

**PREDICTION OF SUCCESS IN VILLAGE FISH FARMING
IN NORTHEAST THAILAND**

by

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ABSTRACT

It is apparent that substantial differences exist between communities with regard to their ability to initiate and sustain community resource management (CRM) projects. The knowledge and identification of these differences is important when formulating policies and planning projects since scarce resources should be allocated to those communities which show the greatest potential for the successful use of these resources and alternative programmes formulated which recognise different community potentials for successful programme implementation.

This study is concerned with inter-community differences as they may affect the success of the “*Village Fish Pond*” (VFP) project in a sample of 205 Northeast Thailand villages. The specific objective of the thesis is to develop an empirical predictive model to identify community characteristics which underlie outcomes of the VFP in Northeast Thailand. The development of the predictive model is based upon a review of literature on the innovation adoption, collective action, and community development and management. The study is concerned with decision-making at the village level in general, and with the factors associated with the acceptance of development projects in particular.

A backward stepwise logistic regression analysis is used to test the predictive model. Data required for the analysis came from two different sources. First, a questionnaire survey was conducted in a sample of Northeast VFP villages (in which the VFP was established between 1986 to 1989) to evaluate the performance of the VFP in each of the participating villages. Second, for the same 205 villages, predictor variables were selected from a national village-level database which is available from the *Institute for the Processing of Information for Education and Development* (IPIED) at Thammasat University in Bangkok. The village community is used as the unit of analysis, project performance is used as the dependent variable, and community characteristics are used as the predictor (independent) variables.

From the questionnaire analysis, the sampled 205 VFP villages were classified into three groups according to their degree of project performance: a complete success, a complete failure, and an indeterminate outcome (neither a clear success nor a clear failure). Since the dependent variable consists of three categories, three predictive models were developed. The first model

distinguishes villages which are more likely to succeed in implementing the VFP from those that are more likely to fail. Here, the dependent variable is coded as “2” (*Success*) and “0” (*Failure*). In the second model, the dependent variable is coded as “1” (*Indeterminate*) and “0” (*Failure*) to represent the differences between those villages which are struggling to continue their VFP activities and those which have rejected the project by stopping all project activities. The third model differentiates those villages that continue to practice the VFP but vary in the degree of success. Its dependent variable is coded as “2” (*Success*) and “1” (*Indeterminate*).

In order to validate the resulting models, 45 villages (about 20% of the total 205 villages) were randomly selected as a validating sample to be used in testing the models for accuracy and efficiency. The majority of the VFP sampled villages (n = 160) was used to test the predictive models. The major results show that only Model 1 achieves a good level of statistical fit with an overall accuracy of 78.16 percent correctly predicted in the model building sample and 70.83 percent correctly predicted in the validating sample. Models 2 and 3 performed less well than expected according to the results of the diagnostic and validation procedures used in the thesis. It is assumed that their low predictive power is due to complication with the indeterminate group, which may result from the short evaluation period used in the research.

In Model 1, nine community characteristics are found to be related to the degree in which community decision-making and performance supported continuing the VFP. The results suggest that property tax (ZPTAX) is the most influential factor in the resulting model. Respectively, in descending ordered of influence, the other variables are: the number household per tubewell and shallow well (WELL), the number of households per television set (HHPERTV), agricultural land use (SOIL_QUAL1), percentage of houses in good sanitary condition (GEN_HEALTH2), percentage of households pursuing the most common industry (INDUSTRY1), the number of community sport activities in the past two years (ZACTIVITY2), percentage of households pursuing fish culture (FRE_RAISER), and the number of households per store (SHOP). In general, it appears that communities with a larger population and territory, a higher economic status, lesser migration to work outside sub-district areas, and a more peaceful society are more likely to succeed in independently implementing and sustaining the VFP than other communities.

In light of the above results, the implications of the results in communal fish culture and rural development planning are examined. Finally, suggestions are made for future research based on the results of the study.

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TABLE OF CONTENTS

ABSTRACT	iv
ACKNOWLEDGEMENTS	vi
TABLE OF CONTENTS	vii
LIST OF TABLES	xi
LIST OF FIGURES	xii
CHAPTER I	1
INTRODUCTION	1
1.1 PROBLEM STATEMENT	2
1.2 RESEARCH OBJECTIVE	5
1.3 SIGNIFICANCE OF THE RESEARCH	6
1.4 STRUCTURE OF THE THESIS	8
CHAPTER II	9
RURAL PLANNING AND RURAL RESOURCE MANAGEMENT:	
THE CASE OF THAILAND	9
2.1 RURAL PLANNING AND DEVELOPMENT APPROACHES	9
2.2 THAI RURAL PLANNING AND DEVELOPMENT	15
2.3 RURAL DEVELOPMENT AND RURAL RESOURCE MANAGEMENT IN THAILAND	23
2.3.1 <i>The Village Fishpond Project (The VFP)</i>	31
2.4 SUMMARY	40

CHAPTER III.....	42
COMMUNITY RESOURCE MANAGEMENT AND THE OUTCOMES OF COMMUNITY INNOVATION ADOPTION	42
3.1 PLANNING AND THE ADOPTION OF INNOVATIONS.....	42
3.2 THE COMMUNITY-BASED RESOURCE MANAGEMENT APPROACH AND COLLECTIVE ADOPTION.....	44
3.2.1 <i>Induced Collective Action in Rural Resource Management</i>	51
3.2.2 <i>Community Adoption: The Community as a Unit of Analysis</i>	55
3.2.3 <i>The Success or Failure of Community-based Resource Management Project</i>	60
3.3 A CONCEPTUAL FRAMEWORK.....	64
3.4 SUMMARY	79
 CHAPTER IV	 81
RESEARCH DESIGN AND METHODOLOGY	81
4.1 THE STUDY AREA	81
4.1.1 <i>Population and Economy</i>	85
4.1.2 <i>Geophysical Characteristics</i>	86
4.1.3 <i>Climate</i>	87
4.1.4 <i>Water Resources</i>	89
4.1.5 <i>Fish Culture</i>	90
4.1.6 <i>Infrastructure</i>	91
4.1.7 <i>Natural Vegetation</i>	91
4.2 THE SAMPLE.....	92
4.3 SOURCES OF DATA	95
4.3.1 <i>Primary Data</i>	95
4.3.2 <i>Secondary Data</i>	97
4.4 STATISTICAL METHODOLOGY.....	98
4.4.1 <i>Logistic Model</i>	99
4.4.2 <i>Dependent Variable</i>	104
4.4.3 <i>Independent Variables</i>	104
4.5 SUMMARY	114

CHAPTER V.....	116
DATA ANALYSIS AND RESULTS.....	116
5.1 THE SUCCESS AND FAILURE OF THE VFP	116
5.2 LOGISTIC REGRESSION ANALYSIS (LRA).....	121
5.2.1 Data Selection for Model Validation.....	123
5.2.2 Results of Model 1: Success (2) versus Failure (0)	125
5.2.3 Results of Model 2: Indeterminate (1) versus Failure (0).....	129
5.2.4 Results of Model 3: Success(2) versus Indeterminate (1)	131
5.3. MODEL VALIDATION	133
5.3.1 Model 1: Success (2) versus Failure (0)	134
5.3.2 Model 2: Indeterminate (1) versus Failure (0).....	134
5.3.3 Model 3: Success (2) versus Indeterminate (1)	135
5.3.4 Conclusion.....	136
5.4 SUMMARY	137
 CHAPTER VI.....	 138
RESEARCH DISCUSSION AND EVALUATION OF RESULTS	138
6.1 PREDICTIVE MODEL 1	138
6.2 PREDICTIVE MODEL 2 AND MODEL 3	147
6.3 CONCLUSIONS.....	151
6.4 SUMMARY	153
 CHAPTER VII.....	 154
CONCLUSIONS AND IMPLICATIONS	154
7.1 SUMMARY OF THE STUDY'S FINDINGS	154
7.1.1 Classification of the Outcomes of the VFP	155
7.1.2 The Predictive Models	156
7.2 IMPLICATIONS AND RECOMMENDATIONS	158
7.2.1 Implications and Recommendations for the Royal Thai Department of Fisheries	158
7.2.2 Implications and Recommendations for Rural Development Strategy.....	162

7.2.3 <i>Implications and Recommendations for Future Research</i>	165
7.3 CONCLUSION	167
BIBLIOGRAPHY	170
APPENDICES	190
APPENDIX I: TRANSLATION OF THE CLASSIFICATION QUESTIONNAIRE	191
APPENDIX II: CORRELATION MATRIX BETWEEN INDEPENDENT VARIABLES	197
APPENDIX III: ORIGINAL 41 VARIABLES SELECTED FROM THE VILLAGE-LEVEL DATABASE	209
APPENDIX IV: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC ANALYSIS FOR MODEL 1	210
APPENDIX V: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC ANALYSIS FOR MODEL 2	213
APPENDIX VI: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC ANALYSIS FOR MODEL 3	216

LIST OF TABLES

TABLE 4-1: THE PROJECT OPERATING PERIOD	93
TABLE 4-2: NUMBER OF VFP VILLAGES IN THE NORTHEAST (1986-89).....	94
TABLE 4-3: NUMBER OF THE SAMPLE VFP VILLAGES USED FOR THE STUDY.....	94
TABLE 4-4: OPERATIONAL VARIABLES FOR FACTORS ASSOCIATED WITH VFP OUTCOMES	109
TABLE 4-5: SUMMARY OF THE VARIABLES USED IN THE STUDY	113
TABLE 5-1: THE OUTCOME CLASSIFICATION TABLE.	120
TABLE 5-2: NUMBER OF CASES SELECTED FOR MODEL BUILDING AND MODEL VALIDATION	124
TABLE 5-3: PERCENTAGE OF CLASSIFIED CASES IN EACH GROUPS.....	125
TABLE 5-4: PARAMETER ESTIMATES FOR THE LOGISTIC REGRESSION MODEL 1	125
TABLE 5-5: CLASSIFICATION TABLE OF THE PREDICTED SUCCESS (2) AND FAILURE(0).....	127
TABLE 5-6: PARAMETER ESTIMATES FOR THE LOGISTIC REGRESSION MODEL 2	129
TABLE 5-7: CLASSIFICATION TABLE OF THE PREDICTED INDETERMINATE (1) AND FAILURE (0)	130
TABLE 5-8: PARAMETER ESTIMATES FOR THE LOGISTIC REGRESSION MODEL 3	132
TABLE 5-9: CLASSIFICATION TABLE OF THE PREDICTED SUCCESS(2) AND INDETERMINATE (1).....	132
TABLE 5-10: ACCURACY TABLE OF MODEL 1	134
TABLE 5-11: ACCURACY TABLE OF MODEL 2.....	135
TABLE 5-12: ACCURACY TABLE OF MODEL 3.....	135
TABLE 5-13: SUMMARY OF PREDICTIVE ACCURACY TABLE OF THE MODEL-BUILDING SAMPLES AND THE VALIDATING SAMPLES OF ALL THREE MODELS.	136
TABLE 6-1: MODEL 1 R STATISTICS AND EXP(B).....	139
TABLE 6-2: DIFFERENCES IN THE PREDICTED GROUPS BETWEEN FAILURE (0) AND SUCCESS (2)	145
TABLE 7-1: CLASSIFICATION TABLE OF THE PREDICTED SUCCESS (2) AND FAILURE(0).....	159

LIST OF FIGURES

FIGURE 3-1: A MODEL OF STAGES IN THE INNOVATION DECISION PROCESS.....	54
FIGURE 3-2: COMPARING THE VFP PLANNING PROCESS AND ADOPTION PROCESS.....	64
FIGURE 3-3: FACTORS AFFECTING THE SUCCESS AND FAILURE OF THE COMMUNITY-BASED DEVELOPMENT PROJECT	78
FIGURE 4-1: LOCATION OF THAILAND.....	82
FIGURE 4-2: THE NORTHEAST PROVINCIAL BOUNDARIES.....	84
FIGURE 4-3: PHYSICAL FEATURES OF NORTHEAST THAILAND	87
FIGURE 4-4: AVERAGE RAINFALL IN KHON KAEN PROVINCE BETWEEN 1951-1970	88
FIGURE 4-5: AVERAGE RAINFALL ISOHYET (MILLIMETRES PER YEAR)	89
FIGURE 5-1: PERCENTAGE OF ABANDONED VFP VILLAGES WITHIN THE 5 YEAR PERIOD.	118
FIGURE 5-2: NORMAL PROBABILITY PLOT OF THE STANDARDISED RESIDUAL FROM MODEL 1.....	128
FIGURE 5-3: NORMAL PROBABILITY PLOT OF THE STANDARDISED RESIDUAL FROM MODEL 2.....	131
FIGURE 5-4: NORMAL PROBABILITY PLOT OF THE STANDARDISED RESIDUAL FROM MODEL 3.....	133
FIGURE 6-1: REPEATED MODEL 2 NORMAL PROBABILITY PLOT OF STANDARDISED RESIDUALS	148
FIGURE 6-2: REPEATED MODEL 3 NORMAL PROBABILITY PLOT OF THE STANDARDISED RESIDUAL.....	149

CHAPTER I

INTRODUCTION

The majority of rural populations in the developing world live near small public water-bodies and depend heavily on these sources of water for a variety of needs (Palm, 1987). While these water-bodies are a source of many basic necessities for the rural poor, perhaps their most important use is to provide sources of life-sustaining animal protein. It has been observed that the rural poor supplement their diets through subsistence fishing in these publicly accessible water-bodies (Kent, 1987). However, their open and public access coupled with a general lack of control and management mechanisms, make public water-bodies vulnerable to over-fishing and environmental degradation. In many instances, the absence of regulative authority over village water-bodies has made it difficult to maintain and enhance their productive capacities. In these cases, the public and open nature of the water-bodies has spurred the need for collective management strategies that are identified by community stakeholders and defined through community consultation (Molnar *et al.*, 1985).

The *World Commission for Environment and Development* (WCED, 1987) has indicated that much of the world's naturally available freshwater fish stocks are being over-exploited or damaged by pollution. The growing depletion of fish and the increasing demand for fish protein have stressed an urgent need to enhance existing stocks or create new stocks through human intervention (Pillay, 1990). In response to this need, new methods of fish farming and ranching (aquaculture) have been developed and implemented in many countries. These methods have proven favourable as they stimulate maintenance of small communal water-bodies, rejuvenate existing fish stocks, increase rural employment and improve on the overall nutritional intake of rural populations.

The significance of community-managed fish culture for local development is well documented throughout the developing world and this is reflected in a sizeable literature (see, for example, Smith *et al.*, 1981; Fernando and De Silva, 1984; Bakar, 1985; Khan, 1985; Senanayake and Fernando, 1985; FAO, 1985 and 1989). Thailand represents one country where community-based fishpond initiatives have been initiated with varying degrees of success.

1.1 Problem Statement

The *Thai Village Fishpond Project (VFP)*, designed by the *Thai Department of Fisheries (DOF)*, is a state-sponsored initiative in support of community fishpond development projects. The objectives of the VFP are threefold: to increase fish production for local consumption; to provide a stimulus for local employment; and to alleviate malnutrition and poverty. Under the VFP, the DOF's mandate is to support the rehabilitation or construction of village ponds (reservoirs, swamps, tanks, etc.); to foster the training of local support personnel; to increase the supply of fingerling or seed fish; and to provide technical advice. However, underlying this government support is the assumption that rural villagers must actively participate in the VFP and eventually become self-reliant in the management of their own ponds as a productive community resource. Hence, the use of fish culture technology and the establishment of community control and management of community ponds has become an important hallmark of the VFP. The DOF believes that VFP ponds will act as a catalyst or foundation for village development and stimulate co-operation and mutual understanding in social responsibilities amongst villagers (DOF, 1982).

Since its inception in 1982, the VFP has been reasonably successful on a number of fronts, including, for example, meeting local nutritional needs (especially in the Northeast of the country), augmenting fish output for local consumption, and generating greater income for participating communities and individuals (Leungtongkum, 1987). In addition, the VFP has become a core activity in village development and has demonstrated its sustainability and political independence from the DOF and other government agencies. Evidence of sustainability rests in the continued participation in VFP activities by many villages since 1982. Beyond the issue of sustainability, the

VFP has trained villagers to be more capable in self-government and more self-reliant, which has, in turn, strengthened community consciousness and cohesiveness and stimulated community development. The VFP has also disseminated aquaculture technology among villagers and communities around the project areas resulting, in some instances, in the establishment of fish ponds by private individuals and communal fish ponds in adjacent villages (Chulalongkorn University Social Research Institute, 1988; Promthep, 1991).

Notwithstanding these laudable achievements, the VFP has not yet fully achieved its primary goal of eradicating malnutrition and poverty among rural people (Van Heel, 1986; Leungtongkum, 1987; Chulalongkorn University Social Research Institute, 1988). As well, the overall outcome of the VFP's implementation throughout Thailand has not been as successful as originally envisaged. Survey results indicate that approximately 30% of participating villages abandoned VFP activities after having received considerable support from the DOF (Chulalongkorn University Social Research Institute, 1988). Unfortunately, many community development programmes around the world have also experienced the same problems. For example, evaluation of the Bangladesh Swanirvar movement in 1977 found that from a total of 354 villages that had began the programme in 1976, only 37 villages had done well and were rated as category "A", while another 96 and 147 villages were rated as category "B" and "C" respectively, and the remaining 74 villages, which had not undertaken any development work, were rated as "D" (Ali, 1986). According to several studies in community development, some rural communities fail to implement or sustain community development programmes, even though similar programmes have already proven to be successfully implemented in adjacent communities (see, for instance, Ohrling, 1977; Fliegel, 1969; and West 1983). Thus, these failures in project adoption extend beyond mere cultural and geographical factors, to encompass more complex community-oriented variables.

The complete success, complete failure or indeterminate outcomes of particular community development projects and self-organised community resource management within the same geographic area is of interest to many researchers, especially in the area of collective action and community development. For example, Sandler (1992) and Wong (1979) indicate that many studies of collective action seek to determine which preconditions are conducive to successful

collective action. In this context, Wade's (1988) study of villages in South India revealed that some villages organised public resource use to a sophisticated degree, while other villages only a few miles away did not organise at all. Similar results are reported in a study by Murray (1977) in terms of village-level reactions to modernisation and development. Results from these studies show that rural communities generally differ in their ability to organise their own affairs, especially in managing their public resources. Rondinelli (1991) concludes in his study on factors affecting the success of community management that the capacity for community management is not well developed in all villages and towns. As community units vary in their capacity for action, it should not come as a surprise that many communities fail in attempting to implement development projects. This suggests that it is important to examine community characteristics before initiating a given village development project.

Decision-makers and planners should seek information which will permit the most effective utilisation of public resources. Development projects and their associated resources must be targeted where they will be used most effectively. In other words, planners must strive to maximise returns for their investment in time and effort in preparing plans and in implementing those plans. Project failures are a waste of scarce resources and they create a negative impression among their proposed beneficiaries. Hence, planning action should help to reduce the risk of failure and increase the probability of success as much as possible. If, prior to an allocation decision, the expected degree of success in implementing a particular project could be determined for each community competing for project approval (funds), planners and decision-makers would be able to allocate resources to those communities that show the greatest potential to use them successfully. By combining an assessment of community adoption potential along with technical and economic feasibility studies, planners can establish pre-screening procedures that can increase a project's likelihood of success.

However, in assessing community potential for successful project implementation, planners need a timely and systematic method of assessment, based on available qualitative and quantitative data. Unfortunately, much community development research is only qualitative in nature (see, for instance, Murray, 1977; Wong, 1979; Wade, 1988; Ostrom, 1990; Sandler, 1992;

and Bardhan, 1993a and 1993b), and difficult to apply to large-scale planning initiatives. However, as an integral part of the VFP, the Thai DOF has collected village-level statistical data in the form of *Village Profiles* since 1984. Despite the availability of these data for quantitative analysis of community characteristics that promote or hinder sustainability of the VFP, the DOF lacks a conceptual framework and the analytical methods to use the data efficiently and effectively.

Despite this, the VFP itself and the associated village-level databases provide an opportunity to investigate the efficacy of village-level development projects. By drawing upon the knowledge gained from qualitative research, utilising adoption of innovations theory, and using the VFP as a case study, existing village-level databases can be matched against project outcomes. This can demonstrate the effect of the predisposition of a given community to succeed or fail in the sustained adoption of a particular community development project.

1.2 Research Objective

Considering the above problem statement, it is evident that substantial differences exist among communities with regard to their abilities to initiate and sustain community resource management projects (see Murray, 1977; Wong, 1979; Wade, 1988; Rondinelli, 1991; Sandler, 1992; Bardhan, 1993a and 1993b; and Mearns, 1995). The relationship between village communities and community development projects can be assessed by comparing village performance in successfully adopting and sustaining a development project across a number of cases. Given this, the principal objective of this study is:

To develop and test an empirical model, based on community development theory and adoption of innovations theory, that allows the identification of community characteristics which contribute to predicting the success, failure or indeterminate outcome of the VFP in Northeast Thailand.

The model must be able to assist planners in determining the expected likelihood of success of each community in implementing and sustaining over time a particular project. The model, in turn, can be used in the pre-screening process with other tools, serving to increase the probability of sustained success for candidate villages.

1.3 Significance of the Research

The research presented in this thesis contributes to knowledge reflected in the existing body of literature in several ways. First, considering the inadequacies of privatisation or state control of natural resources in many developing countries, rural community (local) resource management has been recognised as a viable alternative. By developing a model that allows planners to predict the outcomes of projects and to identify the community characteristics associated with the success of a project, an effective way to promote or replicate community-based resource management methods is forwarded.

The second contribution of this thesis relates to improved planning. Experience from this study will enable government officials and development workers to assess better the capabilities of rural people and their potential for sustaining development projects on their own. Only by understanding the nature of rural communities can rural development workers begin to support villagers in the movement towards self-reliant development. Further, all too often, funds are wasted on projects that are inappropriate in one location, but are needed and are appropriate in other places. Through experience and the knowledge gained from this study, planners can improve their resource and/or project allocation processes by pre-screening candidate communities to ensure that the project will be implemented only in those communities which show evidence of comparable levels of need and which also show the greatest capacity for successful adoption and sustenance.

A third important contribution of this research is a recognition that remedial types of projects can be formulated which increase the capacity of communities that are unable to implement successful community projects by themselves. An important implication of this is that by recognising the different

capacities between communities, community development agencies can aim to help a community in the implementation of a project, rather than simply offering the project “as is” without an adequate assessment of the capability of the community to implement and sustain project activities. Once it is recognised that a community is unable to utilise successfully its own resources for development, it becomes the obligation of the government to assume some responsibility for raising its level of performance. Therefore, this study is intended to provide knowledge and understanding of how local development activities can be manipulated so as to obtain rapid and equitable development. It can also help to guide the design of more effective programmes of research on rural resource management.

The fourth, and perhaps most significant contribution of this research is the development of an analytical model that facilitates the effective use of existing village-level databases in Thailand. The model proposes and demonstrates the use of village-level databases for project planning and policy formulation, such as pre-screening villages that have the greatest likelihood of successfully implementing a particular communal development project. Since the *problem-solving* perspective dominates the current rural development planning and policy literature, village-level databases are likely to be used increasingly to identify the problems and needs of rural communities and to formulate rural development policies and programmes. For example, the Thai government uses village-level databases to classify rural villages into three categories, namely *progressive*, *moderate* and *lagging*, according to their socio-economic status and problems. Using this classification, the government’s rural development policies and programmes can be targeted and formulated accordingly. The model developed in this research reflects an *opportunity* or *community potential* perspective as an alternative way to use national village-level databases. Besides basic problem identification and description, this study demonstrates that village-level databases can also be used to indicate the potential or readiness of a community to accommodate a particular development project.

The final contribution of this study is in the realm of community and innovation adoption research. While much of the available adoption research has focused on the study of individual adoption decisions, it leaves many aspects of collective adoption decisions untouched. By identifying community characteristics as factors associated with a community’s adoption of a particular development project,

this study demonstrates that the community as an integrated decision making unit or a collective adopter unit in developing countries needs more attention from both academic researchers and planning practitioners.

1.4 Structure of the Thesis

The thesis is organised into seven Chapters. Chapter II focuses on the rural planning and development approach in the context of rural community resource management. The Chapter reviews rural development and resource management in the context of Thai rural planning in general and the VFP in particular. In Chapter III, the success, failure and indeterminate outcomes of community-oriented rural development projects and community collective action are examined. From this discussion, a conceptual framework for examining successful community adoption and sustained use of government-initiated community development projects is outlined and a predictive model is also developed for subsequent empirical analysis. Chapter IV reviews the design of the research, including the operationalisation of the independent and dependent variables central to the model presented in Chapter III. Chapter V presents the results of the application of this model to national and village-level socio-economic survey data. The results of logistic regression analysis, as well as the success, failure or indeterminate outcome of community innovation, are then presented and evaluated. In Chapter VI, the policy implications of the results are discussed and their implications for village-level rural development projects are evaluated. Finally, Chapter VII summarises the contributions of the thesis and proposes directions for future research.

CHAPTER II

RURAL PLANNING AND RURAL RESOURCE MANAGEMENT:

THE CASE OF THAILAND

One means of integrating rural development and sustainable resource use is through successful rural community-oriented resource management projects, such as the VFP. Community-oriented resource management (CRM) not only represents a significant shift in the prevailing resource management approach used in developing countries, but it also represents a similar shift in the prevailing rural planning and development paradigms. This Chapter provides an overview of rural development, rural planning and resource management approaches, leading to an integration of sustainable development through a CRM approach. By using Thailand as a case study, the rural CRM approach is examined in the context of Thai rural planning in general and the VFP in particular. The theme of this Chapter is to address the development, rationale and significance of CRM. Furthermore, from the discussion of the problem in promoting the VFP, as noted in Chapter I, a direction for investigation of the research problem is addressed.

2.1 Rural Planning and Development Approaches

Planning implies the desire to exert a certain level of control over the future. It is reflected in a society's attempt to understand and control its own development. In general, planning involves the anticipation of the future and the formulation of systematic programmes of action to attain desired goals. Dias and Wickramanyake (1983) state that in order to achieve development we need to plan, but before we plan we must have a good understanding of what exactly we want to achieve. In an attempt to promote and facilitate development, various development strategies must

be formulated from different perspective on how, and under what circumstances, a nation can increase its rate and direction of change. Over the past forty years, there have been debates about the best approach and the most effective methodology to achieve development. As development concepts have changed significantly over time, there have been subsequent changes in the way that planning is and should be practised.

The notion of “development” has its origins in European preconceptions of civilisations, having first arisen during the 18th century Period of Enlightenment. Early theorists optimistically believed development to be synonymous with the progression of a society from “lower” to “higher” stages of civilisation (Bachmann, 1987). It was not until after World War II, however, that planned development ideologies dominated in developing countries. In many cases, development plans were implemented and promoted in contexts of rapid global economic growth, increasing consumption of material goods, rapid industrialisation, high technology diffusion, and free enterprise capitalism. According to Rostow’s theory of the stages of economic growth (Rostow, 1960), a traditional or pre-modern society could be transformed into an advanced or mass-consumption society by following the developmental steps (stages of economic growth) set forth by developed countries. Hence, economic growth was pursued by developing countries either as an end in itself in attempting to “catch up” with the wealthier nations of North America and Western Europe, or as a means to create the wealth needed for social infrastructure and services that could create a better quality of life. Jazairy *et al.* (1992) indicate that, for the past 40 years, development thinking has been dominated by a paradigm in which the growth of the overall economy is believed to lead automatically to wealth “trickling down” to the poor.

During the era of the economic development approach, centralised planning and administration was considered necessary to guide and control the economy and to integrate and unify nations that were emerging from long periods of colonial rule. Moreover, central control was implicit in the requirements of international assistance agencies (Cheema and Rondinelli, 1983). With financial and technical support from the United Nations, international development banks, bilateral development assistance agencies, national governments, and academic centres, both in

developed and developing countries, the concept of comprehensive national development planning was advanced throughout the Third World during the late 1950s and early 1960s (Sagasti, 1988).

By the beginning of the 1970s, there was evidence that the rational comprehensive approach was not working, as inequalities within and among countries were increasing rather than shrinking (Bryant and White, 1982; Conyers and Hills, 1984; and Gabriel, 1991). Barrow (1995) states that, during the 1960s, it became apparent that the benefits of growth might not materialise or did not “trickle down” to the poor as was anticipated. Hence, the aims of the United Nations’ Second Development Decade (the 1970s) were to widen the range of beneficiaries of economic growth and to shrink the development gap. Todaro (1982, 133) notes an important change in public and private perceptions about development during this period:

“In the developed countries, the major emphasis seemed to shift away from growth towards more concern for the ‘quality of life’. This concern was manifested principally in the environmental movement....Many Third World countries which had experienced relatively high rates of economic growth by historical standards in the 1960s, began to realise that such growth had brought few significant benefits to their poor.”

Several different development approaches such as *Redistribution With Growth*, *Basic Needs*, *Self-Reliance and Popular Participation*, and *Sustainable Development* emerged during the 1980s from the experience of past development efforts and from a new awareness of the significance of social and environmental factors in development theory and practise (Steidlmeir, 1989). These newly emerging development concepts shifted away from development as a process of economic growth designed to achieve a developed society, towards development as a process of improving the general quality of life of the majority of the population, especially those living in rural areas. Concerns with unemployment and under-employment, income distribution, appropriate technology, integrated rural development, improved social services, and with basic human needs became more important than in the past. Central to these new areas of concern was the need to mount direct attacks on poverty not necessarily to displace, but rather to augment, macro-development efforts (Lewis, 1988).

