. If the Nam Mong and Nam Som valleys are now inaccessible due to insecurity, then the whole Pa Mong area should soon become inaccessible from such action and the implementation of the Pa Mong project would seem to be impossible.

c) The land estimation per family displaced, using the USBR figures, turned out to be impossibly low, being 0.64 ha in Laos and 1.34 ha in Thailand. Also, the value estimation for this land and property was taken as tax assessed value which in any country including the United States is customarily below the actual market value. Often it is only a fraction of the real market value especially in underdeveloped countries. Furthermore, half of the land area in Thailand is located in the Nam Som and Nam Mong Valleys which, according to the cadastral survey report, could not be visited because of insecurity. This land on the average has been evaluated at $91 per hectare compared to an average value of $610 per hectare in the Loei Valley (Region 5) and at least $275 per hectare in the Nam Chom Valley (Region 6). This appears to be an under-evaluation and an undue punishment for making the area insecure for government agents. A more realistic price estimate had to be taken based on land prices in Loei and Pak Chom.

d) Compensation and replacement determination will be impossible without adequate land and property titles. The reports by Ingersoll and Thomas and Black indicate that nearly none exist in Northeast Thailand. In the Lao Pa Mong area, no titling has been done at all. The costs of land titling alone will be substantial even if done with aerial photography. No assessment of the cost could be made however and this item is not included in the later calculations.

e) Another item which will increase the total cost by the time relocation has to take place is development growth in the region. It is reasonable to assume that, especially with the development investments undertaken by the Thai government and foreign aid in the Pa Mong area, especially through the ARD programs, the per capita improvements, i.e., the per family compensation costs would increase by multiplier effect and future investments if the dam was not built. An average of two percent annual rate of growth is considered to be very conservative, however in some of the more remote areas, it may still be almost zero. Whatever the actual rate, some growth must have been anticipated to take place or past and present investments in these regions would have clearly been made without purpose. If policy or public knowledge of the reservoir reduces or prevents this growth, then the loss of growth represents an opportunity cost to the population in the area, which must be added to the project costs.

f) Neither has the loss of income from present and future resources, properties and improvements in the reservoir area by inundation, another opportunity cost, been considered in the project costs unless compensation and resettlement have been thought to cover this cost item adequately. But adequacy, i.e., no income loss can only be achieved if full replacement of income, facilities and opportunities can be made at once. Clearly the $740/person relocation expenditure in the USBR study do not cover anywhere near the replacement of present and future incomes for three generations. This cost, however, could be covered by adequate replacement in relocation strategies.

g) Road relocation costs include access roads to dam and dike sites which had to be subtracted. Moreover, the road relocation computation is based on existing roads at the time the survey was made (1966) before the large scale road building program of the Accelerated Rural Development (ARD) program was producing results. According to the data available from the ARD program, all-weather roads in the Pa Mong Region especially in the Pak Chom, Nam Mong and Nam Som valleys have been doubled and tripled and the road relocation costs will have to be increased substantially.

C. Alternative Relocation Strategies with Adjusted Costs

The same facts, internal or external to the Pa Mong region, by which the above "problems" in costing were identified, can also be used to estimate some reasonable corrections (see Table 1). This was done to see what effect more realistic relocation costs would have on the optimal reservoir level cost-benefit ratio and the competitive price of hydro-electric power. Tables 2A & B and 3 show what the new estimated total costs are and the result of the computations. The tables show for each of the two reservoir levels the different cost estimates and computations for four different relocation strategies labelled A to D. Costs for all strategies were computed first for the present population of 48,000 families at the 250m and 63 percent or 30,000 families at the 230m level on which the USBR relocation cost estimates appear to be based. These per capita costs were then multipled by the population estimated in Chapter III to be present in 1990, to arrive at total relocation costs.

Cost figures for the 230m level were reduced to the following percentages of the 250m level based on information in the USBR Report and its Supplement: Land 65%; Other Property 22%; Roads 60%; and, Resettlement 26%*.

The four strategies and specific reasons applied to adjust the cost estimates in each were as follows (all figures are for the 250m level rounded off to the nearest million, see Tables 2 and 3 for details on all levels).

Strategy A:

This strategy is the same as contained in the USBR Report, except for the following cost adjustments:

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*Why the USBR reduced the resettlement item to 26% from $19 million in Plan 250 to $5 million in Plan 230 when the population and other items are reduced to only 60 to 65%, is not clarified anywhere. It has not been adjusted here.

1) a 2% per year growth rate for improvement values was added which amounts to 50% of present improvement values over 20 years or 1/2 of $27 million being $14 million.

2) $5 million for access road construction was subtracted from the $47 million for all road construction leaving $42 million for the relocation of inundated roads.