It generally became accepted that development involves more than just economic growth. Similarly, it also became obvious that development planning must adopt a broader approach. Cheema and Rondinelli (1983) indicated that as the directions of development strategies shifted over the past two decades, questions about the most appropriate forms of planning and administering development policies arose in many developing countries. Further, Rondinelli *et al.* (1983) noted that during the 1970s, Third World governments became increasingly dissatisfied with the results of national planning and administration in the pursuit of economic development. These governments found it difficult to formulate and implement rural development strategies entirely from the centre; therefore, they sought new ways of eliciting greater participation in development planning and administration. Due to increasing criticism of the highly centralised top-down planning required by the former economic development approach, decentralisation of development and planning appeared as a potential solution to the problem of inefficient use of limited resources (Rondinelli *et al.* 1983; Cheema and Rondinelli, 1983; Poostchi, 1986). People increasingly became the subject instead of the object of development, and participation in planning and development processes became ingrained into planning practise. By the end of the 1960s, with the emergence of new development strategies, many governments in developing countries began to experiment not only with the new approaches to development, but also with new political and administrative arrangements for planning and managing development programmes and projects.

Despite the numerous efforts and investments in national and rural development, rural poverty in the Third World still remains endemic and, in many cases, has worsened. In rural areas, which contain about 75 percent of the population of developing countries, poverty is generally widespread, disease endemic, life expectancy low, and educational and literacy levels well below urban levels (Todaro, 1982; Dias and Wickramanayake, 1983; Alexandratos, 1988; Gabriel, 1991; and Jazairy *et al.*, 1992). Moreover, problems in urban development can be traced directly to rural inadequacies. For instance, poor and uneducated rural people who cannot survive in rural areas are compelled to move to urban centres, usually to inhabit urban slums and draw on urban-based social services (Lassey, 1977). In this context, Jazairy *et al.* (1992, xxiii), conclude that:

"The decade of the 1980s has left a difficult legacy for the majority of countries in the Third World. The pace of development has slackened and the problems of poverty and hunger worsened."

A great deal of the current development literature also suggests that problems in rural development have become critical (Johnston and Clark, 1982; WCED, 1987; Griffin, 1987; Alexandratos, 1988; Jazairy *et al.*, 1992). Increasing rural population densities have driven people to exploit marginal lands more intensively. Historically, communities that have lived in these areas evolved their own means of working productively within ecological carrying limits, using fallow methods and crop rotation. However, with rapid population expansion, the ecological carrying capacity is being stretched beyond sustainable margins. Jazairy *et al.* (1992) acknowledge that when people's survival is at stake they are forced to farm increasingly marginal soils, to reduce the fallow periods that are needed for the soil to renew its fertility, to cut vital forests in their search for arable land or fuel, to overstock fragile range lands, and to over-fish rivers, lakes and coastal waters. Rural poverty and malnutrition are closely linked to the degradation of the environment, as poverty depletes natural resources which, in turn, accentuates the suffering of the rural poor. The WCED (1987) notes that poor people are forced to overuse environmental resources for daily survival. As a result, the overuse further impoverishes communities, making their survival ever more difficult and uncertain. Hence, the socio-economic complexity of rural development becomes far more complex when environmental factors are considered. Development must be construed as being more than just the process of improving the general quality of life of the majority of the population, but rather, should be considered as the process of preserving the environment for future generations.

It can be concluded that environment and development are not separate challenges, but rather, they are inextricably linked (WCED, 1987). Economic growth heightens the risk of environmental damage, as it puts increased pressure on environmental resources. As land and other resources become scarce and natural resources continue to be depleted and degraded at alarming rates, societies have found new and creative means by which to ensure the continuous and sustained exploitation of these resources without fully depleting them. There is an urgent need, therefore, for a substantial and rapid evolution of existing resource management systems to support

sustainable intensification of resource use, especially in rural areas where the general well-being of rural people depends heavily on environmental well-being. Even beyond the rural context, economic well-being throughout the world is also directly related to the management and productivity of the environmental system (NRC, 1986). Hence, natural resources that were once taken for granted or even abused in the past must now be looked upon with a new appreciation and concern.

Out of the search for a new development paradigm has emerged a growing interest in the concept of community-based resource management or CRM (Korten, 1986; Berkes and Farvar, 1989). The *National Research Council* (NRC, 1986) proposes that by drawing on adaptations of the experiences of successful traditional resource management, as well as on contemporary scientific insight, resource management systems can be improved so that the resources basic to the availability of food, fuel, fodder, and shelter can be restored and exploited on a sustainable basis. However, as it is unlikely that traditional village communities can accomplish development on their own, and it is acknowledged that the state cannot accomplish it entirely through its bureaucracy, a more dynamic partnership must evolve between the community's capacities and the ability of the state to support the development of enabling policies and institutional linkages (Korten, 1986). CRM seeks to improve co-operation between villages and the state in the control and management of natural resources in order to initiate broader social and economic change. In recognition of the development potential of communities in resource management and in general development efforts, rural development efforts in developing countries are giving growing priority to programmes that emphasise local community control and management of local resources (Korten, 1984). The most successful of these programmes have been in irrigation and social forestry but similar concepts are also applied in health, uplands agriculture, village credit programmes, communal fish culture, and others.

Examination of the specific circumstances of a given project can serve to provide a concrete conceptualisation of the linkages that exist between rural development in general and rural community resource management in particular. Thailand offers a useful case study in this context since linkages between environmental problems, poverty, and development efforts are quite clear throughout the history

of its national development. Moreover, the Thai government has already applied the concept of CRM by introducing new participatory planning and development approach in their national rural development programmes. The VFP is one such programme designed to give people more control over the use and development of their common water and fisheries resources through a participatory approach. In the following sections, trends in Thai rural planning and development approaches are reviewed and the theoretical concept of CRM and its development is discussed in detailed and practical terms. The VFP is then described and the shortcomings observed in the promotion of the VFP are examined.

2.2 Thai Rural Planning and Development

The economic and social structure of modern Thailand is the product of a gradual evolution that started in the middle of the nineteenth century. Many researchers have argued that the forced signing of the Bowring Treaty with Great Britain in 1855 was the starting point of the new “*export-oriented*” mode of production and the era of “*modernisation*” (Phongphit, 1988; Kemp, 1991; Pengyong, 1991). Subsequently, the ideas of trade expansion and superior civilisation of the colonial powers forced Thailand (Siam at that time) to be “*developed*” or rather become “*civilised*” in the western sense of the term.

The World Bank stated in 1980 that Thailand was an anomaly in Southeast Asia, having escaped from colonial domination through the diplomatic skills of its Kings in maintaining the Kingdom as a buffer state between rival British and French spheres of influence. Under King Rama V (reign 1868-1910), who visited many European capitals, Thailand moved towards a rapprochement with Western states and their ideals. What resulted was the development of infrastructure (such as roads, railways, telecommunication, electricity and domestic water supply) alongside the reform of public administration and the education system. These transformations, based on the European principles of functional ministries, bureaucracy, and education, were fundamental influences on national development patterns.

The era of national planned development in Thailand emerged from the political turmoil, economic stagnation, and communist insurgency which followed the Second World War. With influences from the World Bank, the United Nations and the United States of America, Thailand has practised development planning since 1961. Thai development planning is based on a series of five-year national economic and social development plans, of which the first was initiated in 1961. Led by Field Marshal Sarit Thanarat from 1957-1963, the *Budget Bureau*, the *National Economic Development Board*, the *Industrial Finance Corporation of Thailand*, the *Board of Investment*, and the *Tourist Organisation of Thailand* were established (CIDA, 1983). The First National Economic Development Plan (1961-1966) was launched on January 1, 1961.

The First (1961-1966) and Second (1967-1971) National Plans were restricted to improving agricultural productivity and encouraging the private sector to expand industrial activities. Planning for this period emphasised strengthening basic infrastructure and facilities such as highways, electricity generation and distribution, irrigation systems, schools, and hospitals, with the result of remarkable economic growth during the 1960s (Pongquan, 1993). However, a main force driving government development activities in rural areas was to counter the communist insurgency (Hirsch, 1990).

Awareness of the significance of social factors in development grew as it became apparent that economic growth alone had failed to deliver its promised improvement to standards of living. As a consequence, the concept of social development gradually emerged to join the economic development concept in national importance. Although economic development still received high priority in the Third National Plan (1972-1976), social development was to be integrated by providing more social service programmes in rural areas. This plan reflected the change in the meaning of development and its implementation. Ingle (1974) concluded that the Third National Plan, reflecting a significant change in national emphasis, concentrated on the provision of equitable and expedient services in order to increase incomes, reduce disparities, and promote social justice.

The Fourth National Plan (1977-1981) was still dominated by an economic development strategy. In this plan, the income disparity between the rural and urban sectors was recognised and regional planning was introduced to decrease that disparity. To raise the standard of living of rural people, the government formulated regional development policies for land, forestry and water resources. Provincial planning was introduced to serve as a platform for merging the “*top-down*” process (initiated by central government agencies) with the “*bottom-up*” process (from the local level). Watjanapoom *et al.* (1986) states that the Fourth National Plan proposed to distribute development to other regions and to slow down the growth rate of Bangkok. Regional development and growth pole policies were adopted as important strategies in this plan. “*Regional Planning*”, “*Redistribution with Growth*”, and a “*Basic Needs Strategy*” became evident as concerns with the distribution of development and its benefits were introduced.

From the First National Plan to the Fourth National Plan, Thai rural development was initiated to combat the uneven regional development of the national economy and to help solve problems of national security. Suthasupa (1987) states that during the period of 1960-1981, Thailand’s rural development was aimed at increasing national production and income, because it was believed that such a strategy would eventually lead to an increased standard of living for the whole population. At the same time, rural development activities were used as a major element of counter-insurgency movements in sensitive areas and were openly supported by the United States. These rural development efforts, especially those on agricultural development, were often geared towards individuals and farms with the objective of increasing incomes and achieving better standards of living.

Nevertheless, the dominant economic development and rational comprehensive planning methodologies met with little success in Thailand and, in many cases, served to widen the gap between the rich and the poor (see, for example, Judd, 1990; Hirsch, 1990; Pongquan, 1993). As a result, by the end of the 1970s, the purpose and processes of planning and development had come under great scrutiny and proposals for more decentralised development and planning, greater political authority at the local level, and an enhancement of co-operative development efforts had been proposed.

The Fifth National Plan was the first to address past failures in the development strategy and to focus greater attention on the issue of rural poverty. It adopted the concepts of equality in national economic development, spatial development strategies to diffuse growth, and activities to decentralise economic activities to the regions (Watjanapoom *et al.*, 1986). In order to eradicate rural poverty and to solve problems related to the maldistribution of development benefits from past development plans, the Thai government adopted a new rural development approach called the *Poverty-Stricken Area Development Plan* (PSADP). This new approach has based on a territorial perspective which viewed local communities as the locus of “resources”, as well as the locus of “problems” and “needs”. This view led to an adoption of the target area development approach as well as the development of rural information systems in order to identify and determine problems and needs at the community level. According to Suthasupa (1987) and the Thai University Research Association (1985), the PSADP is based on five major principles:

1. Poverty-stricken areas were considered as the target areas (area development approach, with an emphasis on areas with a high density of poverty).
2. Subsistence level was the primary goal of rural development. Minimum basic services were to be made available to rural people in the poverty-stricken areas.
3. The improvement of the capacity for self-reliance among rural people was to be achieved by helping rural people to help themselves.
4. Simple and low cost technology was to be used instead of complex and high cost technology.
5. People's participation was considered to be the way to let rural people solve their own problems to the best of their abilities.

The Fifth National Plan (1982-1986) was considered revolutionary in terms of its rural planning and development strategy. For the first time, villagers were allowed to consider and determine their own needs and problems. They were also allowed to select projects that best suited their needs or problems from a series of projects supplied by government agencies. This approach, called *Bottom-up meets Top-down*, was described by Demaine (1987, 149) as follows:

“The system is not a case of true bottom-up planning. The tambol development committee or village council do not make project proposals on the basis of the specific needs of their individual tambol or village, but rather choose what they see as relevant projects from a “menu” or a series of “menus” which are supplied each year by the participating ministries.”

This enhanced role of the tambol (sub-district) council and village committee forms the cornerstone of the citizen participation aspect of the state-led rural development programme. In principle, villagers have a say in requesting certain projects and thereby gain access to state development resources.

The planning process designed for this special rural development programme follows what is termed the *project menu approach*. This approach starts from the four main national ministries which submit development projects (collected from their departments) to the office of the *National Economic and Social Development Board* (NESDB) for approval and inclusion in the *menu*. The *menu* is then passed down to the lower levels of the planning hierarchy, ending up at the village council (or village development committee). Each village can then select several projects, according to its perceived local needs and problems, with the help and guidance from the tambol development committee. It is the tambol development committee which then determines specific proposals for the projects. The committee, with the help of its advisory group made up of government officers, formulates a tambol development plan by integrating and prioritising proposed projects from its villages.

At this stage it is the job of the district and provincial development committees to scrutinise, co-ordinate, integrate, and prioritise tambol proposals. The final product is the annual provincial plan which is submitted to the NESDB. The NESDB, in turn, sends the provincial plans to each department for approval. At this stage, rural development projects are subjected to normal budgeting procedures within the bureaucracy. First, they are submitted simultaneously to the Bureau of Budget and to the plan co-ordination sub-committee of the NRDC. The budgeted proposals, once screened by the Budget Bureau and the sub-committee against national priorities and internal regulations, are then included in the annual Budget Act for submission to the Cabinet and Parliament. After final parliamentary approval, the operational plan is passed down from the ministries to the provincial authorities for implementation.

Due to the new priority placed on rural poverty alleviation, the special rural development projects on the *menu* are only for those villages that are classified as poverty-stricken. Thus, the village-level database, generally known in Thai as *Kor Chor Chor 2 Khor* (in English the *Village Profile*), has been developed to identify problem areas for consideration by the various line agencies and by the local people themselves. This database is recognised as one of the major innovations in Thai rural development during the 1980s. In 1982, the *Institute for the Processing of Information for Education and Development* (IPIED) was created at Thammasat University in Bangkok with the express purpose of providing a centralised village-level database for local and national planning. The database aims to collect, at two year intervals, broad village-level data for the entire country. The village-level data are converted into 34 indicators covering five aspects of development, namely: basic infrastructure, income and production, sanitation and public health, water resources, and education and religion. From the 34 indicators of village socio-economic status and problems, rural villages can be classified into three categories as *progressive*, *moderate* and *lagging*. These classes provide the basis upon which to target and formulate the government's rural development policies and programmes. The *moderate* and *lagging* villages receive government supported rural development projects, while the *progressive* villages have to invest their own resources for development purposes.

In 1982, the first development *menu* consisted of three major programmes which contained 16 projects in all. The three programmes were: the *village basic service programme*, which included 5 projects (the village fish pond project, the village water resource project, the village small livestock project, the village buffalo bank project, and the village rural development project); the *village activity programme*, which included 7 projects (the district hospital project, the primary health care project, the nutrition project, the agricultural credit project, the legal advice project, the supplementary books project, and the clean water project); and the *village production programme*, which covered 4 projects (the village food production for consumption project, the upland rice seed production project, the soil improvement by organic matter project, and the soil salinity project). Each of these projects was designed to solve a particular type of problem or to accommodate a specific need. The programmes each had their own strategies to bring about local participation, self-reliance, and project sustainability.

Starting with the Sixth National Plan, the rural development programme was extended throughout the country and covered more than a hundred different development projects from most of the ministries.

The decentralised rural planning system described above represents a shift in attention from centralised planning towards community-level planning and development. The concepts proposed in the CRM approach are integral to the design and implementation of development projects in the *menu*. Most of the projects in the *menu* are designed to operate at the village level and it is intended for the village to control and sustain project activities after formal project support from the central government comes to an end. For example, the mandate of the VFP extends beyond simply digging a fish pond, forming a fisheries committee, and establishing communal fish culture. Rather, there is a philosophy behind the project which involves a new mode of development and a new kind of relationship between the government or development agency and the rural people. The government must respect and support local authority and the villagers have to learn to plan, make decisions, and sustain projects on their own. Development agencies have to reorient their thinking to relate to, and work within, collectivities rather than with a series of individuals. Therefore, projects like the VFP not only represent a new decentralised planning system, but they also represent a shift towards the new community-oriented resource management and development approach that is at the core of this thesis.

It should be noted that there is another branch of decentralisation in Thai rural planning and development which began in the closing years of the Fifth National Plan (1982-1986). A customised project based on the community-level planning unit was suggested in order to tailor the design and implementation of projects to the needs and capabilities of their intended beneficiaries (see Korten, 1984 and 1986; Cernea, 1991). Supported by the *Canadian International Development Agency* (CIDA), the foundation of the *Local Development Assistance Programme* (LDAP) launched a community-based pilot project using this new concept of community initiated and implemented development projects. This experiment sought short proposals for development activities directly from villagers themselves (Hirsch, 1990). The Thai government has followed this idea by establishing a *Village Development Fund* under the Sixth Plan as a programme to fund various development projects initiated and proposed by villages. The programme was developed

further in the Seventh National Plan (1992-1996) by channelling development finances to the provincial level. In the Seventh National Plan (NESDB, 1992), a large amount of the budget is allocated to support the decentralisation of administrative authority in rural development by establishing special subsidies for provinces to support development projects or any activities which solve local problems, or to develop local areas in accordance with provincial development plans. Therefore, the decision for approval of funding for the projects under this programme is decentralised to the provincial level.

Thai rural planning and development has gradually shifted from the dominant economic development and highly centralised rational comprehensive planning system to a more decentralised form of development and planning that is broader to include socio-economic aspects of development, citizen participation, and communal decision making. While many communities have benefited from past development projects, many more still suffer from poverty and the negative consequences of past efforts. With the new development approach, based on the CRM concept, the Thai government hopes to be able to reach additional poor communities and integrate them into the overall national development process.

Under the new approach, development is not simply measured by an improved standard of living. Rather, it is gauged by the enhanced capacity of people to cope with the changing circumstances of their lives and their environment. Therefore, instead of directly meeting the needs of people, the new approach is based on the concept that the government should act in an enabling context within which people effectively meet their own needs. By granting people control over their local resources and development decisions, rural people should be able to control the direction and process of development, within broadly defined parameters, according to their own needs and conditions. In order to examine this new approach in more detail, the sections that follow trace the evolution of rural resources management in Thailand, followed by a brief review of the VFP and its development, as an example of the state's promotion of the CRM approach.

2.3 Rural Development and Rural Resource Management in Thailand

After three decades of planned development, Thailand is considered to be the next country in line to join the ranks of *newly industrialised countries* (NICs). Past development successes have been characterised by high growth, poverty reduction, and expansion in the provision of basic education and health (Hirsch, 1990; Sussangkarn, 1992). However, the path followed to achieve these successes has proven to be a major cause of many of the social and environmental problems observed today. Problems and imbalances in different sectors, such as the inequities between rich and poor, and between urban and rural areas, have heightened resource depletion and environmental deterioration (Sussangkarn, 1992; NESDB, 1992). Environmental problems such as pollution, deforestation, cultivation of marginal and fragile lands, soil erosion, flooding, water shortages, and others are now well known. Therefore, Thailand faces serious social and environmental problems that have been compounded and exacerbated over time.

It is generally accepted that the availability of resources is critical in determining the extent of rural poverty and poor management can severely damage the rural resource base. However, insufficient attention has been paid to the broader development context and the linkages between environmental degradation and poverty (Jazairy *et al.*, 1992). In this context, while Thai government agencies are attempting to encourage environmental protection through the enforcement of environmental protection laws, they are, at the same time, encouraging parallel development activities typically associated with unsustainable resource use. This process is quite evident in the Thai national and rural development context where increasing environmental degradation and poverty due to failures of the process of state management and intervention have led to a shift towards CRM and local participation in rural planning and development.

Until the twentieth century, Thailand was sparsely populated and large areas of the country were characterised by uninhabited wilderness. The settlement of outlying regions and the subsequent integration of these areas into the national polity and economy were important processes in the twentieth century development of the country. Hirsch (1990) explains that for more than a century the principal dynamic in Thai agriculture and population was a steady

expansion of the cultivated area, characterised by the establishment of new communities at forest fringes. Because land was abundant, increasing productivity was achieved largely by expansion of cultivated areas. A World Bank study attributes as much as 90 percent of the growth in agriculture over the last 20 years to the expansion of crop areas alone (World Bank, 1986). Actually this expansion has been encouraged by the government in order to meet export goals which were set since the country was opened up for international trade in 1885 (Phongphit, 1988; Kemp, 1991; Pengyong, 1991). This rapid settlement was not only a fundamental part of the development process, it was also a primary cause of deforestation and expansion of populations into rural areas. As farmers are now reaching the limits of readily accessible, good, arable land, this growth has placed increasing pressure on marginal lands and the declining forest cover.

Uhlig (1984) explains that the extension of agriculturally used and settled land cleared from forests or reclaimed from swamps has been developing over a long period of time. This development trend has not only been observed amongst the ASIAN states, but is equally evident in many other parts of the developing world, including Latin America and Africa. The landscape of Northeast Thailand has undergone a significant transformation in the last fifty years. Fifty years ago land was freely available to anyone willing and able to clear the forest and construct paddy fields. However, today village common property resources such as woodlots and pasture have been enclosed and used for the private and unrestricted raising of upland cash crops (Rambo, 1991). In the Northeast today, relatively little virgin forest remains and that frontier is rapidly closing as government policy against forest encroachment is enforced. While the forests, pastures and water sources once offered a wide range of resources to sustain people for a variety of their needs, the remaining natural resources are either inaccessible or unable to sustain the demands of a much larger population.

Narasus (1993) indicates that modernisation and agricultural development have transformed national land use and resource management systems under state control through both privatisation and nationalisation. Feder *et al.* (1988) explain that the evolution of individual land rights and mechanisms to enforce such rights in rural settings are closely related to increases in population density and to advances in agricultural technology. In virtually all instances, farmers or

landowners require an incentive to invest in their land. This incentive is enhanced when the right to cultivate continuously and the right to transfer land are guaranteed. Therefore, land ownership or land use rights are needed and must be sanctioned by the government in order to ensure state control over public lands and proper use of private lands. Traditionally, all land in Thailand belonged to the crown, but any Thai citizen could claim land in order to provide for his/her family. Feder *et al.* (1988) indicate that the first property rights in the land system were introduced in the 1860s when the country began to open itself to international trade and modernisation. It was not until 1954 that the *Land Code* system was introduced and became the basis for the legal system of land rights in Thailand today. Another popular approach of extending government control has been nationalising the ownership of forests and other natural resources on the grounds that local villagers cannot manage and sustain their natural resources. At present, all non-private lands and resources, such as forests, water-resources, and mineral deposits, are under government control, protection and management.

Like many other developing countries, privatisation and nationalisation policies were perceived by the Thai government as the only effective ways to control and manage natural resources (Narasus, 1993). However, by implementing these two policies, the Thai government overlooked the past traditional control systems used by villagers. This has resulted in the overall loss of communal control over the use of common property resources. Feeny (1984) acknowledges that considerable tension has emerged between the traditional Thai villager's view of common property resources on the one hand and official government policy on the other hand. Rambo (1991) indicates that decision-making over resource management is no longer a purely local affair. Today, land use is regulated by a multitude of government agencies, including the national armed forces.

Villagers often appear to have little voice in making decisions about local resource use despite the devolution of decision making capability from the central government described in the previous section. For example, the forested uplands in Thailand, which were traditionally a common property resource used for hunting, and grazing livestock, have been gradually claimed as private property and used for the production of cash crops since the First National Development Plan

was introduced in 1961. Feeny (1984) concludes that because villagers do not own the forest and cannot exclude others from using it, they have little incentive to conserve land use and every incentive to capture the gains from clearing land before someone else does.

The relationship between the loss of traditional communal control systems and the degradation of rural natural resources can be linked to ineffective government management systems and futile economic development processes. As a result of economic development and the establishment of the legal land rights system, people are encouraged to claim new land or expand their current land holdings. Meanwhile, policies of nationalisation have replaced communal control over the use of common property resources, without the capacity to enforce formal authority over those who use these resources. Therefore, the situation of communal resource management has deteriorated into an open access situation, in which resources are open to universal claim and use without incentives for conservation. In general, it can be concluded that the government overemphasises the solutions of privatisation and nationalisation at the expense of local-level controls and self-management.

The loss of surface water-bodies and fishery resources have also evolved in much the same way as land and forest resources. Many water-bodies, both natural and human-made, are generally neglected, under-utilised, and often reclaimed. Gimneken (1989, 13) describes the loss of common property over the competition for land and water resources in Northeast Thailand as follows:

“The public and common lands, or lands considered everybody’s, are decreasing in size. When converted to cropping lands they become privatised and fenced. Even the use of water resources is increasingly claimed by groups or individuals, and the present day development of small and big weirs in streams is enhancing this process and privatising the use of the water too.”

Fishery resources in most public water-bodies are also being rapidly depleted or altogether destroyed. Suraswadi (1987) discusses the drastic reduction of freshwater fisheries resources as a result of a combination of factors including the modernisation processes, such as infrastructure development, deforestation and diminishing flood plain areas, deterioration of water resources, and higher demand due to increases in rural and urban population. In Thailand, efforts invested in fish stocking, conservation

measures, and law enforcement have largely proven unfruitful. Unfortunately, this phenomenon does not stop with the use of natural resources, but it extends to include the use of virtually all public infrastructure in the country. Much of the infrastructure, such as village roads, well hand pumps, and village irrigation reservoirs, built by the numerous government development projects over the years have been and continue to be neglected by the people whom the facilities were intended to benefit.

Hafner (1987) indicates that only 10 to 20 percent of more than 2,000 weir and small reservoirs already constructed in Northeast Thailand are effectively used and maintained by farmers. He concludes that the general failure to make villagers accountable for the management of these resources is a major reason for their low use and inadequate maintenance. It is generally accepted that one of the major reasons for the failure of development projects has been a lack of involvement of rural people and their representative organisations in the planning and implementation of development programmes. A USAID evaluation study in 1983 suggested that the development of community reservoir and irrigation systems should not begin with construction but with efforts to build water management and maintenance capability since, all too often, efforts begin with construction to the original blueprints while completely neglecting important social, institutional, and managerial dimensions. Government and aid agency-imposed projects are also perceived by local people as belonging to the government or donor agency, rather than being a public resource.

In general, planning processes associated with conservation policies and programmes have largely failed because these policies and programmes for rural and agricultural development are often characterised by a narrow sectoral and technical focus. Insufficient attention is often paid to the broader social development context and the linkages between environmental degradation and poverty. Jodha (1992) criticises the disregard of common property resources and their productive potential as a major misgiving of rural development strategies in developing countries that reflects much of the officialdom's indifference towards environmental protection. It was not until local participation became a popular movement in rural planning and development that government departments

began to extend their concern and interest beyond technical expertise, to solicit feedback from rural populations themselves.

It is increasingly accepted that local people not only have a capacity to develop and maintain their own resources, but they also have a deep understanding of their environment. Thus, rural people are now perceived by government and development agencies as important agents in the development and environmental protection process, rather than simply as recipients of state-sponsored policy and welfare. For example, Funnell (1994) acknowledges that increasing concerns over large-scale and highly centralised water resources development and management approaches, due principally to a failure to reach output targets, high costs of supervision, and changes in attitudes towards state control, have led to a shift towards farmer-based management. Rambo (1991) also points out that rural resources and improved strategies for management cannot be analysed in isolation from the social context in which resource management strategies must be implemented. For instance, solving village water supply problems by building bigger ponds for multi-purpose use will not work unless effective social mechanisms can also be created that can keep kenaf¹ growing villagers from spoiling public water resources with their harvest. Given this, government programmes that foster self-reliant communities in the efficient and effective management of resources is needed. Both the government and rural people need to work in harmony in an atmosphere of mutual trust and respect for each other if rural development projects are to succeed.

The best evidence supporting the concept that villagers have the capacity to develop and maintain their own resources collectively is that rural Thailand has had successfully functioning local-level organisations for centuries. Neither traditionally nor formally established co-operation are new concepts on the Thai scene (Hirsch, 1990). Traditional village structures contain many co-operative

¹ Kenaf is the name used in the trade for the fibre obtained from two closely related species of the family Malvaceae, *Hibiscus cannabinus* L. and *Hibiscus sabdariffa* L. var *altissima* (O'Reilly and McDonld, 1983). Kenaf is primarily an export crop, the fibre being used in the manufacture of sacks. This plant needs to be submerged in water for about two weeks for retting (which causes water pollution) before its fibre can be peeled from its body.

elements, and formal co-operatives were established as long ago as 1916, although they have rarely moved beyond a credit function.

Historically, communal activities were widely practised among rural populations in Thailand. Thai farmers collectivised for their mutual assistance and security. The system of “*mutual help*” and of “*common benefit*” is part of the traditional customs of Thai peasants. O'Reilly and McDonald (1983) identify two traditional forms of co-operation found in Thailand: the reciprocal labour group (*long khack*) and the rotating credit institution (*len chae*). They explain that in the *long khack* system the individual may call upon neighbours and kinsmen to help with agricultural tasks, supplying them with food and refreshment. In turn, the individual must be prepared to reciprocate by assisting on the farms of any of his group members, when necessary. Corvée (*phrai*) was also traditional to Thailand in that the local rulers could summon labour for major works such as road building or canal construction. At present, the village headperson has the authority to assemble labour for work activities in the village. However, the best example of community capability of local control and management is the village irrigation associations which maintain and administer the *muang fai* (traditional irrigation systems) of Northern Thailand, and which date back at least to the 13th century (Rigg, 1991).

Ideally, these traditional communal systems support the view that a CRM approach is possible and that they may be used as a bridge from the community to community development. The implication is that a CRM approach can build from/and onto village traditional communal systems and their experiences and thereby facilitate sustainable village-level development. Through the new approach, different alternatives and opportunities are possible. A combination of environmental protection, effective use of local resources and rural development might be achievable through organised rural control and management when and where privatisation and/or nationalisation are deemed inappropriate approaches. For instance, forested areas can potentially be managed to provide some of the subsistence needs of villagers while still yielding desired timber and watershed protection.

Developing small-scale village water resources can provide alternative sources of food and income from fish culture. The VFP, which has adopted the idea of communally owned resources and applied it by establishing community-managed fish production, is a good example of a community-based development project which attempts to use small water-bodies adjacent to villages as sources of food and as a nucleus or foundation for other development activities.

Similar concepts of strong community control over development, such as public participation, decentralisation, and local resource control, are being applied in the areas of health, uplands agriculture, village credit programmes, and other community development programmes. Galjart (1992) indicates that village meetings, working groups, co-operatives, collectively-owned or used land or capital goods, irrigation schemes, interest associations, and primary health care schemes, are all *pooling systems*² of a sort which have become popular in the rural development strategies of government and development agencies. They all share a similar feature, namely the need for some form of collective management.

Thus, the promotion of CRM fits well with concerns for poverty alleviation, participatory development and environmental protection. It has become one of the most significant elements in rural and national development in Thailand not only in terms of resource conservation, but also with regard to social, economic and political development. However, it is still too early to provide an overall performance evaluation of the CRM approaches that emerged in the wake of criticisms and the failures of former conservation policies and their associated planning approaches. At the project level, the VFP, as noted earlier, provides a good working example of what is possible from a community-management development perspective. The VFP also provides an example of the lack of knowledge, understanding and behaviour of communities as major constraints to achieving full project success. Before turning to these constraints, the VFP and its partner projects are now introduced and discussed.

²Galjart (1992) defines pooling systems as the assemblage of labour effort, money, time or any other input from contributors, often under a central decision-making actor and thereafter the redistribution of the fruits of this common effort, often among those who did contribute.

2.3.1 *The Village Fishpond Project (The VFP)*

“Give a man a fish and it will feed him for a day, but teach him how to fish and he can feed himself and his family for life”.

(An ancient Chinese proverb cited by the FAO, 1991)

Aquaculture can be defined as the culture and husbandry of aquatic organisms (IDRC, 1982). It differs from capture fisheries in that it is a technique of stock raising, rather than hunting or gathering. Aquaculture embraces a wide range of activities from extensive sea-ranching and management in large bodies of water to intensive culture with fertilisation and feeding of fish in small human-made ponds (Gerhardsen, 1976). However, it was not until recently that aquaculture technology was scientifically developed and promoted on a large scale throughout the world. Because aquaculture can be undertaken in various areas (such as paddy fields, abandoned mining excavations, small ponds, and other water sources) as well as on various commercial scales (individual, family, co-operative, or corporate), its potential contribution to achieving better nutrition, additional employment, and higher incomes, as well as a better utilisation of marginal lands, cannot be ignored (Panayotou, 1985; Pillay, 1990). The significance of fisheries and aquaculture in rural community development is stressed in much of the current literature (see, for instance, Pillay and Dill, 1976; IDRC, 1982; WCED, 1987; Blakely and Hrusa, 1989; Pillay, 1990). Lovshin *et al.* (1986) indicate that there is an increasing interest in the application of rural freshwater fish culture technology as one of several ways to help meet the nutritional needs of rural people.

Although commercial aquaculture has been recognised as a potential means for alleviating malnutrition and poverty, it can be criticised in that its operations are more responsive to the market demands of middle and upper classes in both domestic and export markets than to the urban and rural poor. Moreover, with the tendency of commercial aquaculture to concentrate on high-valued species, fish inevitably become both physically and economically inaccessible to the poor (Kent, 1987; FAO, 1991). While true to some extent, this reality does not mean that aquaculture cannot contribute to national and rural development initiatives. Pillay (1990) argues that if

aquaculture has to be developed for socio-economic benefits, it needs to be carefully planned for that purpose. In a similar sense, Kent (1987) states that in order to counteract commercial marketing patterns in aquaculture, a basic strategy is needed to support the production of low-cost fish for consumption by the rural poor and/or to stock fingerling fish in publicly accessible waters. However, for the purpose of promoting human development, he emphasises the need to favour projects in which the poor can produce their own food for their own consumption; an approach that is entirely consistent with the concept of CRM.

Although freshwater fish culture is an additional means to achieve the goal of eradicating rural poverty in many Asian countries, problems lie in the under-utilisation of existing resources due to multiple ownership and the insecurity of tenure systems (Panayotou, 1985; and FAO, 1988). Actually, rural people rely heavily on public water-bodies adjacent to their villages. Palm (1987, 145) describes the usefulness of community ponds as follows:

“Community small water-bodies are typically located near a village and are convenient to a fairly large number of people. This has increasingly led to the use of these ponds for a wide variety of purposes. These include water for gardens and crops, bathing, swimming, water for construction and washing equipment, water for cooking, livestock watering, fish production, water conservation, soaking cassava tubers, receptacles for agricultural wastes, a source of nutrient-rich mud for gardens, production of secondary aquatic organisms utilised for human or livestock consumption (frogs, crustaceans, water scorpions, etc.), and recreational fishing for children.”

The under-utilisation of these water-bodies is not due to issues surrounding their usefulness, but rather, to problems related to ownership. As noted in the previous section, problems with communal resources occur when many people use them, but nobody actually has resource ownership. Under these circumstances, water-bodies are overused with little or no concern for conservation, even though little maintenance and/or investment are needed to maintain and/or enhance them. For example, studies reported by the DOF (1982) have shown that fish yields from communal ponds can be increased from none or very low to more than 100

kg/rai³/annum (625 kg/ha/annum) by organising collective pond ownership, introducing seed fish, and applying simple fish culture techniques to the communal pond. Hence, in order to overcome the problems of under-utilisation and environmental degradation, many researchers have recommended community-managed fish culture or group farming approaches to make use of under-utilised water-bodies.

For example, Costa (1988) indicated that in order to increase inland fish production in Sri Lanka, the government recognised the potential of small village irrigation reservoirs for fish culture. He also pointed out that in the case of Sri Lanka, an entire community has to take responsibility for fish culture operations. Further, in Latin America, governments actively promote the construction of family, community, and commercial fish ponds to improve the nutritional and economic well-being among rural groups (Lovshin *et al.*, 1986). In Africa, fisheries development and aquaculture have received considerable attention by many national governments. During the 1980s, management of community small water-bodies for fish production was promoted throughout Africa by the FAO in addition to fisheries development in large inland waters, the sea, or aquaculture in artificial ponds (FAO, 1985 and 1987). Bemacsek (1986, 79) describes the potential significance of the community fishery to rural people in Africa as follows:

"In the long term, small water body fisheries, supplemented with poultry and small livestock, may represent the only secure prospect for self-sufficiency in animal protein and adequate nutritional health for much of Africa's rural population."

In the case of Thailand, fish is an integral and essential part of the daily diet of most people as it is both abundant and affordable. DeYoung (1955) indicates that fish form the most important source of protein in the Thai peasant's diet, while most peasant families devote part of their time to fishing and have some fish at almost every meal. Generally, rural people in Thailand establish their villages around water sources. For example, most villages in Central Thailand are located along river banks or canals. In contrast, in the North and Northeast of the country, villages

³ 1 hectare (ha) = 6.25 rai

are located around or near swamps or flood plains. In both of these regions, public water sources are the principal sources of fish.

Only recently did fish farming start to play an instrumental role in rural development in Thailand. The modern Thai fishery originated in 1926 when the Thai Department of Fisheries (DOF) was first established as a response to a significant decline in natural fish stocks. At the time, the major concerns of the DOF were in resource conservation and sustained yield production. In recent years, fish stocking, conservation, and law enforcement measures have been given high priority by the DOF and the government in an attempt to target production towards anticipated future needs. Nevertheless, declining freshwater fish production, population pressures, pollution and environmental degradation resulting from urbanisation, industrial and agricultural development have stifled many of these efforts (Suraswadi, 1987).

Considering these restrictions, the DOF has had to shift its approach from one of passive conservation to one of active mass production. Beyond this, however, the DOF has had to broaden its narrow sectoral and technical focus to encompass wider development perspectives and incorporate the users of village fishery resources in its perspective. Also, the linkages between environmental degradation and poverty still require greater attention and more study. In short, fisheries can no longer be viewed and practised in isolation from general national and rural development initiatives. Rather, they must be integrated into existing development efforts. Fortunately, improvements in aquaculture technology have become available and have started to have a substantial impact on overall fish production. These developments not only make commercial fish farming a possibility for many, but mass production of fingerling fish also makes it possible to increase fish production in natural and human-made water-bodies as a substitute for declining natural fish populations (Bhukaswan, 1987).

The over-fishing and degradation of the small public water-bodies adjacent to rural communities is one of the major concerns identified by the DOF, as these small public water-bodies contribute greatly to poverty alleviation efforts. As already indicated, lack of specific ownership and open access to small public water-bodies make fish stocking and conservation programmes ineffective against overfishing and degradation. However, by taking advantage of aquaculture on a commercial

scale, control and management mechanisms can be established to maintain and enhance fish production and, subsequently, improve the integrity and sustainability of a high level of fish production.

In an attempt to increase freshwater fish production for rural consumption, the DOF began in 1947 to recommend fish culture in public ponds, swamps, marshes, and reservoirs. The Kamnan (chief of the sub-district) and village headperson (chief) were instructed to stimulate and lead their people in the rehabilitation of their village pond (reservoir) with the goal of increasing its suitability for fish culture. If a pond area was considered too large for available labour input, the DOF provided funds to construct a spillway and complete the rehabilitation process. Bhukaswan (1987) indicated that swamp fisheries implemented mainly in the Northeast of Thailand and their usage patterns are similar to those of traditional fisheries during the Sukhothai period (the 13th to 14th century). However, the swamp fisheries received a very low priority and attention from the DOF compared to the promotion of individual fish ponds and commercial fish farms. It was not until the end of the 1970s that the DOF shifted its attention from promoting commercial fish farms to using fish culture technology to produce food for the poor as a result of the serious crisis in rural poverty, malnutrition, and environmental degradation mentioned earlier.

From its experience in swamp fishery improvement and a realisation of the significant impact of communal fish culture on rural development, the DOF in 1978 decided to pool its experience, technology, personal and budget to form a larger village fish pond initiative. At first, the village fish pond project (VFP) was initiated in 14 villages in the Northeast of the country as a two-year pilot project supported by USAID. The VFP was then included in the development plan for the Poverty-Stricken Rural Areas under the Fifth National Economic and Social Development Plan (1982-1986). Although the DOF still promotes commercial fish farming, it is classified as a technology for better-off farmers than the poor. Higher priority is given to the VFP because, it is perceived as a form of appropriate technology that can be used to combat malnutrition and environmental degradation. Another reason in support of the VFP is that, as natural resources and facilities built by development agencies are perceived as state property, it will encourage villagers to change their attitudes toward communal property use for their own development. Furthermore,

the VFP acts as a bridge between the government and local people that can promote sustainable CRM.

The VFP has the multiple objectives of constructing communal surface water resources in order to provide a year-round source of water for domestic and agricultural uses; increasing fish production for local consumption; providing employment opportunities; and alleviating malnutrition and poverty in targeted communities. Under the auspices of the VFP, only the *moderate* and *lagging* villages identified through the village profile, as described earlier, can make requests for project support to the DOF. If a project is approved for a given village, the DOF constructs earthen ponds averaging 8 hectares in size or rehabilitates old swamps near the village. The pond is then managed by a village committee, which is elected by villagers to determine pond use policies. The village committee is responsible for all aspects of pond management, such as fish feeding, fertilisation of the pond with manure, surveillance against poaching and so on. The DOF, in turn, provides fish seed as well as technical assistance in fish farming techniques, breeding and pond management to the village committee and some villagers. Furthermore, in co-operation with the Community Development Department (CDD) and Agricultural Extension Department (AED), villagers also receive assistance in raising poultry and growing vegetables.

Fish harvesting techniques may differ depending upon village committee decisions and villager's preferences. For instance, some villages raise revenues by selling tickets to people who want to fish on designated fishing days (normally only once or twice a year). In other villages, the village committee harvests and sells fish from the pond on a weekly or monthly basis. Income from the pond goes into a community development fund. In some cases, approximately one third of the income is divided amongst committee members and participants as a personal reward for their services. The remainder is utilised for purposes of pond maintenance and purchase of fish seed for future stockings, as well as for other community uses such as building and maintaining the temple, village electrification, and maintenance of and supply for the school library. Hence, community-managed fish production generates not only a large quantity of fish and employment on a regular basis, but also generates community income for investment in community infrastructure and services, promotes community cohesiveness and consciousness, and community self-confidence through communal activity.

In this context, Leungtongkum *et al.* (1987) found that the villagers in VFP villages in the Northeast were more active in participating in community organisations and spent more income for village development than those in non-VFP villages.

As described in Chapter I, the VFP initiative demonstrates that, if conditions are correct, local people have the capacity to develop and maintain their own resources. By granting people greater control over their water and fisheries resources, a CRM approach to village-level rural development assumes that environmental degradation can be prevented or, in some instances, reversed insofar as degraded community reservoirs can be rehabilitated and depleted fish stocks replenished and fish production increased. Unlike many former development projects, the VFP does not create temporary development conditions, but rather, it can sustain itself through its own income generation and organisation. Moreover, the rural development objectives of increased rural employment, improved nutrition, and income of rural populations can also be achieved and sustained through the efficient and sustainable use of local resources. Therefore, the success of the VFP in many villages is testimony that rural community development and resource management can be accomplished with very little state intervention and without state or private control.

While many of the successful VFP villages provide evidence of the feasibility of communal systems, the means to promote and disseminate the project are still ineffective. As noted in Chapter I, there are documented instances where communal fish culture in VFP participant villages are abandoned. In fact, many community fish pond projects around the world face similar predicaments. For instance, the success of community fish ponds in Panama varies significantly based on their level of productivity and managerial efficiency (Lovshin *et al.*, 1986). It appears that although the potential of community-managed fish culture for local development is well recognised, the community-managed fish production is very difficult to achieve. Palm (1987, 140) also concluded from an analysis of several fisheries projects that:

“Successful community management of small water-bodies for fish production is clearly more difficult to accomplish than with individual farm families. The results of community fish production are consistently disappointing with several exceptions in Panama, China, Israel, and Southeast Asia. In Africa, no

significant investment potential is foreseen for community-managed fish production at this time."

In Thailand, as elsewhere, it is common that new projects or new technologies often fail in the field when they are replicated or expanded from a pilot project or an experimental station. While this would come as no surprise if the failure of specific VFPs were due to unavoidable biophysical (such as poor soil conditions) or economic factors, it is surprising that some projects are abandoned even when the ponds are in suitable condition for cultivation and fish are in high demand. Aside from biophysical and economic factors, clearly there are factors related to the collective nature of the VFP that significantly affect its success. From the literature on this subject, it is apparent that the problems and obstacles rest more in the process of organising a community's decision and actions when implementing the project, than in the appropriateness of fish culture technologies as a viable means of rural development.

Pillay (1990) indicates that after the potential or need for aquaculture development in an area is established, priority has to be given to the study of the community, its characteristics and its potential responses to a project. He further explains that the technology, or the farming system to be adopted, needs to be carefully selected, not only on the basis of the agro-climatic and hydrological conditions of the area, but also based upon the skills and educational background of the target population and their socio-cultural system. His conclusions suggest that success rates of government-sponsored co-operative programmes, such as the VFP, tend to be higher when participants have reached a certain level of socio-economic status. Palm (1987) also reached a similar conclusion in his study of community fish culture in Africa. He noted that although biological, engineering and economic factors have often contributed to the failure of community aquaculture in Africa, the primary reasons for this failure are both social and cultural. He suggests that future community fish production research needs to concentrate on the characteristics of fish farmers and their communities, and not only on the make-up of the fish or the pond.

Blakely and Hrusa (1989) note that there are many factors that influence the rate of social change within a community or region concerning the general promotion of fish culture and the introduction of new fish farming methods. They also indicate that "modern" societies,

characterised by highly developed technologies, a clearly defined division of labour, a high value placed on education and literacy, economically rational planning, and efficient external channels of communication, seek changes and respond rapidly to new ideas. This is in sharp contrast to traditional societies that possess relatively less developed technologies, low levels of education and literacy, planning based predominantly on social rather than economic considerations, and limited external communication. Such traditional societies tend to react very cautiously when new ideas are presented. MacDonald (1976) indicates that the traditional spirit of co-operation of rural communities is essential for the success of rural development projects. Hence, it can be concluded that certain community characteristics can be related to the ability of a community and its members to successfully adopt and sustain development projects such as the VFP.

If the VFP and the use of a communal system for community-level rural development are valid, then why have they not been adopted by all villages eligible for the project? There are no simple answers to this question. However, within the context of government-sponsored projects, it can be concluded that, by the nature of the co-operation required by the community-oriented approach, the success of community-oriented development projects requires more than just technically appropriate technology and suitable bio-physical and economic conditions. This discussion suggests that the outcome possibilities for the VFP and other community-oriented development projects of complete success, complete failure, or mixed success and failure may rely heavily on the ability of a community to manage its collective decisions and put them into practise. Although the relationship between community characteristics and a community's ability to adopt successfully and sustain development projects is recognised, few empirical explorations have been made to identify the community characteristics that are associated with these three outcome possibilities. Furthermore, no attempt has yet been made to develop an analytical model to predict the outcome states of a village-based project or collective action. Given this, the capacity of the planning process to address community differences and increase the likelihood of project success is severely hampered.

The community development literature indicates that the experiences of projects abandoned by their supposed beneficiaries are linked with low adoption rates when new agricultural

technologies are promoted. For example, Fliegel and van Es (1983) indicate that policy makers and planners were frustrated in their efforts to quickly introduce new technology among farmers, because many farmers were reluctant to adopt the recommended technology and some never adopted it at all. In attempting to explain why some individuals adopt innovations while others do not or some individuals adopt innovations more rapidly than others, early adoption research questioned the willingness of farmers to adopt such innovations and, in later research, the farmers' ability to adopt innovations came to be questioned. During the past fifty years, adoption-diffusion research has firmly established theory and research methodologies which enable change agents and planners to categorise potential adopters according to their innovativeness⁴ and to apply a different approach for each adopter category.

To provide a conceptual framework as to why some villages have successfully adopted the VFP and others have not, the theory of collective actions and adoption-diffusion research are drawn upon. Furthermore, adoption research methodology is used to develop models to predict the likelihood of successful adoption and identify village characteristics associated with this outcome. In the following Chapter, a conceptual framework for this research is outlined and an analytical model for the study is developed.

2.4 Summary

There have been significant changes in planning and development paradigms over the past few decades. During the 1950s, virtually all attention was focused on economic planning and development. During the 1960s, social planning was added and during the 1970s decentralisation of planning and development was introduced. For the 1980s, two new dimensions, namely, resources and environment, became increasingly important in the overall planning and development process. With the recognition of the linkage between environment and development, the search for development alternatives that would improve the standard of living of a population without

⁴ Rogers (1983, 22) defines "innovativeness" as the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system.

degrading or destroying community resources and the environment are urgently needed. CRM is such an approach that is receiving growing interest from academics and practitioners as an integrated rural development approach for achieving sustainable development.

In Thailand, the concept of CRM has been applied to many rural development projects with some success. Unfortunately, the basic question of why projects have failed in some villages but not in others has not been adequately addressed. As this research is interested in investigating and modelling this question, adoption research and its predictive possibilities are offered as one possible conceptual framework. From this perspective, a predictive model to identify those villages that are more likely to successfully implement a project and those that might fail can be developed. In the next Chapter, the development of such a model is presented.

CHAPTER III

COMMUNITY RESOURCE MANAGEMENT AND THE OUTCOMES OF COMMUNITY INNOVATION ADOPTION

In Chapters I and II, the development, rationale and significance of community-based resource management (CRM) were reviewed and discussed in the context of Thai rural planning and development. The need for local people to control, manage and protect their resources and environment was identified. However, it was also generally agreed that collective development at the community level is difficult to achieve. In attempting to promote the VFP, the DOF has found that some villages are able to adopt a project successfully while other villages are not. In order to explain this phenomenon and develop a model that can be used to predict empirically the likelihood of possible outcomes, adoption research is used to provide a conceptual framework. The present Chapter consists of three parts. The first part outlines the use of adoption-diffusion research in planning. The second part consists of a general discussion on the adoption process, the issue of collective adoption, the concept of an adoption unit, and the outcomes of CRM projects. In the last part of the Chapter, a framework for the adoption of community development projects is developed. This framework draws on the information given in Chapter II and the preceding sections of the present Chapter. The main objective of Chapter III is to provide an operationalise framework for predicting the likelihood of success, failure or indeterminate outcomes of the VFP within the context of a CRM approach.

3.1 Planning and the Adoption of Innovations

“One of the goals of sociological theory is to provide grounds for predicting human behaviour. The empirical prediction of human behaviour is not meaningful unless it is theoretically based and logically consistent.”

(Rogers and Havens, 1962, 34)

As stated in Chapter II, planning involves the anticipation of the future and the formulation of systematic programmes of action to attain desired goals. Hence, a plan can be described as an idealised statement of goals based on predictions/forecasts and development ideologies. Project plans are often based upon theoretical assumptions, models and interpretations that purport to explain how change takes place or how objectives are to be achieved. Hence, modelling and forecasting occupy an important place in the planning process. Conyers and Hills (1984) define a model as an idealised representation of a real-world situation. Basically, models provide a means of understanding the way in which human-made or natural systems operate and thereby help us explain why things are the way they are. Models can also be used to predict the future. Predictive models using empirical data and statistical analysis can be used to help decision-makers and planners make more reasoned decisions under conditions of uncertainty. It should be noted that although predictions and forecasts indicate probable futures, they do not dictate normative directions of development or planning. Since they also provide means to understand and explain why things are the way they are, they create an opportunity to intervene and guide the future.

Adoption-diffusion theory has been widely accepted and used for project planning and implementation, especially in agricultural development and rural extension programmes in developing countries (Crouch and Chamala, 1980). Rogers (1983) suggests that an adoption model can be useful for identifying potential innovators and laggards (or adopters and non-adopters) and providing change agents, planners and decision-makers with different strategies for dealing with each group. Alves and Morrill (1975) suggest that a variety of models, including adoption models, can be used first to simulate processes of change, and later to help operationalise change. They stress the value of adoption-diffusion models for the dissemination of knowledge, encouraging the use of existing or planned facilities or services and, more generally, to inculcate a population with some desired change in attitude, such as a respect and willingness to integrate or maintain property. They conclude that an adoption model can be used to identify those variables over which planners can exercise the greatest degree of control or those to which the outcome of the adoption is especially sensitive. Using such models, a planner can accelerate or slow the course of the diffusion, change its pattern in space, or affect its final level of acceptance (Alves and Morrill, 1975).

In terms of prediction, FitzSimons (1979) suggests that innovativeness-prediction research may be useful in macro-level studies such as tests of hypotheses to indicate areas for further investigation. Roling *et al.* (1980) also suggest the use of innovativeness-prediction research as one of the planning instruments capable of facilitating development of a profile of potential users (adopter), or to segment users into more homogeneous categories. In fact, the approach of identifying the characteristics of farmers associated with early adoption has been used in action programmes designed to develop and disseminate new agricultural technology among farming populations in many developing countries (see for example Roling *et al.*, 1980; Crouch and Chamala (ed.), 1980; Rogers, 1983).

Much of the early research on the adoption of innovations focused on the attributes of individuals, especially the characteristics of early and late adopters. Therefore, its usefulness has been limited to those programmes aimed at the individual level, such as agricultural development programmes that focus on individual farmers. Meanwhile, as demonstrated in the literature, interest in the adoption unit has shifted, recently, to a collective level. This shift in emphasis is largely due to the fact that, as noted in Chapter II, rural development has also shifted its focus from the individual to the community level.

In the case of community-oriented resource management (CRM), Bardhan (1993b) concludes that it is important to understand the conditions working for and against sustainability of co-operation in situations of economic and social interdependence. Hence, the central theme of this thesis is to understand the adoption outcomes of a specific community-based development project. In the sections that follow, adoption as a collective decision making process and its linkage to CRM are discussed.

3.2 The Community-Based Resource Management Approach and Collective Adoption

“In developing countries, the daily livelihood of the poor depends more substantially and directly on the local commons: irrigation, forestry, grazing, in-shore fisheries and so on. These common property resources usually involve small local communities, which opens the possibility for local-level community organisations to manage resources and resolve conflicts, as an alternative to the

polar opposites of private and state control which usually hog the limelight in public policy discussion."

(Bardhan, 1993a: 87)

The interdependence of environment and development was addressed in Chapter II, as was the need for integrated sustainable development in rural areas. The CRM approach that is now recognised in Thai development planning presents the concept of allowing rural people to manage their local resources in order to achieve sustainable development. Central to this approach is the concept of sustainable resource management and human behaviour working collectively, particularly as they are applied to the context of rural resources and rural communities.

The term environment can be defined as the external conditions and influences that affect the life and development of organisms (Barrow, 1995). Humans either adapt to or seek to modify their environment to achieve security and well-being. Therefore, human societies depend heavily upon the production of goods and services derived from the natural environment. However, since over-exploitation may lead to serious environmental degradation, natural resources must be managed in an effective and sustainable way. Gibbs and Bromley (1989) define natural resources as those components of an ecosystem that provide goods and services useful to humans. They emphasise that components of nature such as soil, water, forests, fish and wildlife are considered to be resources only when they provide a means of sustenance to humankind. This definition implies that natural resources are viewed as developable and should be exploited. However, resources such as forests, pastures, water, wildlife and fish have to be utilised on a sustainable basis if they are to provide annual benefits in perpetuity (Berkes and Farvar, 1989). Since requirements for natural resources increase both with growing populations and growing consumption per capita, an effective resource management system is required to support sustainable intensification of resource use, especially in rural areas. To do otherwise is to risk the destruction of the resource base and the ability of future generations to meet their own needs.

Resource management can be defined as a decision-making process in which solutions regarding the manner, timing and allocation of resource use are sought within the prevailing economic, political, social and institutional framework (Omara-Ojundu, 1992). Effective resource

management requires control of resource access and use. In this context, property rights are an institutional arrangement which define who can control and use resources. The most common forms of property rights are *state property*⁵ and *private property*⁶. However, resources may exist where nobody is able or willing to control their use and they are owned by no single person, yet are used by many (see Gibbs and Bromley, 1989; Barrow, 1995). These types of resources can be classified as *common property resources*. Many resources found in rural areas can be classified as common property and they have a tendency to be over-exploited and destroyed because of poor resource management practices.

The most widely accepted explanation for over-exploitation of resources and potential solutions to this problem was proposed by Garrett Hardin in 1968 and 1978 (Feeny *et al.*, 1990). According to the theory popularised by Hardin (1968), all commonly owned resources (air, oceans, fish, grasslands and so on) are or eventually will be over-exploited. When resources are free or open to everyone, the rational individual has the incentive to use as much as possible before someone else does. For instance, why should one fisherman reduce his own harvest to conserve fish stocks when the fish will be taken by someone else? Such behaviour was coined by Hardin as the *tragedy of the commons*. In order to avoid this resource over-exploitation, it has been argued that resources should be either fully privatised (privatisation) or completely controlled by the central government authority (nationalisation) to ensure sustainable use (Berkes and Farvar, 1989).

Privatisation is based on the belief that humans are primarily motivated by self-interest so that individuals will use their private resources wisely to serve their interest now and in the future. Hence, sustainable patterns of resource use should be restricted to individual control. Bardhan (1993a) indicates that private property rights in resource use is viewed as a way of reducing uncertainty in interaction and inducing individuals to manage resources carefully. As for those resources that cannot and/or should not be privatised, based on their open access and multi-user

⁵ Feeny *et al.* (1990, 5) define state property as the rights to the resource being vested exclusively in government which in turn makes decisions concerning access to the resource and the level and nature of exploitation.

⁶ McGranahan (1991, 1277) defines private property as an institution which assigns to an individual (or corporation) the rights to consume, transform, sell, give away or save a resource, along with the right to exclude all others. Generally private property rights are recognised and enforced by the state.

nature, it is considered to be a government obligation to control and manage them for the sake of equitable resource use and for the overall good of society.

Although the tragedy of the commons concept remains widely accepted, it has been criticised on both theoretical and historical grounds (see Uphoff, 1986b; Wade, 1988; Berkes, 1989; Feeny *et al.*, 1990; Ostrom, 1990; and Bardhan, 1993a). Uphoff (1986b) points out that privatisation itself makes resources vulnerable to owner self-interest. He indicates that although the private ownership option appears to have advantages where it matches the costs and benefits of resource management for the same person, this may not be possible for all people because of the spatial and temporal distribution of costs and benefits. In the context of nationalisation, it is criticised in that no central agency or government could possibly justify the efforts and costs of policing common property in all instances. For example, local natural resources such as forests and range lands in many Third World countries, having been appropriated by the government as “state property”, are damaged and degraded from either legal or illegal over-exploitation because of ineffective management and control by national governments (Korten, 1986; WCED, 1987; Wade, 1988; Jodha, 1992; National Research Council, 1993). Bardhan (1993a) states that the widespread depletion and degradation of the commons in many developing countries bear testimony to the ravages of this nationalisation system. Furthermore, some researchers point out that the turnover of traditional communal resource management systems to a private and nationally controlled system is the second major source of resource depletion. For instance, Gibbs and Bromley (1989: 30) describe their reasoning as follows:

“In post-colonial societies throughout the world, new legislation has been enacted which redefines the rights of the state and the duties of individuals. In particular, land and water resources have been nationalised in the interest of the state. Villagers have seen customary rights replaced, local organisations superseded and their incentives to conserve resources removed. Governments have acted as if they had the capacity to manage resources down to the local level. However, this has created conflicts between local and national interests which individuals rationally exploit in the absence of common-property regimes.”