Strategy B:

This strategy is the same as contained in the USBR Report except that land, other property and road relocation values have been adjusted as follows:

1) The adjustments of land and property are presented in Table 1. The new combined total is $192 million of which $58 million is for property other than land.

2) The 2% growth rate for $58 million over 20 years is $29 million.

3) The $42 million for road relocation was doubled for the relocation of new ARD roads; this is a very rough estimate.

Strategy C:

In this strategy all inundated lands are replaced by project developed land above the reservoir and letting communities largely do their own relocation at the nearest shoreline with assistance. All costs remain the same as in Strategy B except as follows:

1) Land compensation costs are reduced from $134 to $58 million by assuming 104,000 ha to be developed at $350 per ha. This is an estimated average cost figure for developing uncultivated lands with a 0 to 5% slope based on land development data in the USBR Report, Appendix I, pp. vii-20 to 21. This is a very rough estimate pending better data from a detailed shoreline study.

2) The $19 million resettlement costs have been tripled to $57 million to facilitate adequate assistance and administration for the self relocation of communities. This amounts to only about $210 per person but most of the relocation costs in self relocation and replacement is financed by compensation cost figures. The total relocation cost including public facilities and roads per person is thus $1,040 per person or about $6,000 per family; this is not an excessive amount when compared with African expenditures nor with West Malaysia colonization expenditures where costs have been $9,000 per family (see Table 1).

Strategy D:

This is the "family self-relocation" strategy. Costs are the same as Strategy B except that:

TABLE 1

ESTIMATED LAND AND PROPERTY VALUES PER FAMILY
IN THE PA MONG REGION

	In USBR Report	Adjusted for this study
1. Land/Family (all Types: cultivated, fallow and residential):		
in Reservoir Area in Laos	0.64 ha	2.5 ha*
in Reservoir Area in Thailand	1.34 ha	4.0 ha
in Irrigation Area in Laos	4.1 ha	-
in Irrigation Area in Thailand	4.2 ha	-
2. Land Value (all types)		
average in Laos	$ 500/ha	$ 665/ha**
average in Thailand	650/ha	865/ha
3. Total Value of Land and other property per family		
in Laos: Property	$ 320/Family	$ 800/Family+
Land	394/Family	1,700/Family
Total	$ 714/Family	$2,500/Family
in Thailand: Property	$ 700/Family	$1,500/Family+
Land	870/Family	3,570/Family
Total	$1,570/Family	$4,300/Family
4. Total for Pa Mong:		
Laos 20,000 Families	$14	$ 50 mill.
Thailand 28,000 Families++	41	142 mill.
Total 48,000 Families (rounded figures)	$55	$192

*The average land per family by USBR figures appears too low even for survival. The adjustment for the Thai area is backed by USBR figures for the irrigation area and ARD data; for Laos it may still be conservative.

**Average land value increased, to adjust for under-evaluation in Nam Som and Nam Mong Valleys, is about 13 percent.

+Property value is doubled because the tax assessment is assumed to be 50% of real or replacement value.

++This figure was derived from corollary Study No. 7 in Appendix VII of the USBR Report by adding the figures for the first four resettlement projects. The USBR main report cites 24,550 families but gives the above Study No. 7 as the source. The reason for this discrepancy is not clear.

1) Land is compensated at three times the market value as estimated in Table 1, i.e., 3 x 134 - $402 million. This is justified by the costs experienced in replacing equal value lands by purchase outside reservoirs and moving to such places. (See the Ingersoll and Thomas-Block reports on Thailand). E.A.J. Johnson in "The Organization of Space in Developing Countries", p. 347 reports that the Volta Lake resettlement project provided this compensation as an option to displaced families who chose self-relocation.

2) The $19 million for resettlement is assumed to be necessary for administration and assistance for purchasing lands outside the reservoir (Project Cost Figure 3).

Power Costs

Table 3 presents the computation of generated power cost for each of the four strategies at three different reservoir sizes. The computation duplicates the method employed by the USBR in its supplement on optimization. Figures for the smallest size reservoir, the 230m level without Nam Lick and Nam Mong valleys, have been computed by multiplying the per capita relocation costs for each strategy at the 230m level computed in Table 2B, by 157,000 people the estimated population displaced at this reservoir size in 1990. The costs of Nam Lick and Nam Mong dams and dikes have also been subtracted from the engineering part of project costs.

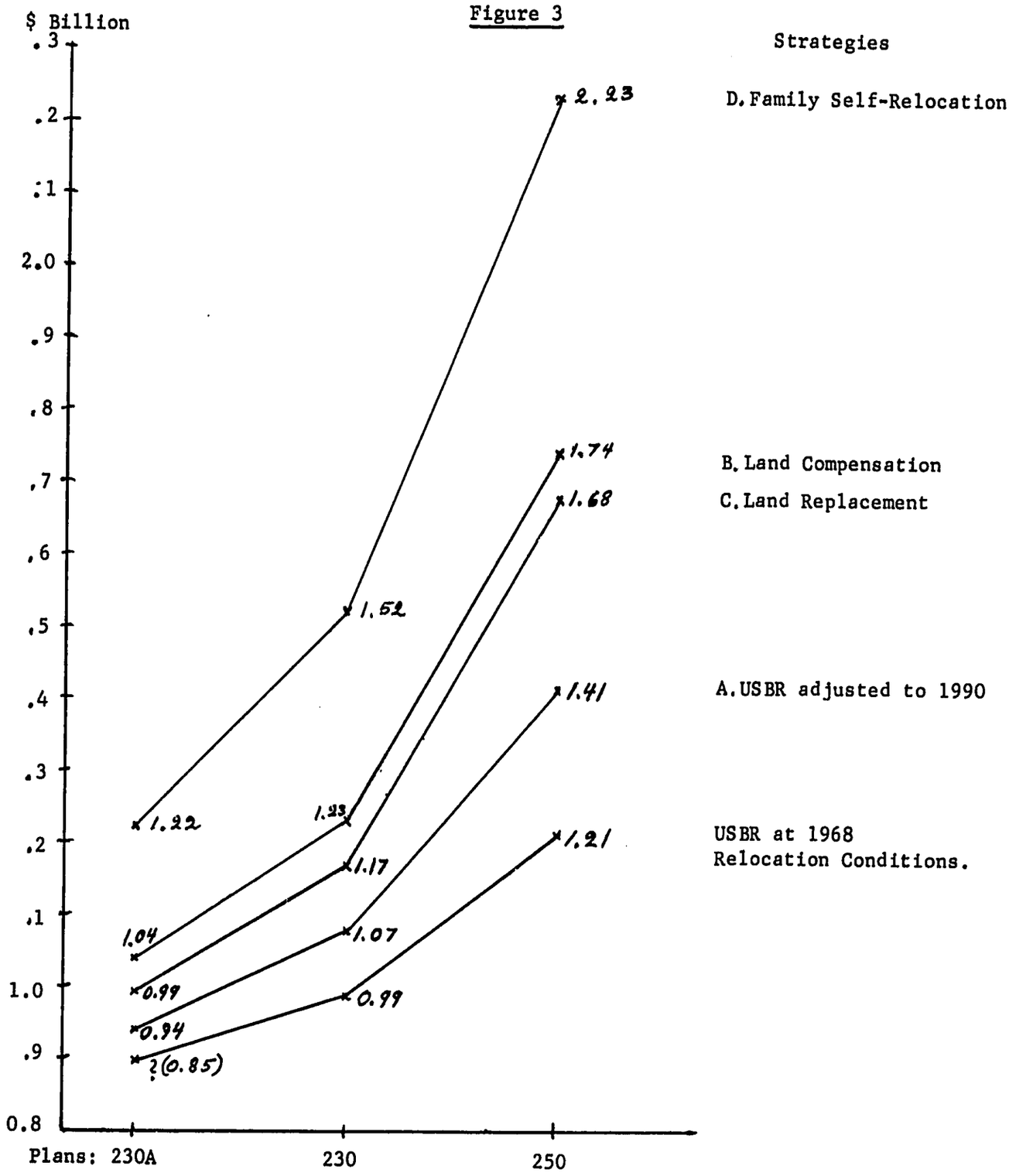
D. Conclusions

The lowest cost strategy at either reservoir level, not considering Strategy A, is Strategy C which requires the replacement of all lands inundated. The project, however, should (following Peter Goslings proposal) also offer the option of Strategy D. to those individuals willing to migrate to and self-relocate in urban or rural areas outside the Pa Mong Region. If the actual relocation strategy will be a combination of strategies C and D the actual total costs of relocation will be somewhere near that of Strategy B.

A comparison of the average energy costs at the different strategies and reservoir sizes show clearly that the smallest size reservoir, i.e., the 230m level without Nam Lick and Nam Mong valleys produces the lowest cost energy in the form of hydro-electric power. On the contrary, energy costs at the other two reservoir sizes are not or are just barely competitive with the thermal-energy if one includes in the computation more realistic relocation costs in strategies B to D then have been used in Strategy A.

This conclusion, should it turn out to be anywhere near correct, has some highly significant implications. The total costs of the Pa Mong Project, according to Strategy B, would nearly be halved from $1.5 billion for plan 250 to $0.8 billion for Plan 230A; the number of families to be relocated would be reduced to 38%; the per capita relocation cost would be reduced to 75%. Many other advantages of this reservoir size have been pointed out in the main report of this study. All together one could conclude that at this reservoir size there is a positive combined social and economic feasibility of a Pa Mong project; at the other sizes it is still highly questionable.