The main criticism of the tragedy of the commons concept is that Hardin overlooked the possibility of joint resource management by local users. He assumed that individuals jointly using common property resources are helpless to change the incentives that make them take the resources as much as possible before someone else takes the resource they jointly use (Ostrom, 1992c). Since the resources are open to many users, each user is more likely to pursue an individual interest than to co-operate to achieve collective goals. The theoretical underpinning of the tragedy of the commons concept is provided by the *Prisoners' Dilemma* game, in which defection or non-cooperation is the dominant strategy of each player, no matter what the other players do (Ostrom, 1990; Stevenson, 1991; Bardhan, 1993b). This is summarised by Wade (1988, 200) as follows:

"Two suspects are being separately interrogated about a crime they jointly committed. They know that if they both stay silent they will receive a light prison sentence. If one stays silent while the other confesses the first will receive a long prison sentence while the other goes free. If both confess they both receive a medium prison sentence. Each person can choose only once -which means that if one chooses to stay silent while the second confesses the first cannot then confess upon learning of his sentence. This is what creates the dilemma. Their joint interest is for both not to confess. But the outcome is that both confess (both defect). From the point of view of either one of them, staying silent while the other confesses would give the worst outcome, and confessing at least ensures that this outcome is avoided while it also opens the possibility that the confessor will go free if the other stay silent."

From this well known strategy, it can be generally concluded that it is unlikely for individuals to co-operate to achieve the collective goal, since each individual is more likely to pursue his/her own interest than the collective goal. The *Prisoners' Dilemma* is not the only theory to support Hardin's tragedy of the commons.

A closely related view of the difficulty of getting individuals to pursue their joint welfare was developed by Olson (1971) in his book the *Logic of Collective Action*. Olson argued that unless the number of individuals participating in collective decision making is quite small, or unless there is coercion or some other device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve common or group interests. Another effort to describe the problems of collective action is the *free-rider* problem (Olson, 1971). As a common

characteristic of the common property resources is its difficulty to exclude any user, everybody can benefit from the collective management whether she/he contributes to that effort or not. Hence, there is very little incentive for individuals to contribute their effort when they can benefit from the efforts of others. Taylor (1987) suggests that if an individual is not excluded from the consumption or use of a public good, it is possible for him to be a *free-rider* on the efforts of others. That is, she/he can consume or use the public good that is provided by others.

Contrary to the tragedy of the commons concept, there are many well-documented empirical examples of traditional local regulations and local participation in their enforcement that have facilitated successful sustained resource use over the long term (see, for example, Wong, 1979; Berkes, 1989; Ostrom, 1990; Stevenson, 1991; Bromley, 1992; and Bardhan, 1993a). McKean (1992) highlights cases of successful collective management of environmental resources such as the common-field systems of England, Northern Europe, India, Nepal, Japan, Bolivia, and Peru that have operated, in some instances, for several centuries without resulting in a degradation of resources. A theoretical explanation of this contradiction is that Hardin's commons and the commons controlled by traditional communal systems are two different systems. The key concept here is "property". There is no property in the commons proposed by Hardin, only the opportunity to use the resources (open access). In many traditional systems, there is a well-defined group which holds the right to use and control over the specific resource. Ostrom (1992b) concludes that in situations where no-one has a property right over a resource, open-access to that resource will result in overexploitation and it may well be destroyed. However, she argues that even when property rights exist⁷, over-exploitation and destruction may not be sufficiently avoided depending on how well the property rights regime copes with problems of allocating the costs and benefits of managing and governing a particular resource. Therefore, the real problem of over-exploitation of the commons is the absence of effective group management that is required to allow the sustained use of a resource over time (Bromley, 1992).

⁷ Bromley (1992) states that there is no such thing as a common property resource; there are only resources controlled and managed as common, state, or as private property.

From the literature discussed above, it can be concluded that examples of collective action abound in the real world. Nevertheless, they vary greatly in terms of their typography and the ways they are developed. Some types of collective action materialise on their own, while others require a stimulus. In other cases, collective action is resistant and requires a great deal of outside support to be initiated (Sandler, 1992). Much of the literature on collective action and communal resource management seeks to examine why solutions to collective action problems are achieved in some places and not in others (for example, Taylor, 1987; Ostrom, 1990; Stevenson, 1991; Singleton and Taylor, 1992; and Sandler, 1992). Hence, while there is no doubt of its feasibility, CRM needs specific conditions or situations to develop.

The management of common property resources may be approached theoretically as a problem of collective actions, which arise when individuals must co-operate in order to achieve a collective goal. Collective action here refers to activities that require the co-ordination of efforts by two or more individuals. Collective action is required for a resource to be managed as common property, when each individual must rely on every other individual's contribution to management. Gibbs and Bromley (1989) indicate that collective use of common resources is created when members of an interdependent group agree to limit their claims on a resource in the expectation that the other members of the group will do likewise. Rules of conduct in the use of the given resource originate within the group, are mutually accepted by the group, and contain their own means for resolving conflicts.

Since the possibility of collective action relies on the relationships among members in a social system and institutions that govern them, co-operation tends to work better in small groups with similarity of needs and clear boundaries, and shared norms and patterns of reciprocity. These are the common characteristics of rural communities in many developing countries. Bardhan (1993b) explains that in such communities, collective decisions and actions are easier to achieve through face-to-face relationships, monitoring is also easier, and social sanctions, in case of violations, are easier to enforce and more effective as well. Many researchers have also argued that local environments are often well integrated into the activity systems of local people. For instance, Berkes and Farvar (1989) indicate that communalism is an important mode of thinking and of managing resources throughout the world. Hence, it should come as no surprise that traditional

resource-management systems are often communal or community-based. As collective decisions and actions, especially at the community level, are the foundation of the CRM approach, the collective decision-making of rural communities is an essential aspect in understanding and promoting CRM.

3.2.1 Induced Collective Action in Rural Resource Management

Emerging from the criticisms of the tragedy of the commons is an alternative form of CRM proposed by many researchers (Wong, 1979; Korten, 1986; Berkes and Farvar, 1989; Stevenson, 1991; Sandler, 1992; Bardhan, 1993a). For example, Wade (1988) argues in favour of “locally-based collective action” as a third option which is distinct from privatisation and state control. In fact, many developing countries have a long history of balanced resource management under highly informal local community institutions as mentioned earlier. Although there is no settled notion of what is the best way to manage/govern common property resources, a CRM approach has become increasingly popular in many countries as a viable alternative to the privatisation or state control of common property resources. As already mentioned, rural people and their communities depend heavily on their surrounding environment, so the notion of CRM for sustainable development is attractive in this regard.

Berkes and Farvar (1989) note that because of the crucial role played by CRM in sustainable resource use, the most significant application is its relevance to rural development. As Grima and Berkes (1989) conclude, the real issue is no longer the feasibility of communal systems, but rather if and how they can be promoted in the contemporary world. Thus, the present challenge is to find a means through which to promote locally-based common resource management strategies for those who need them. The results of the VFP discussed in Chapter II clearly demonstrate that the means to promote and disseminate a community-based project are still ineffective. In order to be more effective in inducing this collective management concept, the decision-making process and factors involved in the adoption of the concept need to be better understood.

The way in which rural people and farmers accept and adopt new ideas or technologies has been the topic of a great deal of research over the last half century. Many development agencies have eagerly sought ways to introduce new ideas to rural people, so that mass transformation and greater economic and social productivity can result. Adoption-diffusion theory provides one conceptual framework to understand the adoption decision and its associated factors. In fact, adoption-diffusion research and theory has served as a major tool for most extension practitioners for developing effective strategies and planning successful extension programmes (Lamble, 1984).

Diffusion of innovations is a multidisciplinary theory of planned social change that is brought about by the spread of new ideas or new technologies throughout a social system⁸ (Goss, 1979). For instance, new agricultural technologies have been adopted to bring about changes among farmers in the process of agricultural modernisation (Singh, 1974). Diffusion is ordinarily thought of as the result of a number of separate individuals or a group "*adoption decision*", which results in the spread of the innovation through a population. In other words, the adoption process centres on the individual or adopter unit and focuses on the adopter unit's behaviour patterns and actions. In contrast, the diffusion process deals with the spread of ideas through various communication channels and social systems to persons or adopter units (Buyukcolak, 1977). A more precise definition of diffusion is posited by Rogers (1983, 5) as "the process by which an innovation is communicated through certain channels over time among the members of a social system".

The diffusion-process consists of four main elements: the innovation, the communication channels, time, and the social system. The success of the diffusion process is often measured in terms of the adoption rate, which is the relative speed at which an innovation is diffused and adopted by members of a social system (Rogers, 1983). In order to increase the rate of adoption, explanation of the "*adoption process*" or "*adoption decision*" has been the focus of many studies of the diffusion of innovations. The study of this adoption decision-making process focuses on identifying the essential functions affecting the process in order to explain the adoption behaviour and provide insight into what can be done to help the potential adopter make a desired decision.

⁸ Rogers and Shoemaker (1971, 28) define social system as a collectivity of units which are functionally differentiated and engaged in joint problem solving with respect to a common goal.

The decision-making process plays an important role in the diffusion process because members of the social system (potential adopters) are faced with choices to adopt or reject the innovation. *Adoption*, in this case, is defined as a decision to make full use of a new idea as the best course of action available, while *rejection* is a decision not to adopt an innovation. It has been recognised that the innovation-decision process is not a single action as people normally take time, sometimes as long as several years, to make decisions about the new ideas (Rogers, 1983). The assumption has often been made that the decision to adopt or reject an innovation is a process that involves a sequence of events and influences which operate through time (Lionberger, 1960). This decision-making process is known as the “*adoption process*” or the “*innovation-decision process*”. This is defined by Rogers (1983, 20) as “a mental or decision-making process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject it and to confirm this decision”.

The adoption process is typically divided into a number of stages which serve as a conceptual framework for organising and analysing information related to an adoption or rejection of an innovation (Reynolds, 1971). Rogers (1983) explains the five stage adoption decision model shown in Figure 3-1 as: 1) *Knowledge*: candidates are exposed to the existence of an innovation and gain some knowledge about the innovation, 2) *Persuasion*: candidates form a favourable or unfavourable attitude toward the innovation, 3) *Decision*: candidates engage in activities which lead to a choice to adopt or reject such an innovation, 4) *Implementation*: candidates put an innovation into use, 5) *Confirmation*: candidates seek reinforcement for the decision they made, but they may reverse this decision if they are exposed to conflicting messages about the innovation. It is important to note that the adoption process can just as logically lead to a rejection decision, even after a prior decision to adopt has been made (typically referred to as discontinuance and is relevant in the context of the Thai VFP).

By regarding the communal resource management concept or a CRM project (like the VFP) as an innovation to be introduced to rural communities, this adoption process can be applied to study factors associated with its adoption. In the case of the VFP, following the adoption process, a project is introduced to a village and its members by the “*menu*” through the national

rural development planning process, as described in Chapter II. This represents the knowledge stage in the adoption process. In the second stage, villagers and the village development committee have to decide whether the VFP matches their needs or not. If they decided that the VFP is what they need and the DOF approves the project, they will get support from the DOF to implement their VFP. As noted earlier, after three years the village must be able to carry on the VFP on its own without support from the DOF. This represents the confirmation stage in the process. The confirmation stage is of major interest in this thesis, since many villages may decided to reject the project while many others successfully adopt the project and enjoy satisfactory benefits from it.

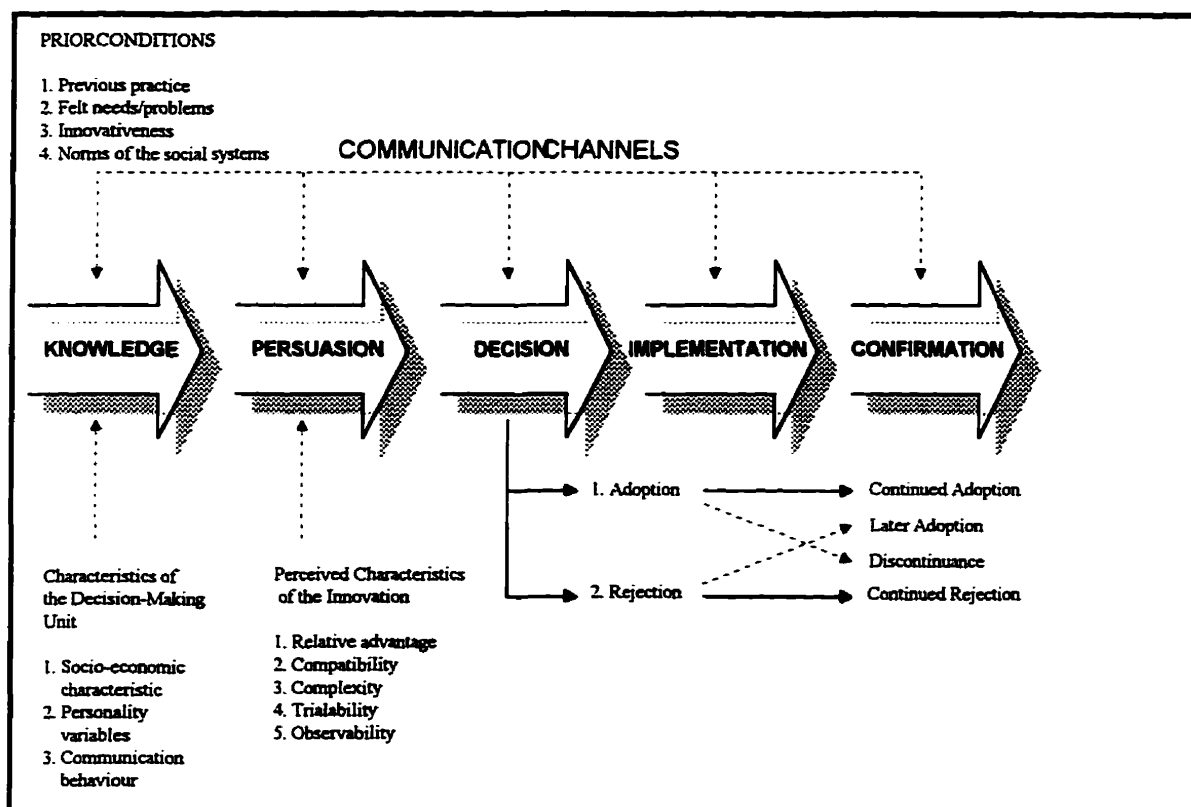


Figure 3-1: A Model of Stages in the Innovation Decision Process.

Source: Rogers (1983, 165).

As already noted, adoption research can be used to identify and distinguish adopters from non-adopters which, in turn, can be used to predict which potential adopters will adopt or reject the innovation. A similar research approach can be used to develop a model to predict the success,

failure or indeterminate outcome of the VFP at the village level. However, before applying this research approach to build the predictive model, the adoption unit and the meaning of successful adoption need to be operationalised.

3.2.2 *Community Adoption: The Community as a Unit of Analysis*

Most empirical research on adoption and diffusion of innovations has focused exclusively on the individual as the unit of adoption (Katz, 1962). However, not all innovations are adopted by, or are intended to be adopted by, individuals. Different sorts of innovations may require different units of adoption. For example, consider the analogy that some types of board games can be played by an individual but other types require more than one person to play. In a rural development context, projects such as an integrated farming system can be adopted by an individual farmer, but communal fish ponds or communal forestry projects can only be adopted by a community. Further, different cultures, situations or circumstances may also require different units of adoption for an innovation. For example, a tube well can be adopted by a rich farmer alone, but for the poorest farmers, it must be collectively purchased and adopted if they are to have any access to this type of expensive technology.

Since the CRM approach is central to this thesis, it is essential to discuss community decision-making processes and community action as a form of collective adoption and to use the community as the unit of adoption. Field *et al.* (1974) indicate that nowhere is the process of collective decision-making more important than in community development, especially in communal water resource management programmes. Despite being an important component of rural development strategies, collective adoption of innovations has received far less attention than individual adoption, suggesting that our present knowledge of communities and their behaviour as functional units is very limited. Fliegel (1969) emphasises that many community-based development programmes have suffered from a lack of a systematic understanding of the concept of a community.

Rogers (1983) forwards his concern on different units of adoption in terms of different types of adoption decisions. As innovations can be adopted or rejected by individual members of a social system or by the entire social system, Rogers (1983, 347) uses different decision-making units to classify different types of innovation-decisions:

- “1. Optional decisions, are made by an individual independent of the decisions of other members of the system;*
- 2. Collective decisions, are made by consensus among the members of the system;*
- 3. Authority decision, made by relatively few individuals in a system who possess power, status, or technical expertise.”*

This classification of innovation-decisions by their adoption unit is essential for selecting a suitable approach to promote successful adoption and diffusion of innovations, such as the VFP. Katz (1962) emphasises that the researcher or practitioner must carefully choose his/her unit of analysis in conducting diffusion research or programmes. On the one hand, she/he must be sensitive to the unit which is the target of the campaign while, on the other hand, she/he must be sensitive to the units which are required by the innovation and/or prescribed by the culture or circumstances.

As collective adoption refers to consensual group decisions about the use of an innovation within a given social system, Rogers (1983) notes that only innovations that require group participation in an adoption decision are considered collective (see also: Rahim, 1968; Brown, 1981; West, 1983). Olson (1971) identifies a collective good in terms of the need of potential beneficiaries to organise themselves to procure it. Otherwise it is not available. James (1989) also notes that some technologies can be diffused on an individual basis, as opposed to those that require communal organisation. Rahim (1968, 116) defines a collective adoption decision in more specific terms as: “the adoption of an innovation by a collectivity in which the decision to adopt is made jointly by the system’s members and the actual use of the innovation involves joint efforts by the members of the system”. West (1983) suggests that collective adoption implies not just decision-making but also, the collective action and organisation used to forge consensus and to engage in collective implementation and long-term project management.

As already discussed in the preceding section, it is essential to achieve some form of collective decision making and collective action in order to use common resources appropriately. For example, Molnar *et al.* (1985) note that collective action is often a prerequisite for government assistance to projects that involve costly investment in infrastructure such as tube wells, irrigation, collective agriculture, fuel woodlots, collective grazing, and fishing. Many environmental protection and restoration programmes also need collective action to be able to succeed or even to start. In fact, Uphoff (1992) indicates that because communities exist as social entities, they create opportunities for collective action for mobilising and managing local resources on a self-directed and self-sustaining basis. Hence, the study of these collective actions must use the community as a unit of analysis.

As the unit of adoption, a community must make a corporate decision. One of the basic democratic principles of a corporate decision is that each individual must have a vote, but the corporate decision commits everybody to the process within an aggregate social unit of a rural community. Fitzsimmons and Freedmen (1981) point out that much of the research on community development has been conducted from a very narrow perspective such that it has rarely ever addressed the crucial issue of how communities operate as total entities. In a broader sense, most community research neither questions the effect of development projects on communities as total entities nor the influence of the community as an entity on specific projects. Fliegel (1969) also indicates that the community is a unique form of social organisation, and should be studied because certain community properties may have particular behavioural consequences. However, the rural community is defined somewhat differently by several scholars, ranging from a loose sense of belonging, to a more formal description of “a social organisation of a more or less large number of families which share the same territory and participate in a series of communal activities” (Kaufman, 1959; Fitzsimmons and Freedman, 1981; Levi and Litwin, 1986; and Wilkinson, 1986). Without a comprehensive operationalisation of the concept of community as a social unit, the data collection and data analysis procedures used in collective adoption research, planning, and policy analysis are inadequate.

Although there have been many studies of rural communities, they have tended to focus only on certain aspects of village life (Whyte, 1976). It was only after the need for rural

development grew stronger after World War II that the village entity was brought into sharper focus by social scientists (Tjondronegoro, 1984). The significance of the village or local community has been recognised by planners and decision-makers, whose belief that sustained national economic development can only be possible if villages are successful in managing their resources.

According to Chiva (1960) there is heterogeneity of rural communities, ranging from nomadic tribes of fifty members up to densely settled agricultural villages of a thousand or more inhabitants. This study cannot deal with such a broad conceptualisation of rural communities. Hence, the scope is limited to rural villages having a certain stability in a given territory independent of size. This characterises the nature of communal rural villages in Thailand, as in many other developing countries, and it serves as the operational definition of a rural community in this thesis.

In many Asian and other developing countries, the village community also coincides with the lowest level of government administration and constitutes the lowest planning unit for both *bottom-up* and *top-down* planning strategies. Moreover, the development effort encompassed in most of the rural development programmes in Thailand has been oriented to the village community. Villages can function as reflectors of the needs and desires of rural people and also as the target of government programmes in planned development strategies. The rural village community in this sense is an administrative territorial unit through which governments channel their services and projects to their citizens.

Nanthasuwan (1988) argues that a village is not only an area governed by a political entity, but it is also a social system that affects the life of all its inhabitants. In most developing countries, the village is considered as a self-contained unit of social and economic activities (FAO, 1983). Kemp (1991) stresses that the rural village is an important agency of social control in that it has considerable local autonomy. In addition, the village community is an important construct of social organisation and is commonly a reference group for its members. Rural people identify with their village community and see its welfare linked inextricably to their own. Many researchers also

suggest that villagers are bound together by various forms of collective discipline and they select leaders empowered to direct the carrying out of tasks of general interest. For example, Brandt and Cheong (1980) note that community members must not only share common beliefs and goals, they must also derive psychological satisfactions from joint participation in work, play, and ceremony. They stress that there must be a common sense of belonging that is stronger than the rivalry, jealousy, and competition that exists among individuals, kinship groups, or natural hamlets.

Combining the territorial and social interaction concepts of rural communities, Hayami Yujiro (1980) defines the village as the basic unit of rural life, representing not simply the place where people live but also a community which mobilises collective actions to supply public goods essential for the security and the survival of community members. In a broader context, Sutton Jr. and Kolaja (1965, 197) define a community as “a number of families residing in a relatively small area within which they have developed a more-or-less complete socio-cultural system imbued with collective identification and a means by which they solve problems arising from the sharing of the area”.

From the above discussion, it is clear that collective decisions and actions are part of a village's every day life. These collective decisions and actions are brought about by an individual social interactions within his or her community. Levi (1986) concludes that the *community* depends on co-operatives (collective decisions and actions) in order to create an environment of self-sustained and self-reliant growth. On the other hand, the *co-operative* depends on the community as a territorial socio-economic basis to receive legitimisation and support for its activities. The simplicity of Chiva's (1960, 9) definition of the rural community best highlights the concept of community as a collective decision-making unit.

“The rural community is a group of households holding a territory and interrelated in such a way that as a unit they can intervene, in accordance with precise rules, in the economic activities and legal rights of each household.”

This discussion has demonstrated that the village community is a legitimate and logical base entity of the development process and, as such, it serves as the unit of adoption in this study.

This base entity is a necessary component in the analysis to understand the outcomes of induced collective adoption in general and the VFP in particular. Another aspect of the adoption process needs to be discussed, namely the meaning of successful adoption. This is undertaken in the next section.

3.2.3 The Success or Failure of Community-based Resource Management Project

In promoting communal resource management, it can be assumed that the primary objective is to achieve a collective adoption through resource management by the village community. Viewed as a relationship between project outputs and outcomes, the decision to continue or discontinue with the project is based upon the level of outputs the project generated. If the project is successful and the outputs, measured by village income, fish production, increased nutrition and so on, are at least equal to expenditure of effort and local financial inputs, the outcome will be progress toward CRM as an operational development model and overall improvement in the level of rural development. On the other hand, if the outputs are less than the level of inputs, it is likely that the village will eventually discontinue the project. In this case, the discontinuance decision will have undesirable outcomes with respect to rural development.

The use of the adoption decision as the outcome of the adoption decision-making process is problematic in defining the adoption, since the adoption decision-making process is dynamic rather than static and because the adoption decision itself is based on the level of outputs generated by the project or an adopted innovation rather than any broader development outcome. Hence, it is not clear as to which point in time the adoption decision should be applied during the decision-making process. Rogers (1983, Figure 3-1) defines the decision of the initial use of an innovation as the adoption (the third stage: Decision), and the outcome of the process is the decision to continue or discontinue to use the innovation (the confirmation stage). Others including Lionberger (1960) and MacDonald (1976) define adoption as the outcome of the process when the potential adopter accepts the innovation for full-scale and continued use. In this thesis, the outcome of the VFP is viewed more generally and the level of project outputs governs the relationship between the initial

and continued use of the innovation. Further, Lionberger (1960) and MacDonald (1976) define the decision to try out the innovation in the third stage as the “*acceptance*” of the innovation and not the adoption. Thus, once an innovation has been accepted, the consequences of the implementation or trial stage will lead the adopter to decide to continue to use the innovation fully which is the “*adoption*”. However, what does a “*successful adoption*” mean when it is applied to a community-based development project like the VFP? Generally, a development project is classified as a success only when it meets a pre-established set of criteria.

Conventional evaluation research emphasises measuring the success or failure of a project against its goal(s) and/or its objective(s). This approach, first, requires establishing which objectives of the project are to be evaluated. Subsequently, these objectives are compared with what is happening on the ground. Any match between what was intended to occur and what has occurred represents success of the project, and anything that has not occurred as it should represents failure. Sweet and Weisel (1979) note that defining the goals of a project and formulating success indicators for measuring progress toward achieving the goals are the first steps in project design. Indicators of success emerge directly from the goals that are chosen, and they reflect the specific changes that the project is designed to promote. Examples of general indicators for rural development project objectives include: increase in net income, increase in production, improved health and nutrition, and increase in individual or group capabilities to solve development problems.

However, it should be noted that there is a distinction between successfully adopting a project and project success in the traditional context of project evaluation. While the traditional evaluation approach emphasises measuring project outcomes in terms of what have been produced or accomplished, mostly in terms of levels of production or economic returns, it ignores a project’s sustainability. Ekong and Sokoya (1982) point out that success and failure are relative value judgements. A programme may succeed in meeting its pre-defined objective(s) but fail woefully in not anticipating the related changes or effects (often, problems) its success have introduced nor in planning for such exigencies. On the other hand, a programme may fail to attain its stated objectives but succeed in other directions, such as solving a new problem whose existence was hitherto unknown to the people.

Cochrane (1979) argues that every project has an impact on people, even in the project infrastructure which tends to be measured in physical terms, for instance, miles of road constructed, disbursed loan funds. He also indicates that every development project contains an implicit statement about social change. This social change is critical to the project's success since unless the change takes place, the project will fail. The implicit hope of a development project is that, at some point, the innovations and desired changes will become self-sustaining. Tacconi and Tisdell (1992) state that a project should provide lasting benefits to the beneficiaries if it is to be judged successful in providing sustainability. Hence, it should continue to provide benefits after completion. Buller and Wright (1990, 3) made the following distinction between a non-sustainable project and a truly sustainable project:

"Outside aid can certainly help in this process (development process), but if, on the withdrawal of such aid, people are incapable of sustaining the improvements that have happened then what occurred was not development but a short-term improvement in living conditions."

Speight (1973) indicates that community development will be considered a success when the *institutionalisation stage* is reached. From his three phases of community development: *initiation*, *diffusion*, and *institutionalisation*, he explains that a community development project achieves institutionalisation when its activities become routine and self-perpetuating for community members. This institutionalisation phase is similar to the confirmation stage in Rogers' model (Figure 3-1) when potential adopters decide to continue and make full use of the innovation. At this stage, the change agent can withdraw, because jobs have been completed as the project becomes standardised and controlled by the community. These ideas of development success lead the project evaluation concept beyond a narrow perspective of whether it achieves its goal(s) and objective(s), to the goal(s) and objective(s) of the development itself.

Therefore, a development project (programme) must be cumulative and must bring not just an improvement in physical and social conditions but also durable gains in people's abilities to control and sustain the conditions. This linkage between development and project success has brought about a new conceptualisation of evaluation that is central to this thesis. From the discussion, it

can be concluded that usually the main criteria to determine the outcomes of a particular project are: project goal(s) and objective(s), its impacts on a whole system in terms of social, economic and environmental effects, and the continued use of project technologies. However, since development implies social and self-sustaining change, a project's acceptance and its continued use by the beneficiaries are the main criteria in determining its outcomes.

The use of project acceptance and its sustainability as the main criteria of project outcomes are not new to studies of the VFP. Although there is no official definition of the project's success at the village level, sustainability of project activities is an underlying goal of the VFP and discontinuance of the project is widely accepted as project failure (Chulalongkorn University Social Research Institute, 1988). In fact, Chantarawarathit (1989, 48), in his study of the VFP in Udonthani province defines the success of the VFP as operation of the VFP in any given village for more than three years. Molnar *et al.* (1985) also point out in their study of community fishponds in Panama that the ability of collectively adopted enterprises to be implemented and operated indefinitely is fundamental to the concept of success of a group endeavour. Hence, the success of community development projects is defined as the degree to which a village actually practices and independently sustains a project. However, it should be noted that if an overall or specific impact of the project is a major concern, a different approach such as goal-free evaluation might be more appropriate to serve the evaluation objective.

From the above discussion, VFP project planning can be viewed as a process of inducing collective adoption by using the village community as the adoption unit to which the project is introduced and intended to be used routinely by the village. Therefore, the village decision-making process (Figure 3-1) can be matched against the project planning process (described in Chapter II) as depicted in Figure 3-2. Considered as an innovation, a CRM project (the VFP in this case) is an input to the village community decision-making process. At each stage the village has to make decisions and implement those decisions which consequently lead to routinising or discontinuing the project activities as the outcome of the process. It can be concluded that a success (full and represent continuation), failure (discontinuation) or indeterminate outcome (partial continuation) of the project is comparatively similar to the success or failure of the attempt to induce collective adoption within a village community.

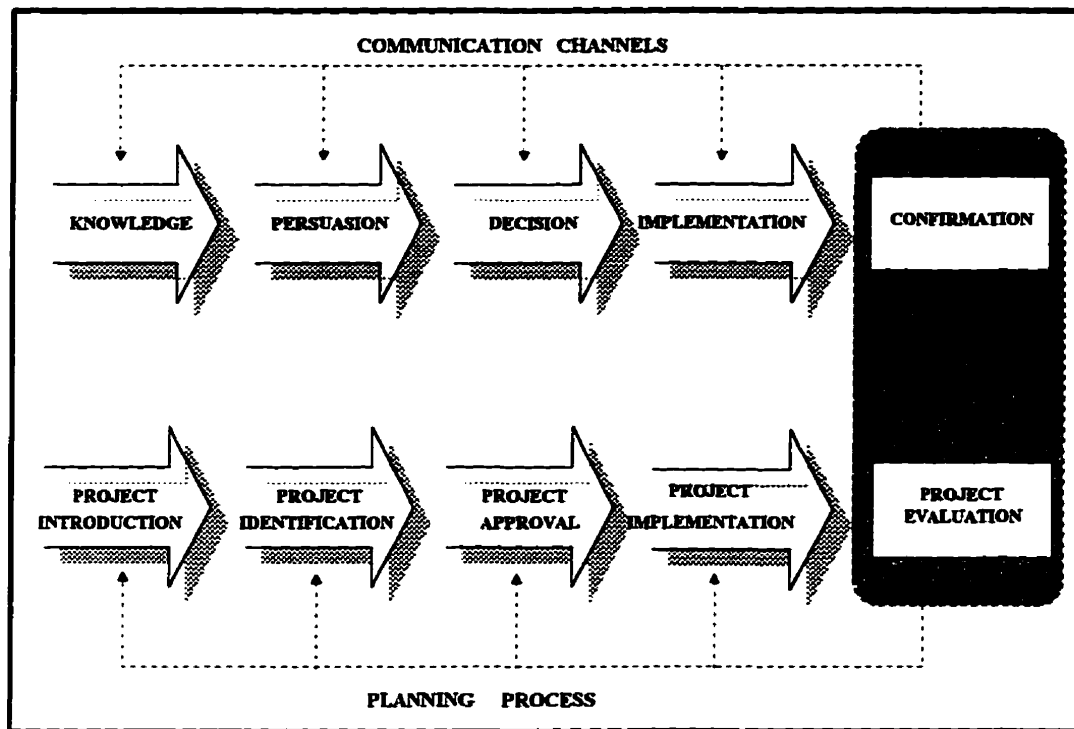


Figure 3-2: Comparing The VFP Planning Process and Adoption Process

By viewing community development planning from the village decision-making perspective (Figure 3-2), factors associated with the decision at each stage can be identified and used to explain the outcomes of that stage. Since this study is interested primarily in the last part of the process (shaded area in Figure 3-2), a conceptual framework relating the success, failure or indeterminate outcome of the project to contributing factors it is developed in the following section. Finally, a model for predicting outcomes of the adoption of the VFP in north-eastern Thailand is introduced.

3.3 A Conceptual Framework

As the continuance of projects is the main criterion used to measure project success, factors affecting a village's decision to continue or discontinue project activities (the fifth stage in

Figure 3-2) must be identified and their contribution to project outcomes must be clearly understood.

From the CRM and community development literature discussed in Chapters I and II, several variables have been identified as being indicators of successful collectively managed systems. For example, Gadgil and Lyer (1989, 240) propose that sustainable use of common-property resources is indeed possible, but it requires certain special conditions, namely: 1) the number of parties sharing access to the resource be small; 2) the parties sharing access repeatedly interact with each other over a long period; 3) such parties share the harvests in an equitable fashion; and 4) such parties are linked to each other by bonds of kinship or reciprocation in contexts additional to the resource use.

In his study of local control and distribution of water systems, Cruz (1989) identifies five significant factors in promoting the collective control of water: 1) environmental conditions that affect seasonal fluctuations in water supply; 2) technology requirements; 3) size of the irrigation system and population serviced; 4) social and political relationships of users; and 5) presence of water rights. Also, in her efforts to modify the theory of collective action to explain the successful cases of collective action, Ostrom (1990) has determined that one or more of the following variables have consistently influenced outcomes: 1) the total number of decision makers; 2) the minimum number of participants necessary to achieve the collective benefit; 3) the discount rate in use; 4) similarities of interests; and 5) the presence of participants with substantial leadership or other assets.

In terms of community development, Rondinelli (1991) identifies six sets of factors that are crucial to the success of community management in the delivery and maintenance of local water systems: 1) adequate incentives; 2) sufficient skills and resources; 3) appropriate processes for water systems operations and maintenance; 4) effective inter-organisational relationship; 5) appropriate technology; and 6) effective systems of monitoring, evaluating and obtaining feedback. Fairbairn *et al.* (1991) note that the success of community-based development projects has often depended on the cohesion and vision of a community, which in turn depends on culture, demographic composition, religion, leadership, historical development, and educational processes.

From these contributions to the CRM and rural community development literature, the factors considered relevant to the outcomes of a community-based development project such as the VFP are discussed in the following classes:

1) Perceived needs

According to Chambers (1983), initial consideration of the people and their needs will ensure the sustainability of a project. Hansen and Erbaugh (1987) state that successful implementation of resource conservation projects, as well as their maintenance over time, depends on the compatibility of the goals of the project and the community's perceived needs. They emphasise that local input should be obtained so that village needs and interests be represented in the project. Speight (1973) explains that recognition of perceived needs is necessary for successful community development, because they comprise a highly emotional committed state of the people which brings them to work together. Perceived needs can be viewed as a result of a crisis or threat facing a community, which in turn motivates community members to work together to solve their problems. Levi and Litwin (1986) conclude that a major motivational factor prompting villagers to participatory actions is a situation of crisis and threat, such as the danger of exploitation of community resources. Hence, it can be concluded that, in general, the community's perceived need is an important factor in encouraging the success of a community-based development project.

2) Project results

The most obvious factor affecting a village's decision to continue or discontinue project activities is the results obtained from the project, especially when they relate to increased productivity. The logical explanation of this factor is that when villagers collectively decide to implement a project they expect a certain level of return from their investments. If the project results are favourable, they are more likely to continue to implement the project to get the same favourable results. However, if they are not satisfied with the project's results, there is no point for them to continue to invest their time and resources in the project. Hence, villagers are more likely to abandon a project if it wastes their time and resources. Hansen and Erbaugh (1987) conclude

that if results, such as higher yields, higher income, or social improvement, are favourable, it is likely that villages will continue to participate in a project as part of their normal routines.

In terms of collective action theory, Seabright (1993) notes that recent work in game theory has devoted much effort to explaining co-operative behaviour in terms of understanding where the long-term interests of individuals really lie. The theory of repeated games draws upon the prisoners' dilemma game, through repeated play. Knowing that the pursuit of short-term interests can harm long-term aims by affecting the reaction of others in future interactions, each individual (player) chooses to co-operate with the interests of the group. Hence, the benefits of co-operation along with other players' future retaliation strategies are the main factors affecting group co-operation. In reality, Wade (1988) finds that the net collective benefit of a collective action is the main factor explaining the presence or absence of collective organisation in the villages he studied. Ostrom (1990) indicates that individuals are more likely to co-operate when the long-term expected net benefits to be achieved by collective action are greater than the long-term expected net benefits for individuals following short-term competition action. Johnston and Clark (1982) also note that the attractiveness of benefits is a primary condition for people to participate in a development project.

3) Bio-physical environment

It is generally known that different technologies, such as different crops or fish species, require different bio-physical conditions according to their particular needs (Pollisco-Botengan *et al.*, 1985). For instance, different crops need different types of soil and water quantity. The bio-physical environment does not only dictate what type of technology is feasible, but also affects yield potentials. Crops or fish may be able to tolerate salinity or acidity up to a certain level, but they thrive best on specific soil and water conditions (Ngowi and Stocking, 1989). Hence, yield of a crop or a specific fish species may vary in different locations. This bio-physical environment requirement is commonly used in assessing the suitability of land for specified purposes as an essential part of agricultural development and land using planning (Ngowi and Stocking, 1989). Adams and Havens (1966) indicate that a community's bio-physical environment places important limitations on the types of economic activities that may be pursued. As the ecological conditions of

rural communities are different, even though they may be located in the same region, this factor may pose constraints that limit project activities. Since bio-physical conditions may affect the project's results, their influences (negative or positive) may determine whether the project's results are favourable or not.

4) Previous knowledge of and experience with a specific technology

Local skills and knowledge are required if villages are expected to manage and control projects independently. Although most development projects include some kinds of training programmes, they are often short-term and designed for small, specific groups of people. Former knowledge and skill of participants give a village an advantage in understanding and applying technology that is involved in the project. This previous knowledge and experience with technology not only helps villagers to understand what the project is in the initial stage, but it also helps them to be better organised in the implementation stage or in time of a crisis. Rondinelli (1991) indicates that a community-managed water system was more successful in villages with better knowledge and skill on how to operate and maintain the water system than in those villages without that knowledge and skill. He concludes that it is often more effective to build on existing technology than to introduce entirely new technologies. This implies that the better the former knowledge and skill of the participants, the more likely the success of the project.

5) Villagers' previous innovativeness

The adoption/use of high yielding variety seeds, fertilisers, and mechanisation is an indicator of farmer innovativeness or readiness to adopt innovations. Although collective innovativeness is neither the aggregate nor average of individual innovativeness, individual innovativeness can characterise the villagers' attitudes toward new ideas or recommended technologies. It may also give some indication of their experience in adoption of government aids. Hence, the villagers' attitudes and their experience in adoption may affect project implementation and the decision to continue or discontinue a project. It is assumed that the higher the villagers' innovativeness or readiness the better the chances of the project to succeed.

6) Community economic status

Adams and Havens (1966) note that even in the most traditional communities, economic factors play an important role in programmes of change. Generally, higher economic status is perceived as indicative of a higher capacity to invest and greater ability to take higher risks. It is well known that poor farmers who cannot afford high cost labour, machines, fertiliser, and pesticides are more likely to fail to adopt new agricultural technology. Similarly, a community may not be able to adopt and sustain a community-based development project because its requirements may be beyond an acceptable risk threshold for many community members. Therefore, the higher a community's economic status, the better the chance of the community-based development project to be successful.

On the contrary, if the collective action seeks to pool economic resources to obtain expensive goods or machinery, higher economic status may have a negative effect as goals can be achieved without the need to pool resources together. The villagers might not be interested in the development project because they are more interested in their own business and they can afford to buy what they need. It may be even cheaper and easier for them to buy than to organise and do the development jobs to provide the same things. In this case, higher community economic status may reduce the chances of success for a collective project.

7) Community structure and size

Since success in a collective action requires the ability to mobilise the personnel and resources of a community, this might be most successful where power is highly concentrated. On the other hand, a concentration of power might be used (by those who have that power) to block a course of action. The concentration of power can be linked to social heterogeneity, intra-village conflicts, and inequality in the community, all of which have a significant impact on community collective actions (Rondinelli, 1991; Bardhan, 1993b). Supported by the general knowledge that prevalence of factions within communities often complicates the problem of achieving effective collective action, West (1983) indicates that attempts to achieve collective action may be doomed

to failure, if disparities in land and power in the community are too high. Bardhan (1993b) concludes that social heterogeneity and intra-village conflicts and inequality may impede collective action in water management. Racial, ethnic, wealth, caste, and religious differences are common causes of conflict or segmentation in communities (Molnar *et al.*, 1985). Social structure also affects the formation of the village committee or project organisation committee and these groups play a major role in the success of collective projects (Kottak, 1991).

The size of an organisation or group has consistently been found to be related to its innovativeness or its ability to carry out innovative collective actions in both adoption research and other community-based studies (Rogers, 1983; Bardhan, 1993b). In the context of community characteristics, community size or group size is often linked to innovativeness (Ellsworth, 1987). Bardhan (1993b) explains that, in small communities, monitoring and social sanctions, in case of violations, are easier to implement. From a decision-making perspective, it is widely accepted that the smaller the number of decision makers, the easier a collective decision and action can be achieved (Ostrom, 1990; Sandler, 1992; Bardhan, 1993b). Further, it can be noted that in a small group of people, communication is easier; thus, collective decisions and actions are easier to achieve. Olson (1971) emphasises that unless the number of individuals in a collective decision making context is quite small, collective decision and action cannot be achieved. Another perspective of the relationship between the size of a community and collective project outcomes is that if the number of beneficiaries is too large, the benefits of the project might be too small to share among them. Molnar *et al.* (1985) found that the number of group members was closely related to fish production capacity in Panama community fish ponds project.

Generally, it can be assumed that a small community with homogeneous and well-united populations is better organised and has better chance to achieve collective actions than a larger community with conflicts and inequality. Similarly, Schwartz (1981) reached the same conclusion that, in general, rural development projects have the best chance to succeed in relatively small, well-bounded, homogeneous, integrated communities. He suggests that communities that lack these traits are encouraged to develop them as a prelude to fruitful community development.

8) Community cohesion and cultural patterns

Social harmony and collective experiences in the community are identified as one of the cornerstones of community collective actions, especially in the community resource management literature (see Ostrom, 1990; Singleton and Taylor, 1992; McKean, 1992; and Bardhan, 1993b). Feng (1979) indicates that mutual understanding and mutual trust are necessary if effective group action is to be expected. It can be assumed that communities with a strong collective tradition can organise their collective action easier than communities without such traditions. The traditional system of mutual help such as “*long khack*” and “*len chae*” (described in Chapter II) is often referred as a good basis for achieving collective action. A past history of successful collective actions can increase the chance of future success of similar collective actions.

In some communities, cultural background promotes extreme individualism, great reliance on household members, and general distrust of others outside the household. Under these circumstances, co-operation may be obstructed (Molnar *et al.*, 1985). Many cultural practices can also affect the success or failure of collective projects. For example, rural people in the north-east Thailand like to drink water from specific shallow wells or ponds. Thus, any project that disturbs these ponds will not get any support from the people. These cultural practices should be studied, as Rondinelli (1993) notes that an inadequate understanding of local social and cultural conditions is one of the most serious constraints in project planning and implementation. However, it is generally accepted that social harmony and a strong collective tradition can encourage the success of collective actions and community-based development projects.

9) Community human resources

The villagers themselves are another key factor affecting the success of community-based development projects, since they are the ones who make decisions, implement those decisions and have to live with their consequences. The health, educational level and ability of village members as well as the availability of labour can affect the success of the project.

The educational level of farmers is repeatedly identified as a major factor related to farmer innovativeness and the capability to adopt new agricultural technology successfully (Andreae, 1981; Rogers, 1983). Mokhzani (1979) states, using data from Malaysia, that successful modern co-operatives generally tend to be those that are managed by people with modern education and experience in functioning within a modern organisation. His example is that urban co-operatives are more successful than rural co-operatives and successful rural co-operatives tend to be those managed by such persons as school teachers and retired government personnel resident in the villages. Feng (1979) also notes that a farmer's educational background is related to the success of group farming operations in Taiwan.

To be able to work up to their potential, villagers have to be healthy. However, poverty and misconceptions on nutrition and bad eating habits may affect the general state of health evident in a village. If the majority of villagers have health problems of some kind, they will not be able to work effectively and also they will need to spend their time and resources to solve their health problems. Sick and ill-housed people also indicate an inability to deal with problems which in turn reflects on the ability to co-operate.

Since agriculture and labour form the backbone of a village's socio-economic base, the availability of labour in the village may represent village agricultural structure or it may be considered as a human resource to be used for a development project. Kottak (1991) notes that human resources, specifically the availability of people, are critical for the success of community development projects. Therefore, it may be assumed that the better the community human resources in both quality and quantity the better the chance of a project's success.

10) Community modernisation

Chamala (1980) states that due to various environmental, economic, social and political factors, villages in India are at different levels of progress and the level of development of a village itself could be a factor which may influence the adoption and diffusion process. Regarding the successful adoption of a collective project, many researchers believe that the level of development

or degree of modernisation has a negative influence on collective action. For instance, modernisation is usually seen as a force that leads to disintegration of traditional communal systems, since modernisation tends to produce greater economic and social differences among community members (Murray, 1977, Singleton and Taylor, 1992). Murray (1977) notes that while economic modernisation can bring significant advantages to villages in rural areas, it also tends to degrade the quality of community life in equally significant dimensions. In terms of traditional resource management systems, Korten and Klauss (1984) note that almost by definition most “modernisation” efforts tend to erode traditional social groupings and associations. Urbanism, industrialisation and the shift to a cash economy from subsistence agriculture, are forces which may threaten local control.

Modernisation is intended to bring about social and economic changes to rural people and their communities. It can be viewed as a positive force to increase people’s ability to carry forward their development efforts. However, modernisation also broadens their minds, gives them better access to more information, goods and services, and better standard of living and health. On the positive side, modernisation can stimulate people into joint efforts to bring about a better life or development to themselves and their community. The degree of modernisation in communities may also reflect the degree of government and development agency presence in those villages. There is no doubt that modernisation has affected rural communities and their activities. However, the direction and degree of its influences are highly variable.

11) Community institutions and organisations

Community institutions and organisations are major mechanisms that facilitate collective action. Berkes and Farvar (1989) indicate that the effective functioning of communal resource management systems depends on the existence of appropriate institutions. Supported by Ostrom and Gardner (1993), they note that empirical evidence from field and experimental settings demonstrates that without effective institutions, common property resources will be under-provided and overused. With existing institutions and organisations to build upon, a project has a better chance of success. On the contrary, without effective institutional and organisational mechanisms, the community will not

be able to sustain project activities independently (Korten, 1980). Feng (1979) indicates that the existence of well-organised farmer groups in villages is one of the critical factors affecting the success of co-operation projects. Therefore, the existence of effective institutions and/or organisations generally stimulates the success of collective actions and community-based development.

12) Communication and accessibility of the community

In a case where the supply of inputs and market for outputs from a project are located outside the community, accessibility and transportation become critical factors in a project's success. While the proximity and accessibility of a rural community to urban areas offer residents various socio-economic opportunities, such as access to government services, information, migration and mobility, accessibility may also work against co-operation as it may prevent effective participation. As easy access gives people the opportunity to work outside their community either regularly or seasonally, their interest and opportunity to join community activities will decrease. Bardhan (1993b) notes that migration and mobility possibilities work against co-operation. Since the CRM approach aims to be locally independent, then accessibility and transportation may discourage collective actions. However, the better the communication of information, the better the chance of a project's success, since it widens villager's knowledge and world view.

Another viewpoint is that government and development field workers are more likely to visit and work with those communities which have easier access than those far off and difficult to access. This might imply that the easier the access communities have to government services, projects, support, and attention from the government, the better their ability to implement community development projects.

13) Leadership characteristics

Leadership and the development of co-ordination mechanisms are significant aspects of collective action. No matter how participatory a project is, someone must have or be given

sufficient authority to oversee operations. Hence, it is necessary for the group to have persons who have leadership skills to unite and lead them to overcome problems (Pongsirijun, 1992). Strong leaders can get others to contribute labour to a project, make sure a group makes and implements decisions, and also act against *free-riders* and trouble makers (Molnar *et al.*, 1985). Therefore, the qualities of the community leader are another key factor affecting the success of collective action. Correspondingly, no leadership and ill-intentioned leadership represent serious threats to the collective action (Rahim, 1968; West, 1983; and Molnar *et al.*, 1985).

Rahim (1968) found that villages with better educated and forward thinking leaders had the highest success rate with collective irrigation systems. West (1983) suggests that leader(s) at different stages of the collective decision-making and action process may have different characteristics. For example, introducers who initiate or introduce the project idea tended to be younger, better educated, with more external contact than others. Decision makers are the most respected persons and tend to be the oldest among leaders and have the highest social status. Implementers who organise actions tend to fall between the other two types in age and are more locally oriented. Molnar *et al.* (1985) note that community leaders are not necessarily better educated or wealthier than non-leaders, but they are more interested in the wider world, have had prior experience in some form of community organisation, and have a concern for community welfare.

In terms of the adoption of innovations, Rogers (1983) refers to persons having influence over the behavioural change of others as “*opinion leaders*”. He notes the characteristics of opinion leaders that make them different from their followers as: 1) having higher economic status; 2) greater mass media exposure; 3) being more cosmopolite; 4) greater contact with change agents; and 5) being more innovative. Hence, the stronger the leader, the greater the chances of success.

14) Participation in decision-making and project control

One of the major reasons for the failure of development projects in many developing countries has been the lack of involvement of local people and their representatives in the planning

and implementation of development projects (Korten, 1980; Agere, 1982; Rondinelli, 1991; Tacconi and Tisdell, 1992). Tacconi and Tisdell (1992) emphasise that, from the identification of a project to its evaluation, people's participation is an essential factor for success. With participation from the intended beneficiaries, a project can be more appropriately located and designed to fit better local needs, and regulated so users have incentives to spend money and time maintaining the initial investment (Wunsch, 1991). As a result, local participation becomes a general requirement of successful rural development projects. Participation is also very important in collective action as Feng (1979) notes that whether group farming is successful or not depends largely on the degree of member participation in the joint effort. Therefore, the higher the degree of participation by village's members, the greater the chance of project success.

15) Equitable distribution of project costs and benefits

A sense of equity or fair treatment is a necessary condition for the sustained operation of a co-operative venture (Molnar *et al.*, 1985). Hansen and Erbaugh (1987) indicate that equitable distribution of project costs and benefits is essential to collective efforts and this equity should be defined by the project participants. This also includes an appropriate sanction process when someone attempts to extract more than his/her fair share of benefits. Collective projects are likely to be resisted by those who benefit least from existing distributive mechanisms (West, 1983). West (1983) identifies four reasons for large farmers or the power elite in a community to resist collective projects that include the lower strata. First, the elite may be seeking to monopolise external project aid for themselves. Second, they may want to block and control potential competition for markets. Third, they may want to monopolise access to key natural resources and finally, they may want to maintain their status quo or the status stratification system. The equitable distribution of project costs and benefits is also emphasised in many traditional resource management studies as a critical condition for the success of communal resource management (Gadgil and Lyer, 1989; Ostrom, 1990; Singleton and Taylor, 1992; and McKean, 1992).

Another aspect of the distribution of project costs and benefits is a protection and sanction mechanism. If *free-rider(s)* consume public goods that are provided by others, the probability that

other individuals will also break the rules increases and the co-operation will collapse. In this regard, West (1983) concludes that since products of any collective project become collective property, actual successful protection of that collective property becomes a key to long-term success of the project. In traditional local resource management, Ostrom (1990) notes that the system of sanctions is often quite flexible and graduated, depending on the seriousness and context of the offence. Rondinelli (1991) indicates that effective community management depends on developing and using monitoring, evaluation and feedback procedures to ensure efficient operation and maintenance. Hence, the better the distribution of the project cost and benefits, the greater the chance of a project's success.

On the basis of the above discussion, the last part of the comparison model presented in Figure 3-2 can be expanded to include the factors, discussed above, that influence project outcomes. This expansion is presented in Figure 3-3. This model suggests that a village's decision to continue, discontinue, or partially continue the VFP is the outcome of these factors and the constituent variables used to operationalise them.

The majority of these factors (numbers 3 to 12) can be classified or measured as community characteristics. Since community characteristics are present even before a project is started, they precede all of the other factors as the predisposition of the community to succeed or fail. These community characteristics reflect or contribute to the ability of community residents to take collective action when needs or opportunities arise.

In general, some communities are more active and better placed for working together to achieve their collective goal(s) than others, and certain community properties may have particular behavioural consequences (see Duncan and Kreitlow, 1954; Van den Ban, 1960; Gamson and Irons, 1961; Hawley, 1963; and Fliegel, 1969). For example, Kammeyer (1962) finds that a relationship exists between several demographic and ecological variables and the type of decisions made by communities on issues such as fluoridation, school consolidation, or school desegregation. A community needs a certain amount of capacity of skill and resources to be able to perform its collective actions. This capacity is a prerequisite within the community for success and it varies

considerably from one community to another (Korten, 1986). Hence, any given community may not be able to adopt and implement a given development project equally well. One could also expect the successful adoption of a particular project to be distributed according to the variation of community characteristics.

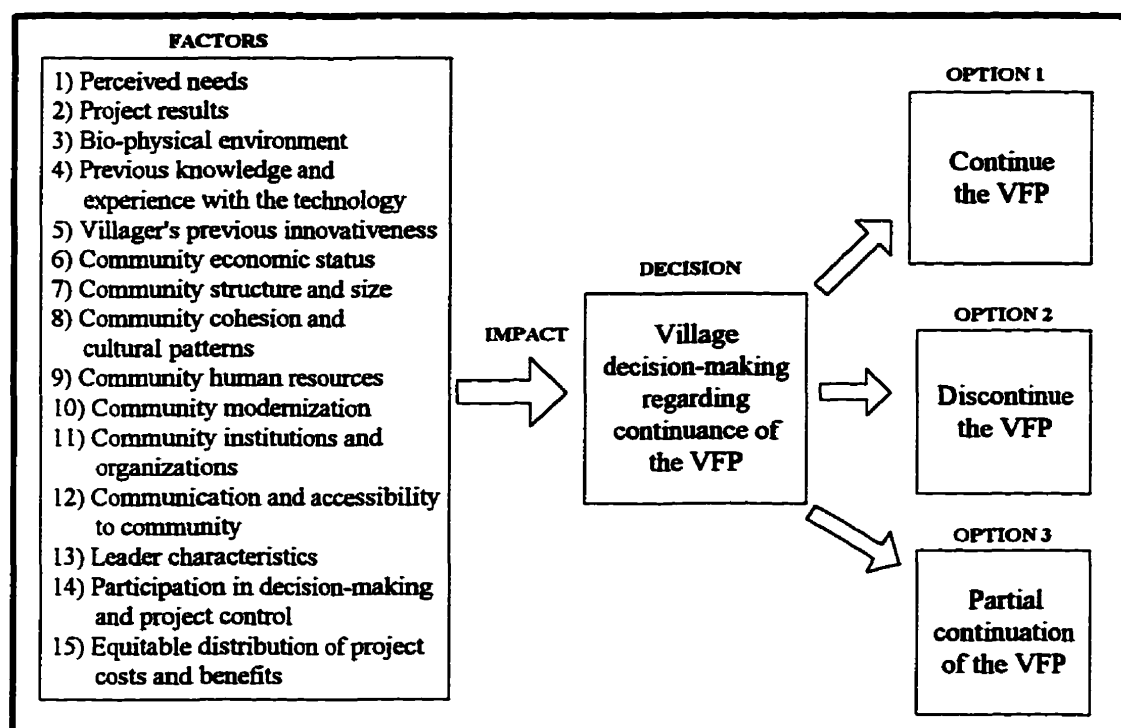


Figure 3-3: Factors Affecting The Success and Failure of The Community-based Development Project

In the case of CRM, Ostrom (1992a) acknowledges the importance of group-level attributes (degree of community) as a major factor influencing the success of common-pool resource management, especially when other variables are held constant. From a comparative study of successful and unsuccessful common-pool resource user-groups, Singleton and Taylor (1992) identify user-group collective capacities as an answer to the question of success and failure of different user-groups. They point out that user-groups possess different degrees of community within their groups which, in turn, affects their collective capacities for governing and managing their own resources.

The concept of using decision-maker characteristics to predict decisions is not new in social research. In fact, adoption models are widely accepted and used for predicting the adoption decisions of potential adopters. Although adoption research focuses more on adopter communication characteristics and behaviour than the ability to adopt innovations, it has demonstrated a close relationship between the adoption or use of innovations and characteristics of the adopter (Ilbery, 1985). For more than two decades, researchers have dealt analytically with specific instances of diffusion and sought to develop models to explain and/or predict the rate of diffusion and identify characteristics of each adopter category (FitzSimons, 1979; Rogers, 1982; Ilbery, 1985). Further, Rogers (1983) indicates that innovativeness-prediction research began in the mid-1950s and by the late 1960s up to about 80 percent of the variance in innovativeness was explained by the use of statistical techniques such as multiple correlation. By using adopter characteristics, as explanatory variables, the adoption model (Figure 3-1) can be analysed to predict likely outcomes of actions of potential adopters. The eventual goal of this research is to predict innovativeness and achieve an improved understanding of the complex interrelationships among the independent variables, acting together, in their association with innovativeness behaviour (Rogers, 1983).

Hence, as the strength of communities varies, one would expect to observe different degrees of performance in terms of their collective action. This explains why some communities are successful in their implementation and sustenance of the VFP, while others are not. Since the major purpose of this study is to develop a model capable of predicting, with an acceptable level of statistical reliability, which villages are more likely to succeed in implementing the VFP and those which are not likely to succeed, especially after DOF support ends, relevant community characteristics are hypothesised and selected as predictor variables in an operationalisation of Figure 3-3. The research design required to operationalise this model is presented in the next Chapter.

3.4 Summary

As CRM usually requires collective decisions and actions from all or the majority of members of a community, this study considers the process of project planning, implementation and

evaluation as a continuing decision-making process by which a whole community acts as a unitary decision maker. The success, failure or intermediacy of a project is linked to the community decision to continue or discontinue project activities. This Chapter has discussed and identified the factors affecting this community decision. Since this thesis aims to develop an empirical model to predict the likely outcomes of a project, community characteristics reflecting the predisposition of a community to succeed or fail in implementing the project were selected as surrogate variables/indicators for predicting project outcomes. In the next Chapter, a methodology is described to develop an empirical predictive model from the conceptual model developed in this Chapter.

CHAPTER IV

RESEARCH DESIGN AND METHODOLOGY

The CRM approach has gained much support and interest recently, but its successful and practical promotion has yet to be fully explored. Since adoption research is commonly directed towards finding means of accelerating the adoption process, Chapter III provided a conceptual framework for predicting likely outcomes of projects at the village level. In Chapter III, the relationship between the village community as an actor and decision maker and community-based development projects were described and factors affecting community decisions regarding continuance of projects were determined. Similar to the innovativeness-prediction model, a conceptual model relating community characteristics and the community decision regarding project continuance was constructed. This Chapter describes the research design and methodology used to develop an empirical predictive model from the model developed in Chapter III and related specifically to the VFP in Thailand. The first section of the Chapter describes the study area and the reasons for its selection. Sampling procedures, data sources, data collection methods, and the analytic procedures used in the thesis are then described. Finally, the contributing factors are operationalised and constituent hypotheses are stated for examination in Chapter V.