Figure 3



Pa Mong Total Investment Costs for Alternative Reservoir Sizes and Relocation Strategies

TABLE 2A

PLAN 250

Costs of Relocation Strategy Alternatives for the Pa Mong Reservoir 250m Level

Cost Item	Strategies and Costs (US Dollars) A	B	C	D
1. Land and other improvements (mill.)	55	192	0	402
2. Other improvements only (mill.)	(27)	(58)	58	58
3. Growth of improvements by 1990 (2%/year = 50% over 20 yrs.) (mill.)	14	29	29	29
4. Land developed for replacement (164,000 ha at $350/ha) (mill.)	0	0	58	0
5. Resettlement or relocation assistance and administration (mill.)	19	19	57	19
6. Roads relocation (mill.)	42	84	84	84
7. Total relocation costs (mill.)	130	324	286	592
8. Total project other costs (mill.)	956	956	956	956
9. Total project costs at 1970 prices and population (USBR estimate) (mill.)	1,086	1,280	1,242	1,548
10. Relocation costs as percent of total project costs	12%	25%	23%	38%
11. Relocation costs per family (Total Cost ÷ 48,000 fam.)	2,710	6,750	5,950	12,700
12. Relocation costs per person (Reloc. Cost ÷ 275,000 pers.)	740	1,180	1,040	2,150
13. Total relocation costs with 1990 population (item 11 x 72,000 fam.) (mill.)	198	494	436	927
14. Total project costs with 1990 population but 1970 prices (mill.)	1,154	1,450	1,392	1,883
15. Relocation costs as percent of total project costs; 1990 population	19%	34%	31%	49%

TABLE 2B

PLAN 230

Cost of Relocation Strategy Alternatives for the Pa Mong Reservoir 230m Level

Cost Item	Strategies and Costs (US Dollars) A	B	C	D
1. Land and other improvements (mill.)	24	100	0	261
2. Other Improvements only (mill.)	(6)	(13)	13	13
3. Growth of improvements by 1990 (2%/year = 50% over 20 yrs.) (mill.)	3	6	6	6
4. Land developed for replacement (107,000 ha at $350/ha)	0	0	37	0
5. Resettlement or relocation assistance and administration (mill.)	5	5	15	5
6. Roads relocation (mill.)	23	46	46	46
7. Total relocation costs (mill.)	55	157	117	331
8. Total project other costs (mill.) (USBR estimate)	783	783	783	783
9. Total project costs at 1970 prices (mill.)	838	940	900	1,114
10. Relocation costs as percent of total project costs	7%	17%	13%	30%
11. Relocation costs per family (Total cost ÷ 30,000 fam.)	1,840	5,230	3,900	11,200
12. Relocation cost per person (Total cost ÷ 168,000 pers.)	328	935	700	1,970
13. Total relocation costs with 1990 population (item 11 x 42,000 fam.) (mill.)	77	220	164	470
14. Total project costs with 1990 population but 1970 prices (mill.)	860	1,003	947	1,253
15. Relocation costs as percent of total project costs; 1990 population	9%	21%	17%	38%

TABLE 3

Optimization of Pa Mong Reservoir Levels and Relocation Strategies

	PLAN 250				PLAN 230				PLAN 230A			
	250m Reservoir Level Strategies				230m Reservoir Level Strategies				230m Level minus Nam Lick and Nam Mong Strategies			
	A	B	C	D	A	B	C	D	A	B	C	D
1. Total Costs in 1990 (million)	1,154	1,450	1,392	1,883	860	1,003	947	1,253	750	840	805	1,002
2. Interest Cost during Constr. factors*	1.12	1.12	1.12	1.12	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
3. Present Worth of Investment in 1990 (million)	1,295	1,620	1,560	2,110	980	1,140	1,080	1,430	855	960	912	1,140
4. Present Worth of OM&R (million)	117	117	117	117	89	89	89	89	80	80	80	80
5. Present Worth Total (million)	1,412	1,737	1,677	2,227	1,069	1,229	1,169	1,519	935	1,040	992	1,220
6. Present Worth of Energy at Load, Thermal (mwhr x 10^6)	299	299	299	299	217	217	217	217	217	217	217	217
7. Average Energy Cost Hydro Power (mills/Kwhr)	4.74	5.83	$\boxed{5.63}$	7.48	4.92	5.58	$\boxed{5.38}$	7.00	4.30	4.80	$\boxed{4.56}$	5.62
8. Average Energy Cost Thermal Alternative (mills/Kwhr)	5.94	594	594	594	560	560	560	560	560	560	560	560

*These factors were found by comparing Total Costs in Table 13 and Present Worth of Total Investment in Table 2 of the USBR Supplement. Relocation Costs were included in this calculation because the USBR had done so.