4.1 The Study Area

Thailand and its north-east region are described in this Chapter to provide general background information of the study area. Thailand, formally known as Siam by Westerners, is a tropical country located in Southeast Asia covering an area of 514,000 square kilometres. As shown in Figure 4-1, the country occupies a strategic position with its main land-mass adjoining Kampuchea (Cambodia) and the Lao People's Democratic Republic (Laos) to the east, and

Mynmar (Burma) to the west. The peninsula portion of Thailand is flanked by the Gulf of Siam and the Andaman Sea and borders Malaysia to the south. The country is divided into four relatively distinct regions: the fertile central plain, the mountainous north, the north-eastern plateau, and the south peninsula. Its population was estimated to be 60 million in 1996 (from Thai newspaper: ThaiRad, 1996).

In Thailand, like other developing countries, the majority of the population lives in rural areas and their lives depend mainly on agriculture. About 40 percent of the country's total land area is cultivated, and some 29 percent is forest. Rice is the staple cash crop, although its dominance has declined in recent years. Other major crops include maize, sugar, tapioca, rubber, tobacco, bananas, pineapples, and kenaf (Robinson *et al.* 1991). Agriculture not only enables Thailand to be self-sufficient in food, but also makes it one of the world's food-exporting leaders. Although recent national income from the industrial sector has grown rapidly and has become the major share of the GDP, replacing agriculture, agriculture is still considered to be the economic backbone of the country.

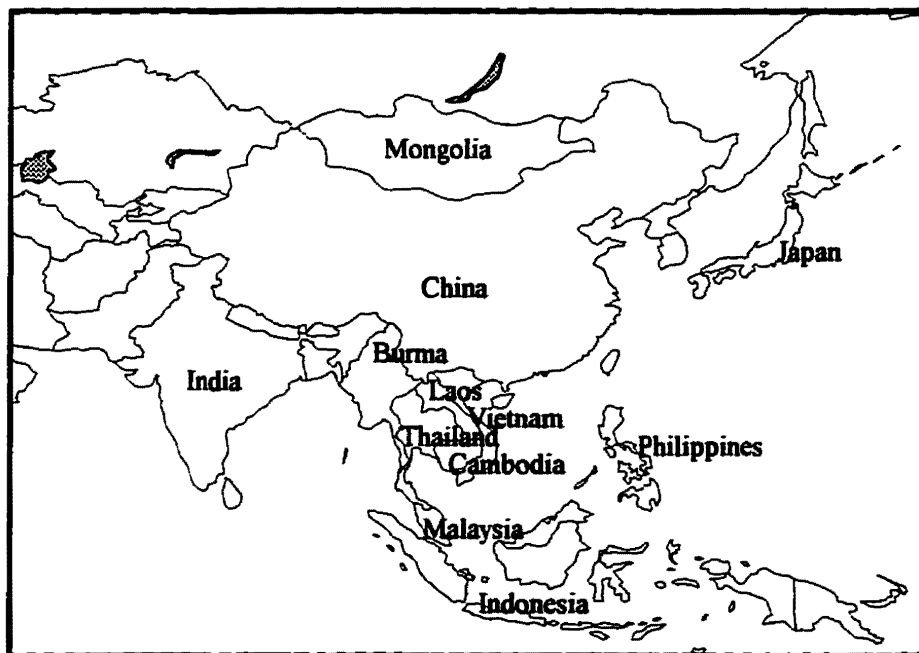


Figure 4-1: Location of Thailand

In order to make the research undertaken in this thesis manageable in terms of available personal, funding, and databases, only the north-east region of Thailand was selected for this study. Such a narrow focus, however, also limits the diversity of cultural and geographical characteristics of the study area. An additional reason for selecting only the north-east region of Thailand is because the VFP project was originally designed and developed there and currently more than 60% of the national VFP projects are located in this region (Chulalongkorn University Social Research Institute, 1988). In order to develop a general overview of the north-east region, this section is devoted to describing some key aspects of the area.

The Northeast encompasses one third of the country's population and land (170,218 square kilometres) and is the poorest region in terms of resources, economic development and personal income. This area is notorious as a difficult cultivating environment for small farmers. Low and erratic rainfall, nutrient-poor soils with low moisture-retention capability, restricted availability of surface water supplies, cultural isolation, poor communications, and general insecurity make existence in the Northeast difficult for rural people. Rambo (1991, 14) describes the north-eastern region of Thailand as follows:

“Located between 14 and 18 degrees north latitude and 100 and 106 degrees east longitude, the Northeastern Region has an area of some 170,000 square kilometres. It is separated from the Central Region of Thailand on the south by a 400-meter elevation mountain range and from the Northern Region to the west by 1300-meter high mountains. The Mekong River marks the boundary with Laos to the north and east. The eastern border with Cambodia follows a broken chain of low hills.”

Seventeen provinces are located in this region (Figure 4-1). Each of the 17 provinces (*Changwat*) is headed by an appointed governor representing the national government. The provinces are subdivided into districts (*Amphoe*) and sub-districts (*Tambol*). The heads of districts, sub-districts and villages (*Moo Bahn*), who are responsible for governing both officials and people, are called “*Nai Amphoe, Khum Nun and Phu Yai Barn*” respectively. Central government agencies are represented at the local level by officers who work within the provincial and district administration. The village headperson or chief is elected by local villagers and subsequently appointed by the governor.

He/she generally serves as the intermediary between villagers and the district administration. The headperson's other duties include attending meetings at the district headquarters, keeping village records, arbitrating minor civil disputes, and serving as the village peace officer. He/she also represents the state at the village level, transmitting and implementing state policy whenever needed. The village headperson also directs personal assistants who occupy various positions and roles in village administration. These people make up what is termed the *Village Committee*. Through such committees, the village becomes a "state" in miniature. Therefore, to some extent, the village can be conceived of as an autonomous society with its own economic and political system, way of thinking, decision making structure, and social system.

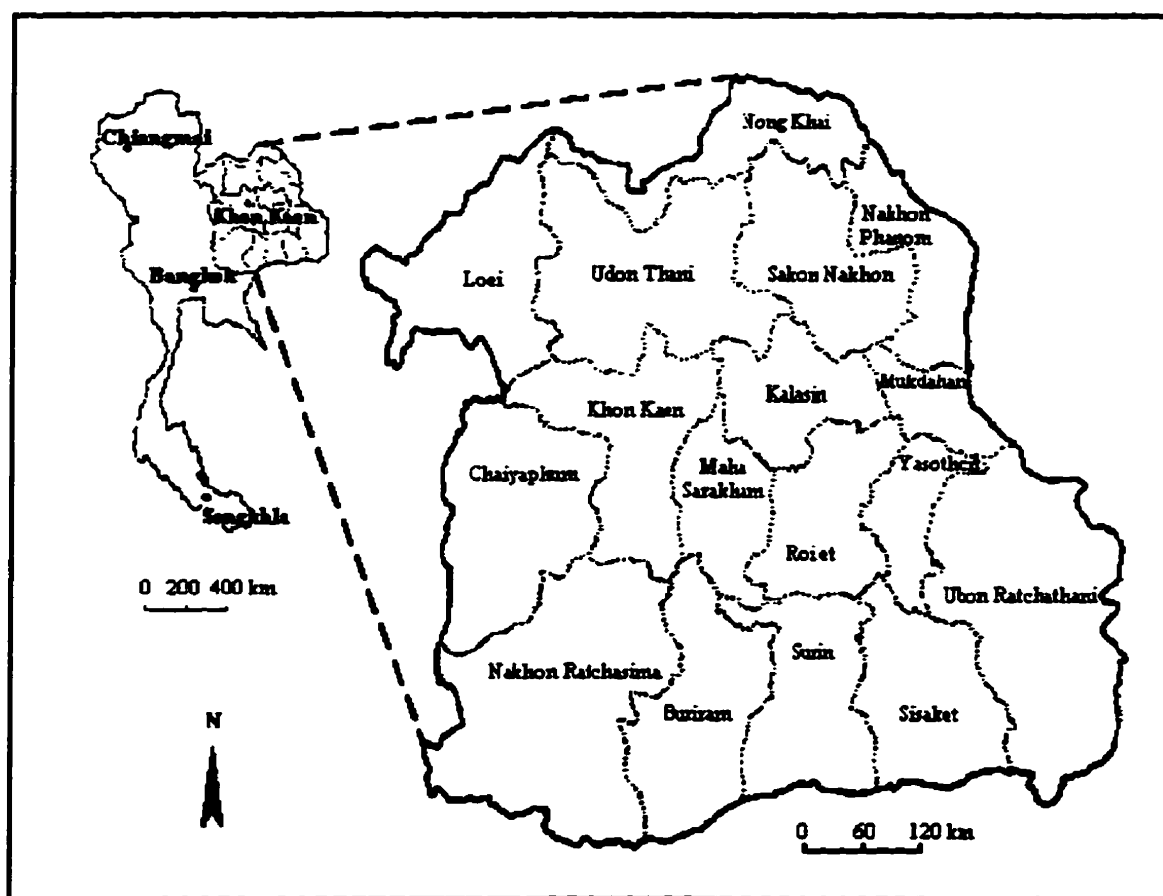


Figure 4-2: The Northeast Provincial Boundaries

Source: Subhadhira *et al.* (1988, 11).

4.1.1 *Population and Economy*

Northeast Thailand's population is approximately one third of the population of the entire country. The Northeast's population growth rate, which presently stands at about 2.68%, is the highest of all regions in Thailand. However, since the introduction of family planning in the early 1970s, the birth rate has slowly declined and family size now averages less than six persons per family (Kachondham *et al.*, 1992). Although rural inhabitants of the region display cultural, social and economic similarities resulting from a traditional rural lifestyle and a shared religious belief in Buddhism, there is, nonetheless, considerable ethnic diversity (Subhadhira *et al.*, 1988). A majority of the region's population belongs to the *Thai-Isan* ethnic group and is concentrated in the central and north-eastern portions of the region. The second largest ethnic group is the *Thai-Korat* and is concentrated in the south-west of the region. Other important ethnic groups include the *Phuthai*, *Khmer*, *Chinese*, *Vietnamese*, *So* and *Kui*.

The population of the Northeast is mainly engaged in productive agriculture. In general, agricultural production may be subdivided into three categories: crop production, livestock production, and forestry/fishery activities. Rice is the most important food crop and is grown on roughly 80 percent of the total cultivated land. Cassava, kenaf and maize are also important cash crops and cover roughly 90 percent of the total upland cropping land. Forestry and fishery activities also contribute to the rural diet and economy. Collection of natural foods from forest lands and paddies, as well as fish production in ponds and paddies, provides an important source of food in many rural areas and also generates cash through sales.

Despite this, approximately 30% of the region's population is living in severe poverty, with income levels rarely surpassing 3,000 *Baht* (Cdn\$ 150.00) per person per year (Rambo, 1991). This amount is only about 42 percent of the national per capita income. Chronic unemployment and under-employment occur and seasonal migration for employment outside the region is a common pattern for many rural households (Subhadhira *et al.*, 1988).

4.1.2 Geophysical Characteristics

The geomorphology of north-east Thailand is termed the “*Korat high plain land*” because it is characterised as a shallow basin or saucer-shaped area slightly downward sloping to the north-east (Donner, 1978). This huge saucer-shaped basin is bounded on the north and the east by the Mekong river, on the south by the *Dong Phya Yen* mountains, and on the west by the *Phetchabun* mountains, which rise to about 1,000 feet above sea level (Figure 4-3). In the central part of the highland of the northern section of the region, the *Phupan* mountain range curves from north-east to south-west at an altitude exceeding 600 meters above sea level. The basin area consists of a flat-topped mountain and dissected peneplain surface characterised by undulating hills at an altitude ranging from 200 to 1,000 meters above sea level. By far the greatest part of the plateau is undulating or flat, and, in general, is very poorly watered. Figure 4-3 shows that the *Mun* and *Chi* rivers together drain about two thirds of the area, while the border provinces along the *Mekong* river are drained by the *Mekong*’s direct tributaries. Subhadhira *et al.* (1988) pointed that only about 20 percent of the Northeast is suitable for irrigation or has potential for large scale water resources development. Hence, the remaining 80 percent of the rural inhabitants in the region must rely on small-scale water sources such as wells, weirs and tanks, and on rainfall.

The soils of the north-east region have a coarse texture, poor structure, low organic matter content, low fertility status and low water holding capacity. As a result, the region’s soils provide lower yields per unit than soils found in other regions of Thailand. Statistics suggest that roughly 12 million rai (1,920,000 ha.) or 11.5 percent of the region’s soils is unsuitable for cultivation of any kind and another 20 percent is recommended to be kept in reserve or used only for grazing (Arbhabharama *et al.*, 1988). Only 40.5 million rai (6,480,000 ha.) or 38.4 percent of the region’s soils is believed suitable for paddy agriculture, while another 30.7 million rai (4,912,000 ha.) or 29 percent can be classified as suitable for upland crop cultivation. Furthermore, soil salinity is also an increasing problem in many areas (TISTR, 1987). According to 1981 estimates, salinity problems affected approximately 17.8 million rai (2,848,000 ha.) and another 19.4 million rai (3,104,000 ha.) were believed likely to face similar problems in the near future (Northeast Development Centre, 1981).

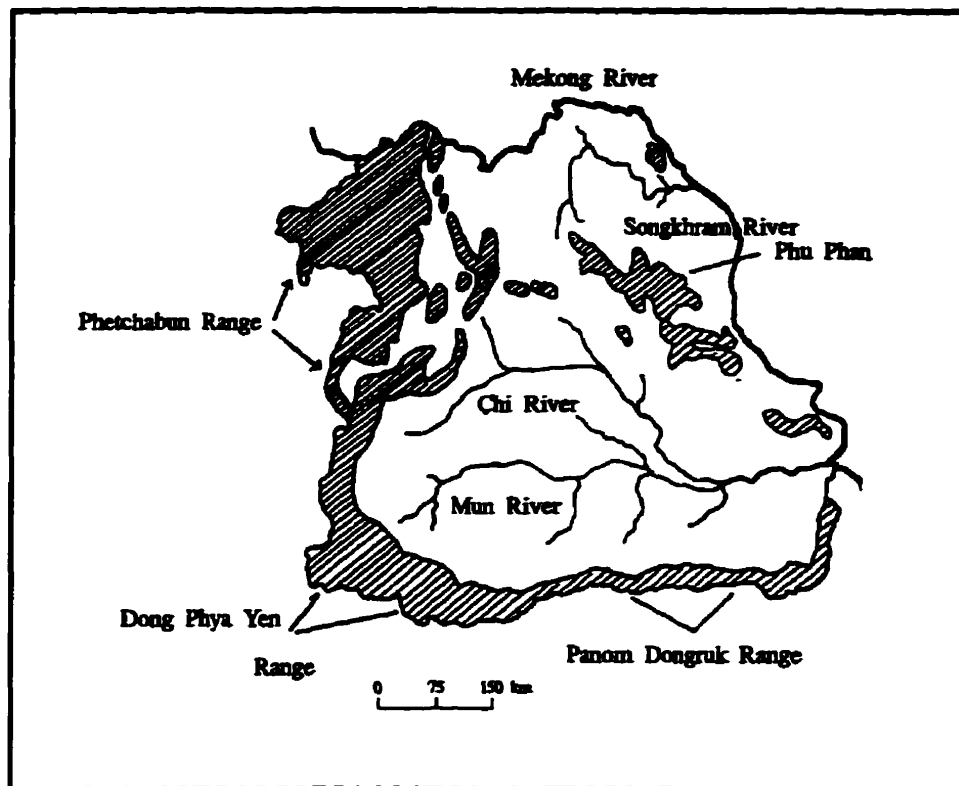


Figure 4-3: Physical Features of Northeast Thailand

Source: Subhadhira et al., (1988, 12).

4.1.3 Climate

In terms of climate, the Northeast is described as semiarid tropical with distinct wet and dry seasons. The average annual precipitation for the region is approximately 1,300 to 1,400 mm with 80 percent received within the 6 month rainy season from mid-April through mid-October (for example see Figure 4-4).

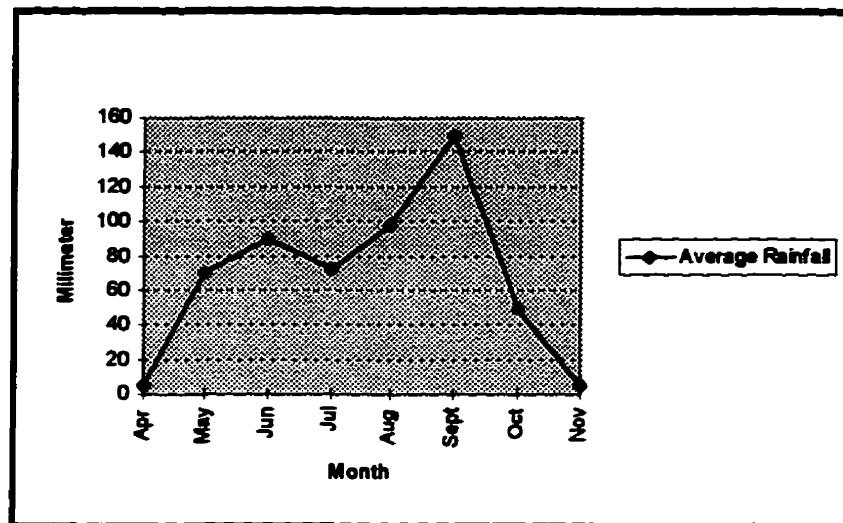


Figure 4-4: Average Rainfall in Khon Kaen Province between 1951-1970

Source: Mongkolsawat *et al.* (1988, 16).

However, the region's geophysical characteristics create special conditions. The western half of the region is substantially drier (1,100 mm/annum) as a consequence of the rain shadow effect from the western mountain ranges. In contrast, annual rainfall in the extreme north-east corner of the region is often 1,800 mm. The actual amount and pattern of rainfall can be extremely erratic and unpredictable however, not only from year to year, but also within the wet season itself (Subhadhira *et al.*, 1988). The average rainfall isohyets of the region are shown in Figure 4-5.

The overall climate is divided into three basic seasons: the cool season (November through February); the dry or hot season (March through May); and the wet season (June through October). Cool season temperatures normally range between 17°C and 31°C. Average dry season temperatures are considerably higher (to mid 30s °C) and sometimes reach as high as 46°C. With the onset of the wet season, temperatures become more bearable (25- 34°C), although the humidity substantially increases.

The mean maximum and minimum temperature recorded at various locations in the region do not vary significantly throughout the year. During the dry season, the mean low temperature in *Loei* province is about 18.9°C, while the highest mean temperature is about 36.5°C, recorded at *Khon Kaen*

province. The lowest mean temperature of the cold season is about 12.9°C in *Loei* province, while 31.1°C is the highest mean temperature recorded in *Surin* province.

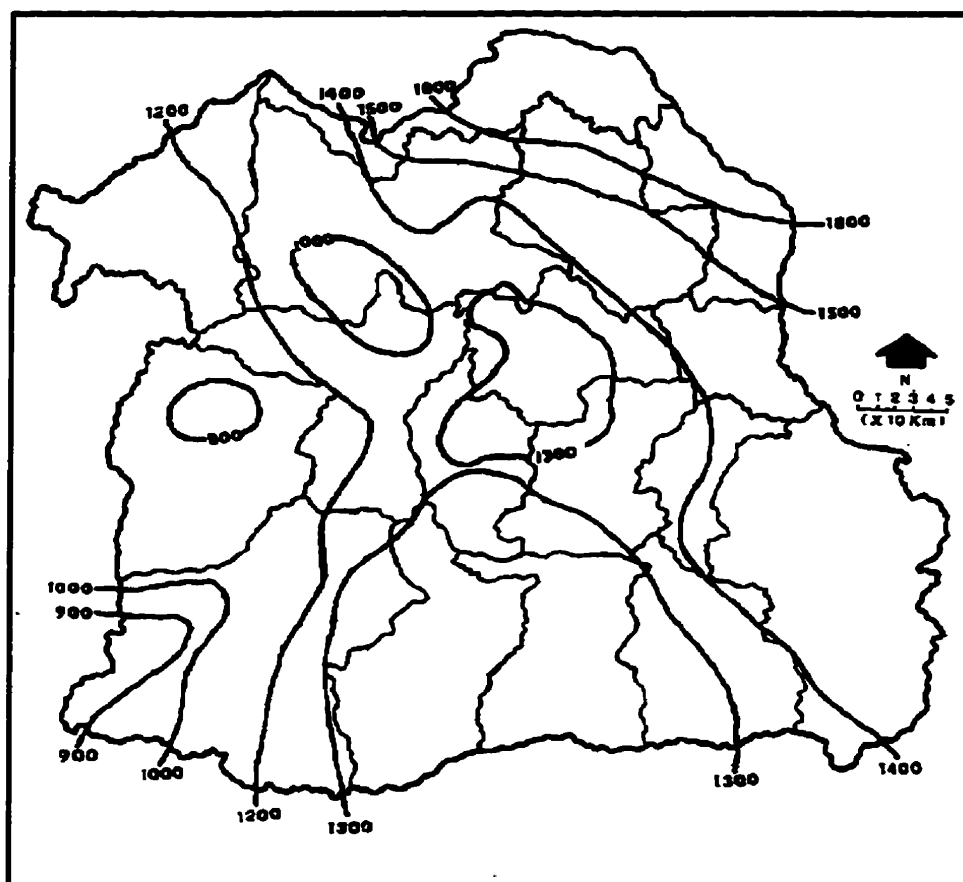


Figure 4-5: Average Rainfall Isohyet (millimetres per year)

Source: Mekhong Committee (1974, 44).

4.1.4 Water Resources

Surface water resources of the Northeast consist of both natural and developed impoundments, rivers of various duration and reliability, ditches, and canals. Many swamps are generally inundated at some time during the rainy season when flooding accommodates extensive migrations of fish. Human-

made impoundments constructed by both government agencies and private sector interests serve to increase water retention for various purposes. This is achieved by the processes of damming, embanking, and excavating.

North-eastern Thai villages were traditionally established with consideration given to the quantity and quality of nearby water supplies. Many are located on the banks of permanent streams, lakes and/or ponds. Phongphit and Hewison (1990) point out that water resources are one of the four main elements considered by individuals when selecting a location to establish a village (the others being location relative to lowlands, location relative to highlands, and proximity to forest resources). They explain that the main reason villagers choose to settle close to a natural water resource is not because of a need for agricultural water, but rather, it is for human and animal consumption and for the provision of food such as fish, crabs, shrimp, plants and vegetables. In general, villagers usually dig wells for drinking water and for community consumption. Similarly, they may also dig a community pond to have more water for animals and for growing vegetables throughout the year.

4.1.5 Fish Culture

As already noted, the majority of the people in north-eastern Thailand suffer from the effects of poverty and malnutrition. However, the cultivation of fish can prove an effective means of combating these. Fish are a cheaper source of animal protein for rural consumption than pork, chicken or beef, but is an insufficient stable resource largely due to seasonal fluctuations. However, the seasonal limitations of natural fish production are slowly being overcome by year-round fish culture production. Aquaculture in north-eastern Thailand began to take root in irrigation areas approximately 10 years ago. The most popular species used for culture are herbivorous species such as the Silver Barb (Puntius gonionotus), Nile Tilapia (Oreochromis niloticus), Common Carp (Cyprinus carpio), Chinese Carp and Rohu. Most of the fish farms in the region are small-scale and produce fish solely for local consumption.

4.1.6 *Infrastructure*

It should be noted that the region's infrastructure has improved considerably in recent decades. Surfaced highways provide links between the provincial capitals and district centres, and the region itself is linked to Bangkok by a major highway as well as by air and rail services. Dirt or gravel roads provide access to almost all villages. Educational and medical infrastructures are also improving, even in the more remote rural areas. It is estimated that roughly 80 percent of the population has completed primary school (Subhadhira *et al.*, 1988). The availability of health services is improving by the establishment of several district hospitals, small health service centres, mobile medical service teams, and local medical care volunteers.

4.1.7 *Natural Vegetation*

As recently as 1939, most of the north-east surface was covered by mature forest with only 6.9 percent of the area under cultivation (Rambo, 1991). However, at present, less than 13 percent of the surface is classified as forest⁹, with much of that already degraded by shifting cultivation and logging.

The natural vegetation of the region is primarily that of a dry *Dipterocarp* forest predominant at lower elevations with dry evergreen and mixed deciduous forest on hillslopes (Rambo, 1991). Scattered in various parts of the region are also areas of grassland. These are generally low-lying areas with very sandy infertile soils. These grassland areas are often flooded in the wet season. These flooded areas yield a rich harvest of fish at the end of the rainy season and offered sparse dry season pasture for cattle. However, both natural forest and grassland are rapidly disappearing components of the north-east landscape as they are converted into cultivated lands.

⁹ In 1987, the north-east forest cover was estimated to be roughly 13 percent (Subhadhira *et al.*, 1988).

4.2 The Sample

The north-east region contains approximately 24,000 villages, of which only 597 received VFPs from the DOF between 1982 and 1992. However, not all of the 597 VFP villages can be used for this study. The number of VFP villages selected were limited for the following reasons.

First, although the VFP was first launched in 1982, village-level data for the Northeast prior to 1986 are not available due to problems in data structure and compatibility of data format. Hence, those VFP villages initiated prior to 1986 cannot be included in the analysis. Second, in order to evaluate how successful villages have implemented and sustained the VFP on their own, there must be sufficient time for a village to operate independently from the DOF before it can be adequately assessed. As indicated in Chapter II, the DOF grants three years of support to every VFP village so that village committee members and villagers have time to acquire skills to take total control of the project. In principle, the VFP should be evaluated after the three years of initial training and the trial stage while it is still under the tutelage of the DOF. After this initial three year period, another two years should be allotted for villagers to get accustomed to being on their own in managing VFP project matters.

Thus, for the purpose of this study, a five year period was established as the time frame during which to evaluate village decisions concerning the VFP. This five year period allows for the three years of DOF support followed by two years of independent project control and management by the community. Although it can be argued that the longer the period of time given after the initial three years the better the evaluation of village actions can be, this study is unfortunately limited by the number of the VFP villages available for the analysis and the overall operating period of the project. Within the scope of the study and given these constraints, a total of 224 villages can be used. If the project's operating period were extended, this number would be further reduced, making the sample too small for any meaningful statistical analysis.

As demonstrated in Table 4-1, only the north-east VFP villages established between 1986 and 1989 were selected for this study. The shaded areas in the table represent the initial three years of operation under DOF support and the diagonal hatching represents the following two years of independent project operations. By establishing this five year project operating period, the village decisions on whether to continue with the project or not can be evaluated and compared, even though the VFP in each village may have been established in different years. It should be noted that this evaluation concerns only the village decisions within this five year period. Whatever happened after that period, such as a decision to discontinue the VFP, is not assessed.

Year	1986	1987	1988	1989	1990	1991	1992	1993
1986								
1987								
1988								
1989								

Table 4-1: The Project Operating Period

The names and locations of the target VFP villages were obtained from DOF headquarters in Bangkok. From Table 4-2, which shows the number of sample VFP villages in each province and in each year, 224 VFP villages were identified as the target population for this study. However, the number of villages used in the statistical analysis is lower than 224, as many constraints were encountered when the field research was carried out.

Only 216 of the 224 VFP villages were surveyed due to time constraints and erroneous village locations. As the target VFP villages are scattered throughout the north-east region, it was necessary to spend considerable amounts of time travelling from one VFP village to another and after arriving it was necessary to find suitable key informants to interview. Hence, when the village could not be located from the information supplied by the DOF, there was no time to find the correct location and return for interviews.

Province	1986	1987	1988	1989	Total
1.Kalasin	5	7	3	4	19
2.Khon Kaen	4	3	4	4	15
3.Chaiyaphum	2	3	3	3	11
4.Yasothon	4	3	3	3	13
5.Nakhon Phanom	2	3	3	3	11
6.Nakhon Ratchasima	6	4	3	3	16
7.Buriram	6	3	3	4	16
8.Maha Sarakham	4	3	3	1	11
9.Roi Et	3	4	3	3	13
10.Loei	1	1	2	2	6
11.Sisaket	4	3	2	5	14
12.Sakon Nakhon	3	2	2	2	9
13.Surin	6	5	3	4	18
14.Nong Khai	3	3	3	2	11
15.Udon Thani	4	3	4	3	14
16.Ubon Ratchathani	2	3	3	5	13
17.Mukdahan	4	3	3	4	14
Total	63	56	50	55	224

Table 4-2: Number of VFP Villages in the Northeast (1986-89)

Another problem encountered in the field involved 9 villages that were mismatched with the village-level database. Additionally, 2 villages were excluded because one village rented the village fish pond to an individual for personal use and another village pond had been modified by another development programme. The final number produced a sample of 205 VFP villages as shown in Table 4-3. These 205 VFP villages cover a period of four years of project operation from 1986 to 1989.

	1986	1987	1988	1989	SUM
1. Village Profiles corrected (<i>Kor Chor Chor 2 Khor</i>)	23215		24174		
2. Number of VFP villages	63	56	50	55	224
3. Number of surveyed VFP villages	62	53	50	51	216
4. Number of the sample VFP villages	59	51	45	50	205

Table 4-3: Number of the Sample VFP Villages Used for the Study

4.3 Sources of Data

As stated in Chapter I, the main objective of this study is to develop a model to predict the known outcomes of VFP activities and to establish the relative importance of community characteristics in determining the outcomes of the VFP in north-east Thailand. One of the preconditions of such a model is the need for a complete village-level database for all VFP villages before the VFP began. The most comprehensive village-level database available for this study is the *Kor Chor Chor 2 Khor* survey (the village-level database described in Chapter II). As this is collected every two years, it is the only existing village-level database that contains data collected before the VFP was launched in each village. The village-level data were obtained from the *Institute for the Processing of Information for Education and Development* (IPIED) and not directly from the villages themselves, hence they are classified as secondary data.

This study also required an up-to-date source of information on VFP activities in target villages in order to evaluate village decisions regarding the project. As already mentioned, approximately 30% of participant villages abandoned the VFP after it had been established. It was therefore necessary to obtain information about project activities and results in each targeted VFP village in order to assess individual village decisions and the status of the VFP. Since these up-to-date data could only be obtained directly from each VFP village by means of a questionnaire, they are considered here as primary data.

4.3.1 Primary Data

A questionnaire (see Appendix I) instrument was designed to collect data from both a key informant from each village and from interviewer observations. It is divided into three sections. In the first section, the interviewer was required to observe the fish pond and discuss its bio-physical conditions with the key informant in order to answer questions one to eight. The discussion of pond conditions led to questions nine and ten concerning fish culture in the pond. Through

observation and discussion, the interviewer was required to complete the questionnaire with accuracy and to make conclusions on the adequacy of the pond for fish culture, and, in the third section, to comment on the current status of fish culture. The second section is the most important part of the questionnaire. In particular, questions four and nine are the focus of the survey. The other questions were intended to get general information concerning people's attitudes toward their project and other fish culture within the community. In question four, the key informant determined the status of the VFP, whether the village had decided to abandon the VFP, and, if so, when that decision took place, and why the decision was made. Question nine contains a timetable of the essential activities of communal fish culture. From this table, activities of fish stocking, harvesting and the income gained from the pond could be determined for each year during the study period. Information from the questionnaire was used to measure the status and performance of the VFP in each village in order to classify villages according to the success, failure or indeterminate outcome of the project.

After a list of target VFP villages, and their location, identified by the criteria discussed in Section 4.2 were obtained, the questionnaire was administered during several field visits by the author and six assistants between August and December 1993. The questionnaire was originally prepared in English and then translated into Thai (Appendix I). Pre-testing of the questionnaire was carried out twice in Nakon Ratchasima province to check whether it was adequate to elicit the required responses and whether it could be suitably applied to the prevailing situation in the study area. After completion of the pre-testing phase, several questions were modified to improve clarity and the ease of understanding for the subjects.

The questionnaire was designed to obtain information specific to VFP activities and results. The village headperson, a village committee member, or a head of a household living near the pond and participating in the VFP, qualified as key informants for the village interview. The first task of the field interviewer was to identify one of the key informants, because only one of them needed to be interviewed to obtain a village-specific response. The village headperson or a village committee member was favoured, as they held positions of authority in the village. He or she was requested to recall to the best of her/his knowledge the nature of VFP activities and results

over the years that the project had been in operation. Information from the questionnaire was then used to determine the performance of the VFP in each of the participating villages.

4.3.2 Secondary Data

Data on community characteristics were drawn only from the 1986 and 1989 national village-level database. As indicated earlier, village-level data for the north-eastern villages were obtained from the *Institute for the Processing of Information for Education and Development (IPIED)* at Thammasat University in Bangkok. The *Kor Chor Chor 2 Khor* questionnaire consists of approximately 500 variables. However, a subset of the village variables was purposively selected for analysis in this study. The selected variables and their standardisation are discussed in the next section.

Since the village profiles are gathered and processed by other organisations for other purposes, they have several limitations, as is the case with any secondary data. First, since the village-level database contains data for two year intervals, each data set represents two sets of VFP villages within that data collection interval. In the absence of alternative sources of data, the 1986 data set was used to derive characteristics for 1986 and 1987 VFP villages, and the 1988 data set was used for 1988 and 1989 VFP villages. Implicit within these data is the assumption that village characteristics, as detailed in the village profile, do not change significantly over a two year interval. Second, as it is not possible to assess the accuracy and reliability of the village-level data used in this study, it has to be assumed that the data are of an acceptable standard to predict the success, failure or indeterminate outcome of VFPs in sample villages. Researchers who have used the village profile for some time have provided assurances that these data are deemed to be acceptable in terms of accuracy and reliability, especially with regard to common statistical variables such as those related to the number of households and economic variables indicating the economic status of the village (personal comments from Miss Abha Sirivongd na Ayudhaya, researcher of Chulalongkorn University Social Research Institute on September 30, 1993 and from Dr. Suriya Smutkupt, Professor of Khon Kaen University, on December 20, 1993). Third, use of the existing database imposes a limit on the type and number of variables available for the

analysis. There are a number of community variables, such as the ethnic composition of a village or bio-physical data related to the village fish pond, which would be desirable to incorporate into the study, but for which no data presently exist in Thailand.

As discussed in the previous Chapter, the ecological conditions of rural communities and the fish ponds affect yield potential which in turn affects the decision to continue or discontinue the project. Hence, this study omits several possibly major factors influencing project outcomes by excluding many bio-physical variables, especially those variables that indicate the ecological conditions of the fish pond. There are three reasons for excluding these variables. First, no bio-physical data were collected before the VFP was initiated in the sample villages, and the bio-physical data collected in the questionnaire cannot be used for prediction since they were collected long after the project was implemented. Second, since one of the major elements of the VFP involves pond rehabilitation or construction, the ecological conditions of ponds might be altered so much that the bio-physical data prior to the rehabilitation/construction are invalidated. Third, information related to fish production should be collected and analysed in a technical feasibility study carried by the DOF officers, since the predictive models discussed in this thesis are intended to assist planners in the project approval process, but not to replace other procedures that are already in place.

4.4 Statistical Methodology

Since the major purpose of this study is to develop a model to predict which villages are likely to succeed in implementing the VFP and which might not succeed, especially after DOF support ends, the VFP villages had to be grouped into homogeneous categories according to project outcomes. The project outcomes may be classified as complete success, complete failure or indeterminate outcomes (as discussed in Chapter III). Thus, the dependent variable of this study is a qualitative measure of the outcomes of the VFP in which a value (such as 0, 1 or 2) is assigned to each outcome. With three classes of possible outcomes coded into discrete values, the multinominal logit model is an appropriate statistical technique with which to predict outcomes.

However, if it is desired not to include all three classes in any single model run, a dichotomous variable with two classes can be created from the three possibilities. Pagoulatos (1987) indicates that, under these circumstances, the most commonly used qualitative response model is the Logit model, which allows an investigation of the effects of explanatory variables on dichotomous dependent variables (also see Kleinbaum, 1994). An advantage of using a Logistic model is that it is not only designed to operate with a dichotomous dependent variable that is derived from qualitative data. Further, the model also allows for the independent variables to be continuous or categorical. The Logistic model determines which factors are associated with an outcome and allows estimation of a multivariate statistical model to predict outcomes. Thus, Logistic Regression Analysis (LRA) was selected for use in this thesis.

4.4.1 *The Logistic Model*

LRA is a multivariate technique used for estimating the probability of an event occurring. Kleinbaum (1994) describes LRA as a mathematical modelling approach that can be used to describe the relationship of several independent variables to a dichotomous or discrete dependent variable. In LRA, the probability of an event occurring can be directly estimated as:

$$\text{Prob(event)} = \frac{1}{1+e^{-z}} , \quad \text{Equation 4.1}$$

where z is the linear combination:

$$Z = B_0 + B_1X_1 + B_2X_2 + \dots + B_pX_p ; \quad \text{Equation 4.2}$$

where B_0 to B_p are coefficients estimated from the data; X_1 to X_p are the independent variables; and e is the base of the natural logarithm, approximately 2.718¹⁰ (SPSS, 1993).

Wrigley (1976) explains that predictions from the logit model can take any values in the range $-\infty$ to $+\infty$, but the predicted probabilities found by substituting B_0 to B_p into the model are

¹⁰ The American Heritage Dictionary (Morris, 1981) indicates that “natural logarithm” or “Naperian logarithm” is a logarithm to the base e which is equal to 2.71828... as it was invented by John Napier.

confined to the range 0 to 1. Given Z values that can range from $-\infty$ to $+\infty$, the model shows that the estimated probability or predicted dependent values will always be between 0 and 1 regardless of the value of Z :

$$\text{when } z \text{ is } -\infty, \text{ then} \quad \text{Prob(event)} = \frac{1}{1+e^{-(-\infty)}} = \frac{1}{1+e^{\infty}} = 0; \quad \text{Equation 4.3}$$

$$\text{and when } z \text{ is } +\infty, \text{ then} \quad \text{Prob(event)} = \frac{1}{1+e^{-(+\infty)}} = \frac{1}{1+e^{-\infty}} = 1. \quad \text{Equation 4.4}$$

The conceptual model developed in Chapter III, can then be substituted into the logistic regression model framework where y is the probability of an event occurring or an outcome of the VFP, and X_1 to X_p are community characteristics used to predict project outcomes¹¹. The probability of an event occurring that is a complete success is equal to “1”, a complete failure is equal to “zero” and indeterminate outcomes fall in the range between these polar extremes. Clearly, the closer an outcome probability is to 1 the greater the chance of success and the closer to 0 the greater the chance of failure. By using known (observed) independent variables (X_1 to X_p) and a dependent variable (0 or 1), the terms B_0 to B_p , which are unknown parameters, can be estimated. The model, with its estimated parameters B_0 to B_p , can be used on the observed independent variables (X_1 to X_p) from another group of observations (e.g. villages in other areas) and the probability of an event occurring on the dependent variable can be obtained (predicted) from the model.

In order to estimate the unknown parameters B_0 to B_p , a mathematical method is needed and since the LRA model is non-linear, the *least-squares method*¹², which is commonly used for estimating the parameters in linear models, is no longer appropriate (SPSS, 1993; Everitt, 1994;

¹¹ The discussion in Chapter III suggests that the influence of several independent variables can influence the values of a dependent variable according to the general function $y = f(x_i)$, where y represents the outcomes of induced adoption of the communal resource management project (the VFP), and x_i represents various combinations of the independent or predictor variables which characterise villages.

¹² The least-squares method selects regression coefficients that result in the smallest sums of squared deviations between the observed and the predicted values of the dependent variable (SPSS Inc., 1993).

and Kleinbaum, 1994). Kleinbaum (1994) indicates that *Maximum Likelihood Estimation* is the preferred estimation method for LRA, as it can be applied in the estimation of complex non-linear as well as linear models. Wrigley (1985, 35) explains the logic of the maximum likelihood procedure as follows:

“First, we derive an expression for the likelihood of observing the pattern of response category choices in our data set. Second, we note that the value of this expression depends upon a number of unknown parameters (B_0 to B_p , etc.) which we wish to estimate. Third, we take as our estimates those values of the parameters which maximise the likelihood of the observed pattern of responses. Given that the response category choices are viewed as independent drawings from a binomial distribution, the likelihood of obtaining the particular sample of response category choices which we observe in our data set is simply the joint probability of occurrence of the observed choices.”

In general, the maximum likelihood method requires an iterative solution algorithm for parameter estimation (SPSS, 1993; and Kleinbaum, 1994). A likelihood function is calculated and maximised to obtain the maximum likelihood solutions. The results reported in this thesis were obtained using the LRA routine contained in SPSS for Windows Version 6.1. The results are presented and discussed in the following Chapters.

Another aspect of operational model building is that, conceivably, a large number of independent variables can have varying degrees of influence on the dependent variable. Hence, it is necessary to isolate or identify a subset of available predictor variables that will yield an accurate prediction with as few terms as possible (Kleinbaum, 1994 and Gilbert, 1993). A simpler model has several advantages in this respect, such as an ease of interpretation and variable acquisition (SPSS, 1993 and Everitt, 1994). Everitt (1994) indicates that if a small number of predictor variables produce a model which fits the data only marginally worse than a larger set, then a more parsimonious description of the data results. Since a relatively large number of independent variables are available for this study, only variables that are a priori expected to be good predictors of the dependent variable and that operationalise as many of the factors in Figure 3-3 as possible are required to build the model. The selection of these variables is guided by the conceptualisation of the CRM approach and village level development projects presented in Chapter III.

There are three common methods for identifying important subsets of predictor variables. These include *forward selection*, *backward elimination* and a combination of both, known as *stepwise regression* (Everitt, 1994). The forward selection procedure begins with no predictor variables in the model and sequentially adds one variable according to some optimality criterion, such as satisfying a statistical significance test to enter. Once a variable is included in the model it will remain throughout the process. This may become a disadvantage to the model, since it does not eliminate variables which can become non-significant after other variables have been added (Jobson, 1991). Jobson (1991) points out another disadvantage of the forward selection procedure is that since some variables never get in, their impact on the coefficients of the model is never determined. The backward elimination method is, in a sense, the opposite of the forward selection procedure. Backward elimination begins with all variables in the model, and, at each step, variables are evaluated for removal, normally according to statistical criteria (SPSS, 1993).

The SPSS programme offers *stepwise regression* and *backward elimination* methods for automated model building in its LRA routine. In this study, the backward elimination procedure was selected in order to give all selected variables a chance to be evaluated in terms of their importance in predicting the dependent variable¹³. By using the *change in likelihood* (or the *Likelihood-Ratio test*) as a statistical significance test for assessing whether a variable should be removed from an existing model during backward elimination, a satisfactory predictive model may be obtained. This likelihood-ratio (LR) test is the most appropriate method for inclusion/exclusion determination as it requires the model to be re-estimated without each of the variables. The change in likelihood tests for the null hypothesis that the coefficients of the terms removed are not significantly different from zero is obtained by dividing the likelihood for the *reduced model* by the likelihood for the *full model* (SPSS, 1993). The likelihood-ratio (LR) test involves estimating the model with each variable eliminated in turn and inspecting the change in the log likelihood value when each variable is deleted (removed). Kleinbaum (1994, 131) explains that:

¹³ Jobson (1991, 264) indicates that the advantage of the backward elimination method over the forward selection method is that the backward method permits the user to see the impact of all the variables simultaneously.

"In general, the likelihood ratio statistic, like an F statistic in classical multiple linear regression, requires the identification of two models to be compared, one of which is a special case of the other. The larger model is sometimes called the full model and the smaller model is sometimes called the reduced model; that is, the reduced model is obtained by setting certain parameters in the full model equal to zero. The set of parameters in the full model that is set equal to zero specify the null hypothesis being tested. Correspondingly, the degrees of freedom for the likelihood ratio test are equal to the number of parameters in the larger model that must be set equal to zero to obtain the smaller model."

In order to test the null hypothesis that the coefficient of the term is not significantly different from zero, the log likelihood significance level of each variable in the model is calculated and compared to the cut-off value (by default 0.1). If the observed significance level does not allow the null hypotheses to be rejected with reasonable confidence, the term is removed from the model. The process continues until no variables meet removal criteria. As a result, only predictive (independent) variables with a significance of Log LR greater than 0.1 (reject the null hypothesis that the coefficient of the term is not significantly different from zero) remain in the model. Since the removal criterion was set at 0.1, it can be concluded with at least 90% confidence that each independent variables included in the resulting model is relevant. In fact most variables were statistically significant at the 95% confidence level. That is, there is only a .05 or 5% chance of making an erroneous decision on variable retention and this is acceptable according to statistical norms.

Furthermore, *Model Chi-Square*, which is the difference between -2 time the log of the likelihood (-2LL) for the model with only a constant and -2LL for the current model, is also provided by the programme. The model chi-square statistic tests the null hypothesis that the coefficients for all of the terms in the current model, except the constant, are equal to 0 (SPSS, 1993). Hence, by considering all of the independent variables in the resulting model together, the relevance of the model can be assessed by the model chi-square test which was set at 95% confidence level for this study.

In addition to the above statistical tests, a further model validation procedure was applied. There is no assurance that a resulting model might fit other groups of samples equally well, even

though the model is selected to fit a particular sample (a sample that the model was constructed from). Finley (1968) notes that a predictive model may be accurate and efficient for the sample from which it is derived and for time and space dimensions within which it is constructed, but its predictive power on samples (cases) other than the original one needs to be determined before it can be used. Thus, the model needs to be validated to assess its accuracy and efficiency across samples other than the original one. Within the limitation of the available VFP samples, some of the sample VFP villages were selected to be used for model validation, as described in the following Chapter.

By using the statistical tests provided by SPSS and the model validation procedure, the resulting models should be reliable within an acceptable level of error.

4.4.2 Dependent Variable

To build the predictive model the values of the dependent variable must first be determined. Subsequently, the next step of the model building process is to determine the outcome (success, failure or indeterminate) values for the VFP in each village. The questionnaire administered to key informants in the sample VFP villages provided the source of data for measurement of the dependent variable. Information from the questionnaire was used in conjunction with operational criteria to determine the outcomes of the VFP in the sample VFP villages. This procedure is described in Chapter V.

4.4.3 Independent Variables

Although fifteen factors affecting the project outcomes were determined in Chapter III, it was recognised that only some of these factors (factors number 3 to 13 in Figure 3-3) could be operationalised in the predictive model. Only factors that existed prior to the beginning of the project, were selected for inclusion. The majority of these factors (numbers 3 to 12) can be

measured as community characteristics. Hence, in order to operationalise these factors affecting project outcomes, the independent variables (X_1 to X_p) are selected from the village profile or the village-level database, discussed in Chapter II.

Some of the 519 variables in the village profile inevitably measure very similar things. For instance, four variables are related to roofing material on houses in the village. In such cases, it is appropriate to select only one of these variables. However, in other instances it may be appropriate to include a number of variables that measure one important factor, even though they may be highly correlated. This would be done either because the variables capture a slightly different aspect of the community under study or because that characteristic is regarded as particularly important. For instance, the variable representing the number of households in the village is highly correlated with many other variables (Appendix II), yet it was felt that it should be included. Since, even though they are highly correlated, they represent a different factor affecting project outcomes determined in Chapter III.

From the 519 variables in the village-level database, 38 (shown in Table 4-4 and also Appendix III) were selected to represent the factors affecting project outcomes. Each of these predictor variables is logically derived from one of the factors affecting the project outcomes discussed in Chapter III; section 3.3. Following a statement of the measure for each of the independent variables selected to represent the factors affecting the project outcomes, the nature of their expected effect on outcome is hypothesised.

1) Bio-physical environment

This factor is operationalised as the degree of favourable agricultural conditions resulting from a village bio-physical environment. The following variables were selected as indicators of the bio-physical environment: WELL (the number of tubewells and shallow wells) represents the availability of water in the village; RICE_PROD (average rice yield) represents the soil fertility measured as rice production per unit (Kg./rai); DRY_AGR (number of households farming in the dry season) indicates the availability of water for agriculture, specifically in the dry season;

SOIL_QUAL1 (agricultural land use) measures land prosperity (categorised as “0”, or poor, when only 50% or less of village land was used for agriculture, and “1”, or good, when 75% or more of the land was used for agriculture); **SOIL_QUIL2** (soil problems) indicates the soil problems perceived by villagers (categorised as “0” when there are no problems and “1” when the soil has salinity, acidity or sandy problems); and **AREA** (total village area) measures the primary resource (land) available in the village. Based on the observations from the literature it is hypothesised that success of the VFP is significantly related to community bio-physical environment factors:

- 1.1 VFP success is positively related to the number of wells in a village (WELL);*
- 1.2 VFP success is positively related to the average rice yield (RICE_PROD);*
- 1.3 VFP success is positively related to the number of households farming in the dry season (DRY_AGR);*
- 1.4 VFP success is positively related to the amount of land used for agriculture (SOIL_QUAL1);*
- 1.5 VFP success is negatively related to the village's soil problems (SOIL_QUIL2); and*
- 1.6 VFP success is positively related to the total village area (AREA).*

2) Previous experience with the specific technology

Since the VFP is a fisheries project, previous experience with fisheries technology is operationalised as the extent to which a community possesses knowledge of aquaculture and fishing techniques. There are two variables indicating community possession of aquaculture and fishing knowledge: **FRE_FISHER** (number of households practising fresh-water fishery) indicates the fishing knowledge; and **FRE_RAISER** (number of households pursuing fish culture) indicates aquaculture knowledge. As noted in Chapter III, local skills and knowledge are required if villagers are expected to manage a project independently and successfully. The assumption is that the higher the number of households practising fresh-water fishery and the number of households pursuing fish culture, the more expertise in fishing (**FRE_FISHER**) and fish culture (**FRE_RAISER**) the village possesses, and consequently the higher the likelihood that the VFP will be successful. Thus, the operational hypotheses are:

- 2.1 Success of the VFP is positively related to the number of households practising fresh-water fishery (FRE_FISHER); and*
- 2.2 Success of the VFP is positively related to the number of households pursuing fish culture (FRE_RAISER).*

3) Villager's previous innovativeness

The previous innovativeness of a village can be operationally measured by four variables: LATRINE1 (number of households with a toilet); FERTILIZ (number of households using fertiliser in agriculture); AGRTOOL3 (number of households with a small tractor); and GEN_HEALTH1 (percentage of 15-44 year old couples using birth control services). Based on expectations from the literature for this class of variables, discussed in Chapter III, it is hypothesised that:

- 3.1 The higher the number of households with a toilet (LATRINE1) the higher the likelihood of success of the VFP;*
- 3.2 The higher the number of households using fertiliser in agriculture (FERTILIZ) the higher the likelihood of success of the VFP;*
- 3.3 The higher the number of households with a small tractor (AGRTOOL3) the higher the likelihood of success of the VFP; and*
- 3.4 The higher the percentage of 15-44 year old couples using birth control services (GEN_HEALTH1) the higher the likelihood of success of the VFP;*

4) Community socio-economic status

Community socio-economic status is operationalised as the extent to which villagers possess specific economic resources. The following variables are postulated as the indicators of community socio-economic status: MILL (total number of rice mills) indicates the production capacity of a village; SHOP (number of stores) reflects the consumption of villagers; ROOF2 (number of households with a tin roof) indicates the general economic status of village members;

and INDUSTRY1 (number of households pursuing the most common industry) is a measurement of the diversification of the agriculture and additional sources of household income. In accordance with the factors affecting project outcomes as discussed in Chapter III, it is hypothesised that success of the VFP is:

- 4.1 positively related to the total number of rice mills (MILL);*
- 4.2 positively related to the number of stores (SHOP);*
- 4.3 positively related to the number of households with a tin roof (ROOF2); and*
- 4.4 positively related to the number of households pursuing the most common industry (INDUSTRY1).*

5) Community structure and size

Community structure and size are consistently identified as factors affecting the success or failure of community development projects. However, community structure is very difficult to operationalise in quantitative terms. Land holdings and the number of village members' occupations are only two variables in the village-level database that can be related to the community structure. Hence, this dimension of influence on project outcomes is operationalised by these variables: LAND1 (number of households who have enough land for farming) indicating the degree of land disparity in the village which may, in turn, reflect the disparity of power in the village; AGJOB (number of households pursuing only agriculture) indicating primary occupations of village members; and HH (total number of households) was select to represents the village size. Based on the literature it is hypothesised that:

- 5.1 Success of the VFP is positively related to the number of households who have enough land for farming (LAND1);*
- 5.2 Success of the VFP is positively related to the number of households pursuing only agriculture (AGJOB); and*
- 5.3 Success of the VFP is negatively related to the total number of households (HH).*

Factors Affecting Communal Project Success	Community Characteristics
Bio-physical environment	Number of Tubewells and Shallow wells (WELL)
	Average rice yield (RICE_PROD)
	Number of households farming in the dry season (DRY_AGR)
	Agricultural land use (SOIL_QUAL1)
	Soil problems (SOIL_QUAL2)
	Total village area (AREA)
Previous experience with the specific technology	Number of households practising fresh water fishery (FRE_FISHER)
	Number of households pursuing fish culture (FRE_RAISER)
Villager's previous innovativeness	Number of households with toilet (LATRINE1)
	Number of households using fertiliser in agriculture (FERTILIZ)
	Number of households with small tractor (AGRT00L3)
	Percentage of 15-44 year old couples using birth control services (GEN_HEALTH1)
Community economic status	Total number of rice mills (MILL)
	Number of stores (SHOP)
	Number of households with a tin roof (ROOF2)
	Number of households pursuing the most common industry (INDUSTRY1)
Community structure and its size	Number of households who have enough land for farming (LAND1)
	Number of households pursuing only agriculture (AGJOB)
	Total number of households (HH)
Community human resources	Number of households whose members work as labour for hire (LABOUR)
	Number of 14-50 years old illiterate persons (SCHOOLING)
	Percentage of houses in good sanitary condition (GEN_HEALTH2)
	Number of 1 day to 5 years old children suffering malnutrition level 2 (STARV2)
Community modernisation	Number of village services (VILL_SERV)
	Number of households with electricity (ELECTRIC)
	Types of agricultural credit used (AGCREDIT)
	Types of health facilities (GEN_HEALTH3)
	Average number of household members (MEMBERS)
Community cohesion	Area of community grazing land (PUB_FIELD2)
	Total number of community cultural activities (ACTIVITY1)
	Total number of community sport activities (ACTIVITY2)
	Number of disputes and crimes reported (LAW)
	Property tax (PTAX)
Communication and accessibility to community	Number of households whose members work outside the sub-district (WORK_FORCE)
	Number of training courses held (TRAINING)
	Public transportation to the district town (YES_ROAD1)
	Number of households with motorcycles (VEHICLE2)
	Number of TV sets (TV)

Table 4-4: Operational Variables for Factors Associated with VFP Outcomes

6) Community human resources

Community human resources are operationalised in terms of general village health status, educational level and ability of village members, as well as the availability of labour. These variables are measured by: GEN_HEALTH2 (percentage of houses in good sanitary condition); STARV2 (the number of 1 day to 5 year-old children suffering malnutrition level 2), LABOUR (the number of households whose members work as labour for hire); and SCHOOLING (the number of 14-50 year-old illiterate persons). For this class of variables it is hypothesised that success of the VFP is:

6.1 positively related to the percentage of houses in good sanitary condition in a village (GEN_HEALTH2);

6.2 negatively related to the number of 1 day to 5 year-old children suffering malnutrition level 2 (STARV2);

6.3 positively related to the number of households whose members work as labour for hire (LABOUR); and

6.4 negatively related to the number of 14-50 year-old illiterate persons (SCHOOLING).

7) Community modernisation

Community modernisation is operationalised by the measurement of the degree of the effects of modernisation in a village. Six variables are postulated as the indicators of the effects of the modernisation: VILL_SERV (number of village services) including facilities such as village temple, primary school, library; ELECTRIC (number of households with electricity); AGCREDIT (types of agricultural credit used) indicating the number of different types of agricultural credit available in the village; GEN_HEALTH3 (types of health facilities) indicates the availability of local medical care volunteers and the availability of a village medicine bank in the village; MEMBERS (average number of household members). Since modernisation was observed to be related to project outcomes discussed in Chapter III, it is hypothesised that success of the VFP is:

7.1 positively related to the number of village services (VILL_SERV);

- 7.2 positively related to the number of households with electricity (ELECTRIC);*
- 7.3 positively related to the types of agricultural credit used (AGCREDIT);*
- 7.4 positively related to the availability of local medical care volunteers and the availability of a village medicine bank in the village (GEN_HEALTH3); and*
- 7.5 negatively related to the average number of household members (MEMBERS).*

8) Community cohesion

Community cohesion is very difficult to operationalise quantitatively. Five variables were used as surrogate measures of this aspect of village life: PUB_FIELD2 (area of community grazing land); ACTIVITY1 (total number of community cultural activities in the past two years); ACTIVITY2 (total number of community sport activities in the past two years); LAW (number of disputes and crimes reported); and PTAX (property tax). These variables were selected, because they represent forms of co-operation and social harmony in the village. For this class of variables it is hypothesised that:

- 8.1 Size of community grazing land (PUB_FIELD2) is positively related to success of the VFP;*
- 8.2 Total number of community cultural activities in the past two years (ACTIVITY1) is positively related to success of the VFP;*
- 8.3 Total number of community sport activities in the past two years (ACTIVITY2) is positively related to success of the VFP;*
- 8.4 Number of disputes and crimes reported (LAW) is negatively related to success of the VFP; and*
- 8.5 Amount of property tax (PTAX) is positively related to success of the VFP.*

9) Communication and accessibility to community

Communications and the accessibility of the community are operationalised as the extent to which villages possess the means of communication and transportation: WORK_FORCE

(number of households whose members work outside the sub-district) indicates the degree of accessibility and the degree of outside contacts; TRAINING (number of training courses held) indicates a village's ability to access government support and also the degree of government attention to the village; YES_ROAD1 (public transportation to the district town) and VEHICLE2 (number of households with motorcycles) measure availability of transport; TV (number of television sets), indicates a villages' ability to receive new information from the outside. It should be noted that three variables, namely WORK_FORCE, VEHICLE2, and TV may reflect community economic status as well, since they relate directly to the level of villager's income. Based on expectations from the literature it is hypothesised that:

- 9.1 the higher the number of households whose members work outside the sub-district (WORK_FORCE) the lower the likelihood of VFP success;*
- 9.2 the higher the number of training courses held (TRAINING) the higher the likelihood of VFP success;*
- 9.3 the greater the availability of public transportation to the district town (YES_ROAD1) the higher the likelihood of VFP success;*
- 9.4 the higher the number of households with motorcycles (VEHICLE2) the higher the likelihood of VFP success; and*
- 9.5 the higher the number of television sets (TV) the higher the likelihood of VFP success.*

The 38 variables previously described are not directly comparable in their original form. For example, the values of variables such as number of households in the village, average rice yield per rai, number of households with automobiles, or number of television sets in the village, have little meaning when considered on their own as they depend, in absolute terms, on the size of the village. To overcome this problem the variables must be indexed and transformed into comparable measurement units. This was achieved by using *Percentages, Ratios and Standard Scores (Z scores)*. The results from the standardisation procedures, which allow values of the variables to be compared between villages, are summarised in Table 4-5.

Variable Name	Standardisation Method
ZHH	Z score of the total households (Z score)
MEMBERS	Average number of household members (ratio: persons/household)
ZPTAX	Z score of the Property tax (Z score)
WELL	Number of households per Tubewells & Shallow wells (ratio: households/well)
ZVILL_SERV	Z score of the number of village services (Z score)
ELECTRIC	Percentage of households with electricity (Percentage)
HPERTV	Number of households per one TV set (ratio: households/1TVset)
YES_ROAD1	Public transportation to the district town (discrete: yes/no)
VEHICLE2	Percentage of households with motorcycles (Percentage)
ROOF2	Percentage of households with a tin roof (Percentage)
LATRINE1	Percentage of households with toilet (Percentage)
SHOP	Number of households per store (ratio: households/store)
ZAGCREDIT	Z score of types of agricultural credit institutions (Z score)
ZMILL	Z score of the total number of rice mill (Z score)
LABOUR	Percentage of households whose members work as labour for hire (Percentage)
AGJOB	Percentage of households pursuing only agriculture (Percentage)
RICE_PROD	Average rice yield (ratio: Kg/rai)
FERTILIZ	Percentage of households using fertiliser in agriculture (Percentage)
DRY_AGR	Percentage of households farming in the dry season (Percentage)
ZPUB_FIELD2	Z score of the size of public grazing land (Z score)
FRE_FISHER	Percentage of households practising fresh water fishery (Percentage)
FRE_RAISER	Percentage of households pursuing fish culture (Percentage)
INDUSTRY1	Percentage of households pursuing the most common industry (Percentage)
AGRTOOL3	Percentage of households with a small tractor (Percentage)
SOIL_QUAL1	Agricultural land use (discrete: 0 or 1)
SOIL_QUAL2	Soil problems (discrete: 0 or 1)
LAND1	Percentage of households who have enough land for farming (Percentage)
ZAREA	Z score of the village area (Z score)
SCHOOLING	Percentage of 14-50 year-old illiterate persons (Percentage)
ZTRAINING	Z score of the total number of training courses held (in the past two years) (Z score)
ZACTIVITY1	Z score of the number of community cultural activities in the past two years (Z score)
ZACTIVITY2	Z score of the number of community sport activities in the past two years (Z score)
STARV2	Percentage of children suffering malnutrition level 2 (Percentage)
GEN_HEALTH1	Percentage of 15-44 year old couples using birth control services (Percentage)
GEN_HEALTH2	Percentage of houses in good sanitary condition (Percentage)
GEN_HEALTH3	Types of health facilities (discrete: 0 or 1)
WORK_FORCE	Percentage of households whose members work outside the sub-district (Percentage)
LAW	Number of disputes and crimes reported per 100 HH (ratio)

Table 4-5: Summary of the Variables Used in the Study

One reason for using standardised scores is that they provide natural weights that are informative and appropriate when the intention is to measure differences among villages rather than to assign them absolute scores (Murray, 1977). However, variables such as *Total number of households* (HH), *Average rice yield* (RICE_PROD), and *Total village area* (AREA), do not have

a standard unit to measure against. Knowing the total number of households in a village conveys little information about village size compared to other villages. Although it can be used to compare two villages to show which village is bigger or smaller than another village, without a definition of what is a big or small village, the village size cannot be judged against its population. By using a standardised score, data are altered to a common metric. In effect, the standardised scores express how non-typical a village is related to the mean of the population, or the distance of a given observation from the mean of the distribution (Murray, 1977).

A standardised or Z score, is expressed in standard deviation units as:

$$z_i = \frac{x_i - \bar{x}}{s_x}, \quad \text{Equation 4.5}$$

where z_i is the standardised score for observation i , x_i is a particular observation on variable x , $\bar{x}$ is the mean of the distribution for variable x , and s_x is the standard deviation of the distribution for variable x (SPSS, 1992).

For variables such as *Number of Tubewells and Shallow wells (WELL)*, *Number of households farming in the dry season (DRY_AGR)*, *Number of TV sets (TV)*, and *Number of households with motorcycles (VEHICLE2)*, the use of Z scores may lead to misinterpretation of the variables as they depend upon the size or the total number of households in each village for their meaning. By using Z scores, the larger the village, the higher the probability to get the larger Z score. A simpler way is to convert these variables into a percentage or ratio in which they are measured against the same standard unit.

4.5 Summary

This Chapter has outlined the procedures used to select the study area and the sample for this investigation. The conceptual model developed in the previous Chapter was operationalised specifically with respect to the VFP in Northeast Thailand. The dependent variable was identified and the independent variables were operationalised, and the data needed for this study were

identified. The primary data from the questionnaire survey provided the measurement of the dependent variable, while the independent variables were drawn from the 1986 and 1989 national village-level databases. Backward Stepwise Logistic Regression Analysis was described. In the following Chapters measurement of the dependent variable is discussed and the results of the analysis are presented.

CHAPTER V

DATA ANALYSIS AND RESULTS

In the previous Chapter, sample size, data collection methods, and statistical analysis procedures were discussed. The present Chapter is concerned with evaluation of the VFP outcome in each village, which constitutes the first part of the analysis. After the field surveys were completed, data from the questionnaires confirmed that, as suggested in Figure 3-3, the evaluation of the VFP outcomes in each village is more complicated than a simple dichotomy between success or failure. The sample VFP villages were classified according to their VFP activity performances and a backward stepwise logistic regression analysis was used to estimate the extent to which villages that have succeeded in implementing and sustaining communal fish culture can be distinguished from villages that have failed. The tasks in this Chapter are to describe the results of the VFP evaluation and the predictive models that result from the backward stepwise logistic regression analyses.

5.1 The Success and Failure of the VFP

As project acceptance and its continued use by the beneficiaries are the main criteria in determining the success or failure of CRM projects, an operational classification procedure needed to be developed to measure outcomes. After the field surveys were completed, information from the questionnaires revealed that the evaluation of the VFP outcomes in each village regarding the successful adoption of the project must be classified into three groups, namely complete success, complete failure, and an indeterminate category. Besides those villages that rejected the VFP by discontinuing all VFP activities within the five year study period, some villages continued

practising VFP activities but were not completely/truly successful in their continuance. For example, some villages restocked their communal fish pond every year or almost every year after harvesting their mature fish and they also received income (from selling fish or fishing tickets) for investment in the next season and/or for other needs. However, many villages occasionally stock their ponds, mostly only when they get fish free from the DOF or other agencies. In addition, many villages received little income from their communal fish pond, so that they had to rely on external agencies to continue their communal fish culture activity. Because of varying levels of self sufficiency, the villages that still continue their VFP activities were further classified into two groups.

The first group comprises villages which have successfully adopted the VFP by demonstrating regular practice of VFP activities and their ability to sustain the project on their own. These villages are regarded as cases of complete success. Villages in the second group are those whose VFP outcomes are classified as being between success and failure, or indeterminate, because their project outcomes cannot be determined with certainty within the study time frame. This complication indicated that a practical means to determine and measure different levels of acceptance or success was needed. Moreover, each indicator developed for this use had to be relatively easy to observe and to measure in order to produce a reliable result at the lowest cost of data correction.

From discussions with several villagers and DOF officials, it was concluded that there is no generally accepted best measure of project success. Consequently, three elements were selected as the most important indicators in determining the status of the VFP in each village. The first indicator is the community decision to continue or discontinue VFP activities. The second indicator is the regularity of fish stocking in the communal fish pond. The third is the income generated from the communal fish pond. Several variables were selected from the questionnaire to construct these indicators. From the indicators, a classification procedure was divided into two steps described in the following manner.

As the discontinuance of the project is clearly a case of project failure, the villages that rejected the VFP by abandoning all project activities were classified without ambiguity into the “Failure” category and assigned a dependent variable value of “0”. Three variables from the questionnaire were used to classify this category. The first variable was the villagers’ determination of the project status (Question 4, Section II of the questionnaire in Appendix I). This was checked against the interviewer’s conclusion in Question 2, Section III of the questionnaire. Another variable (Question 4, Section II), *the year when the village abandoned the VFP*, indicates the time when the village decided to abandon the VFP.

Results from the questionnaires show that 52 villages out of the 205 sampled abandoned the VFP within the 5 year study period. One village (1.9% of 52 villages) dropped out of the project in the first year. Six and fourteen villages (11.5% and 26.9% of 52 villages, respectively) also dropped out in the second and third years. Abandonment by 22 villages (42.3% of 52 villages) occurred in the fourth year, and nine further villages (17.3% of 52 villages) quit the VFP in the fifth year of operation. These results are shown in Figure 5-1. Thirteen additional villages abandoned the VFP in the sixth, seventh and eighth operating years. However, because these abandonments occurred after the 5 year study period, they were not included in the analysis as belonging to the Failure (0) category.

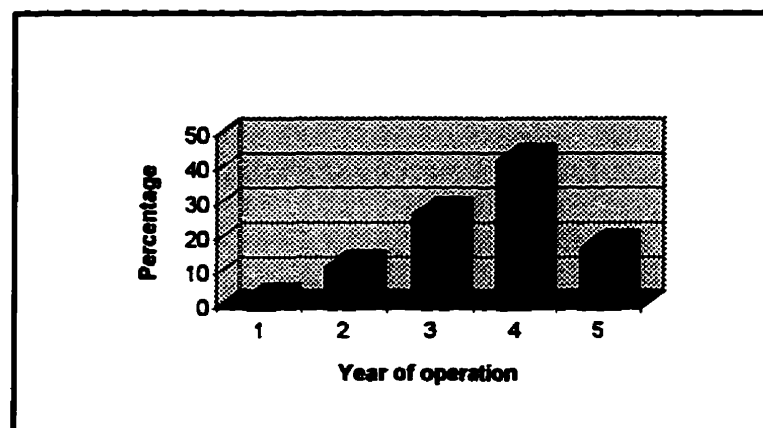


Figure 5-1: Percentage of Abandoned VFP Villages Within the 5 Year Period.

In the second step, the regularity of fish stocking and the income generated from the communal fish pond were used to indicate the performance and sustainability of the VFP in each village. Since yearly fish production of each communal fish pond is an unreliable measure of the VFP performance due to difficulties in measurement and the absence of a standardised and systematic measurement across the region, it cannot be used as an indicator to measure a degree of success in fish culture. Instead this evaluation examined how regularly the village implemented communal fish culture activities. Two elements of fish production were identified as key indicators of fish culture activity and the villager's ability to sustain this. Since it is the most important task in initiating fish culture, fish stocking is considered a key indicator in determining that villages have started a communal fish culture. Income generated from the communal fish pond is also considered as the most important indicator in determining the productivity of fish culture in each season and the village's capacity to invest in the next season. In normal circumstances, it should take about six to eight months for fish to be big enough to be harvested. Therefore, each village should stock and harvest the fish every year. By using the answers from the first and the last column of Table A-1 in the questionnaire (Appendix I): *Number of Fish Introduced* and *Income from the VFP*, the number of fish stocked and income gained were obtained and matched against project expectations. The result is an array of villages, differing in degree of completeness on what is a key activity of the VFP.

As this evaluation was constructed to allow each VFP village to have five years to operate before the evaluation, the most successful villages should be able to operate their communal fish culture five times (once a year) if they restock and harvest their fish every year. However, this is an ideal situation which is not possible for most of the VFP villages, as some of the villages could not start their fish culture activity in the first year of operation because of delays in pond construction/rehabilitation. Slow growth rates and unexpected droughts or floods might delay or interrupt their fish culture as well.

To be practical, the possible delays in the first year and other years with unexpected problems have to be taken into consideration in setting up a minimum accomplishment of what can be classified as the successful VFP village. Thus, a successful VFP village should have at least three fish stocking seasons and three years of income generated from the VFP within the five year period. From this minimum expectation, the rest of the VFP villages that stated they still practice VFP activities can be classified into two groups. The first group comprises those villages which

stocked their pond and gained income from their communal fish pond three times or more within the five year period. This group was assigned as the “*Success*” category and coded as “2”, because they are considered to have accomplished at least the minimum expectation. Those which did not meet the minimum expectation were classified as the “*Indeterminate*” group and coded as “1”. Their VFP activities are considered to be irregular and their ability to sustain the project is considered weak because they have less than two years, if any, income from the VFP.

The results indicate that the 205 VFP villages were classified into three categories (Table 5-1). Fifty-two villages (Failure group) out of the 205 (25.4%) rejected the VFP within the five year evaluation period. The rest of the 153 villages were divided into two groups: Indeterminate (1) and Success (2), according to the degree of completeness of their expected key project activities. Only 59 villages (28.8%) were classified as practising successful adoption, since the villages in this category have demonstrated regularity in implementing the VFP and the ability to sustain project activities independently. A larger number of VFP villages (94 villages, or about 45.8%) were classified as belonging to the indeterminate category according to their inability to sustain the project and irregularity in communal fish culture activity.

Province	VFP villages	Classifications		
		Success (2)	Indeterminate (1)	Failure (0)
1. Kalasin	17	8	7	2
2. Khon Kaen	13	5	7	1
3. Chaiyaphum	11	5	6	0
4. Yasothon	13	3	7	3
5. Nakhon Phanom	10	2	5	3
6. Nakhon Ratchasima	15	3	8	4
7. Buriram	10	1	4	5
8. Maha Sarakham	10	4	4	2
9. Roi Et	11	5	3	3
10. Loei	6	1	2	3
11. Sisaket	14	3	8	3
12. Sakon Nakhon	8	4	2	2
13. Surin	17	1	9	7
14. Nong Khai	11	4	3	4
15. Udon Thani	13	8	4	1
16. Ubon Ratchathani	13	2	8	3
17. Mukdahan	13	0	7	6
Total	205	59	94	52

Table 5-1: The Outcome Classification Table.

The results of this classification comprise the observed values of the dependent variable (y_i) of the logistic model. With the known dependent variable and observed independent variables (x_i) from the village-level database, predictive models were estimated for VFP outcomes. The results are described in the following sections.

5.2 Logistic Regression Analysis (LRA)

This section presents the results from the backward stepwise LRA between the independent variables and the dependent variable. The objective of this analysis is to predict project outcomes as classified using the previously described procedure. Although LRA can handle dependent variables with more than 2 categories (polychotomous)¹⁴, as noted earlier, the simplest form of the model was used by dividing the analysis into three models with a dichotomous dependent variable in each model. The results of this analysis are easier to interpret than the polychotomous case and the predictive models constructed from the analysis are also easier to use. The first model, which is the main focus of this thesis, represents an attempt to distinguish villages which are more likely to succeed in implementing the VFP from those that might fail. In this instance, the dependent variable is coded as “2” and “0” (*Success versus Failure*). In the second model, the dependent variable is coded as “1” and “0” (*Indeterminate versus Failure*) to examine differences between those villages which are struggling to continue their VFP activities and those which have rejected the project by stopping all project activities. The third model differentiates those villages which continue to practise the VFP but vary in degree of success. Its dependent variable is coded as “2” and “1” (*Success versus Indeterminate*).

The initial identification of independent (or predictor) variables yielded 38 independent variables (Table 4-5) as described in the previous Chapter. The backward elimination method was selected for automated model building for reasons explained in Chapter IV. As a result, final

¹⁴ Gilbert (1993, 139) indicates that there is a version of logistic regression that uses the *multinomial logit* model, which can handle dependent variables with more than two categories, but it is then often more difficult to arrive at clear and sociologically meaningful interpretations of the resulting odds ratios.

models consisting of influential variables and their estimated coefficients were produced. By fitting the estimated coefficients into the model, the probability of outcome values was calculated.

LRA is less restrictive to use than linear regression model. Unlike the linear regression model, the LRA does not require the same assumptions concerning independent variables. Its explanatory variables can be both continuous and discrete. However, the LRA does require that the observations “Prob(event)” (the dependent variable) from Equation 4.1 are independent and can be adequately described by the logistic model represented by Equation 4.1 (Hosmer and Lemeshow, 1989). Since the observed dependent variables for this study were collected from VFP villages scattered throughout the region, it can be assumed that the observations are independent (i.e. selection of one does not determine selection of any other). As for the adequacy of the resulting model in describing the phenomenon of interest or explaining the relationship between the dependent variable and independent variables, diagnostic methods similar to those used in linear regression analysis are required. In this thesis the “*Normal Probability Plots of the Standardised Residuals*” was selected to examine the adequacy of the resulting models.

In order to assess whether or not the final models fit the data, “*Classification Tables*” and the normal probability plots of the standardised residuals were calculated in SPSS. Using the classification table, the effectiveness of the LRA is evaluated by comparing predictions from the models with observed outcomes (or actual classifications). As a result, the accuracy of the model in predicting the outcomes of the VFP can be evaluated in terms of the percentage of correct predictions.

The normal probability plot of the standardised residuals is another diagnostic method provided by SPSS in order to examine the adequacy of the resulting model. The normal probability plot of the standardised residuals works on the underlying assumption that the standardised residuals are approximately normally distributed, with $\mu = 0$ and $\sigma = 1$ (SPSS, 1993). The standardised residual is the residual divided by an estimate of its standard deviation. In this case, it is:

$$Z_i = \frac{\text{Residual}_i}{\sqrt{P_i(1 - P_i)}} , \quad \text{Equation 5.1}$$

where the residual is the difference between the observed probability of the event and the predicted probability of the event based on the model. By using a normal probability plot, each calculated standardised residual is paired with its expected value from the normal distribution¹⁵. If the standardised residuals are approximately normally distributed, it can be expected that the points will fall more or less on a straight line (SPSS, 1993).

There are two reasons why the inspection of standardised residuals relied on visual assessment of the residual plots, instead of using further statistical tests to confirm this (Wrigley, 1985). First, although the residuals can be scaled to have zero mean and unit variance, they typically have a very non-normal distribution. Wrigley (1985) explains that as the response variable can only take the values 0 or 1, residuals close to the value zero will not occur except for extreme values of P_i . In such regions, where there is a high or low probability of the first response category being selected, the residuals have a very skewed distribution. The second reason is that the majority of test statistics for residual patterning which exist have been developed for ordinary least squares linear models. As a result, they are not immediately applicable to the residual plots from the logistic model. Hence, the assessment of the residual plots from the logistic model relied upon visual inspection only.

5.2.1 Data Selection for Model Validation

Since the objective of backward stepwise LRA is to select a “best” subset of predictor variables, a good way to test a model is to see how well it predicts. Although there are various ways to assess whether or not the model fits the data, such as the use of the classification table and the normal probability plot of the standardised residuals, they cannot validate the model beyond the original data set. As described by Finley (1968), there should be no prediction by an instrument (predictive model) until it has been applied to cases other than the ones from which it has been constructed or to the same cases at a different point in time. He explains that the validity of the

¹⁵ The expected value from the normal distribution is based on the number of cases in the sample and the rank order of the case in the sample (SPSS, 1993).

predictive instrument depends upon its stability, which is the maintenance of accuracy and efficiency over time and across samples other than the original one.

In this study, while the classification table and the normal probability plot of the standardised residuals were used to assess how well the logistic model performed relative to the original data set used, approximately twenty percent of villages were randomly sampled out of the total 205 cases to be used as validating samples in order to assess the model's predictive efficacy. Fisher and Van belle (1993) refer to this technique as the "*split-half*" technique which estimates the logistic regression coefficients from the first half of the data and applies the model to the second half. This procedure produces unbiased estimates of the classification probabilities. However, because the sample size of this study is relatively small (205 cases), it was divided unequally into a small group (about 20%) and a larger group (about 80%). Assumed that the model will perform better if based on a larger sample, a larger group was used to construct the predictive model and the smaller group used to validate that model (Table 5-2).

Year	Total VFP villages	Model-building group	Validating group
1986	59	44	15 (25.42%)
1987	51	39	12 (23.52%)
1988	45	37	8 (17.77%)
1989	50	40	10 (20.00%)
Total	205	160	45 (21.95%)

Table 5-2: Number of Cases Selected for Model Building and Model Validation

For clarification, the following definitions are given. The "*model-building sample*" refers to the sample utilised in the construction of the predictive model. The "*validating sample*" is the sample utilised in testing the model for accuracy and efficiency.

The outcomes of the VFP were classified into three categories (Success, Failure, and Indeterminate), and the proportions of these categories in both the model building group and the validating group are relatively similar (Table 5-3).

Classification	Total VFP sample		Model-building sample		Validating sample	
	Villages	Percentage	Villages	Percentage	Villages	Percentage
Success (2)	59	29%	45	28%	14	31%
Indeterminate (1)	94	46%	73	46%	21	47%
Failure (0)	52	25%	42	26%	10	22%
Total	205	100%	160	100%	45	100%

Table 5-3: Percentage of Classified Cases in Each Groups.

5.2.2 Results of Model 1: Success (2) versus Failure (0)

From this model, 29 independent variables were removed according to the backward elimination procedure described in the previous Chapter. The resulting nine variables (Table 5-4) are the best predictors.

Variables in the Equation							
Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
ZPTAX	1.0171	.3929	6.7001	1	.0096*	.1975	2.7652
WELL	-.0357	.0145	6.0520	1	.0139*	-.1834	.9650
HHPERTV	-.0417	.0178	5.4995	1	.0190*	-.1704	.9591
SHOP	.0206	.0131	2.4534	1	.1173	.0613	1.0208
FRE_RAISER	-.1299	.0823	2.4913	1	.1145	-.0639	.8782
INDUSTRY1	.0227	.0101	5.0154	1	.0251*	.1582	1.0229
SOIL_QUAL1	.9381	.4053	5.3580	1	.0206*	.1669	2.5551
ZACTIVITY2	-.4413	.2651	2.7715	1	.0960	-.0800	.6432
GEN_HEALTH2	-.0245	.0109	5.0681	1	.0244*	-.1596	.9758
Constant	.9625	.9071	1.1260	1	.2886		

* Significant at $\alpha = .05$

Table 5-4: Parameter Estimates for the Logistic Regression Model 1

The estimated coefficients (under column heading B) and related statistics from the logistic regression model predict the success or failure of the VFP from a constant and the following variables: ZPTAX, WELL, HHPERTV, SHOP, FRE_RAISER, INDUSTRY1, SOIL_QUAL1, ZACTIVITY2, GEN_HEALTH2. By applying these estimated coefficients to the logistic

regression model, described in Chapter IV, the resulting equation for the probability of the VFP success or failure can be written as:

$$\text{Prob(event)} = \frac{1}{1+2.718^{-z}} , \quad \text{Equation 5.2}$$

where $z = 0.9625 + 1.0171 (\text{ZPTAX}) - 0.0357 (\text{WELL}) - 0.0417 (\text{HHPERTV}) + 0.0206 (\text{SHOP}) - 0.1299 (\text{FRE_RAISER}) + 0.0227 (\text{INDUSTRY1}) + 0.9381 (\text{SOIL_QUAL1}) - 0.4413 (\text{ZACTIVITY2}) - 0.0245 (\text{GEN_HEALTH2})$.

With this predictive model (Equation 5.2), only the observed values of these nine variables are needed to predict the success or failure of the VFP in each village. If the predicted dependent value is less than 0.5, it can be predicted that the village will fail. But if the predicted value is greater than 0.5, it can be predicted that the village will succeed.

The fourth column (labelled **Wald** in table 5-4) shows the Wald statistic which is the square of the ratio of the coefficient (under column heading **B**) to its standard error (shown in the column labelled **S.E.** in Table 5-4). The Wald statistic, which has a chi-square distribution, is used to test the null hypothesis that the coefficient is not significantly different from zero (0). The significance level for the Wald statistic is shown in the column labelled **Sig.** It should be noted that three variables out of the nine entered (constant not included) are not statistically significant, at least at the 0.05 level (shown in the column labelled **Sig.**).

Despite this, there are three reasons to keep these three variables (**SHOP**, **FRE_RAISER**, and **ZACTIVITY2**) in the final model. First, since the significance level of the log likelihood (shown in Appendix IV) for the model if each of these three variables is removed from the model is less than the cut-off value (by default 0.1), the null hypothesis that the coefficients of the variables removed are 0 is rejected. This means the three variables will affect the model outcome. Second, if the three variables are removed from the model, the model's predictive power, or its accuracy, is reduced by 10 percent. As shown in Table 5-5, the overall percent correct of the model including these three variables is 78.16 percent. If the three variables are removed from the model, the overall percent correct is reduced to 67.82 percent. This is quite low, since there is a 50 percent

chance to correctly predict the dichotomous outcomes. Third, the three variables seem to represent important factors identified in the literature. Specifically, **SHOP** represents the economic status of the village, **ZACTIVITY2** represents the cohesiveness of the villagers, and **FRE_RAISER** represents community fish culture knowledge and the level of commercial fish farming in the village.

The fifth column (labelled **R**) is the *R* statistic¹⁶ which is used to determine the partial correlation between the dependent variable and each of the independent variables. Small values for the *R* statistic indicate that the variable has a small partial contribution to the model. Moreover, as this *R* statistic can range in value from -1 to +1, a positive value indicates that as the variable increases in value, so does the likelihood of the event occurring. If the *R* statistic is negative, the likelihood of the event occurring decreases as the value of the variable increases.

As noted earlier, the effectiveness of the model can be obtained by comparing the predictions from the model with the observed values in a classification table. The result of this comparison is shown in Table 5-5. From the table, 32 villages were correctly predicted by the model as failures. Similarly, 36 villages were correctly predicted as successes. Hence the model predicts 68 (32+36) of 87, or 78.16 percent, of the observations correctly. This is a quite satisfactory result from the perspective of assessing the probability of success or failure for villages not yet in the VFP.

Observed	Predicted		Percent Correct
	Failure (0)	Success (2)	
Failure (0)	32	10	76.19%
Success (2)	9	36	80.00%
Overall Percent Correct			78.16%

Table 5-5: Classification Table of the Predicted Success (2) and Failure(0)

¹⁶ The equation for the *R* statistic is: $R = \pm \sqrt{\frac{\text{Wald statistic} - 2K}{-2LL_{(0)}}}$, where *K* is the degrees of freedom for the variable (SPSS, 1993). The denominator is -2 times the log likelihood of a base model that contains only the intercept, or a model with no variables if there is no intercept.

As indicated above, another way of assessing how well the resulting model fits the data is to plot the standardised residuals to determine if they are normally distributed. The result of this is shown in Figure 5-2. The majority of the points cluster clearly around a straight line. Since it is almost impossible to find data that are exactly normally distributed (SPSS, 1993), it may be concluded that the standardised residual plot in Figure 5-2 appears to be normally distributed. Therefore, the underlying assumption that the standardised residuals are approximately normally distributed was not contradicted by the data.

From Table 5-5 and Figure 5-2, it can be concluded that Model 1 fits the data with a predictive accuracy of 78.16 percent correct. If its validation also yields a satisfactory result, then the main objective of this thesis is achieved and Model 1 will be very useful for the DOF's VFP planning process.

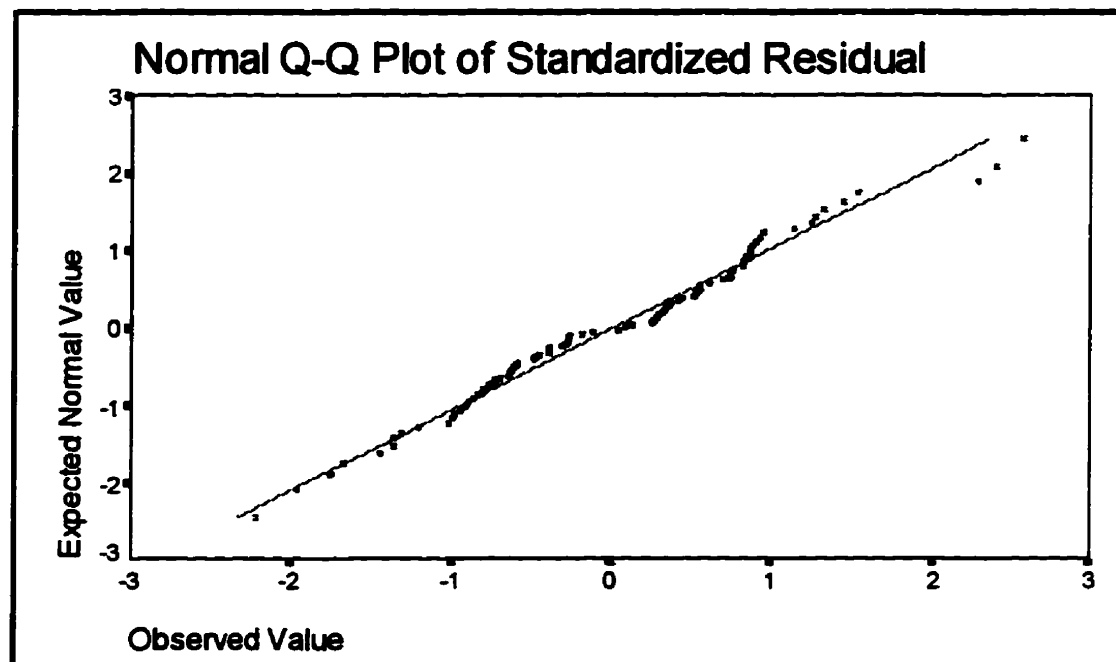


Figure 5-2: Normal Probability Plot of the Standardised Residual from Model 1

5.2.3 Results of Model 2: Indeterminate (1) versus Failure (0)

The second model differentiates between villages that are struggling to continue their VFP activities and those that have rejected the project by stopping all project activities. These are coded in the dependent variable as “1” for the *Indeterminate* group and “0” for the *Failure* group. The final result of the backward stepwise LRA was achieved after 27 variables were removed from the model, leaving 11 variables (in Appendix V). The independent variables and their estimated coefficients are presented in Table 5-6.

From Table 5-6, the logistic regression equation of Model 2 (the probability of the VFP to be in the indeterminate group or the failure group) can be written as:

$$\text{Prob(event)} = \frac{1}{1+2.718^{-z}}, \quad \text{Equation 5.3}$$

where $z = 4.8812 + 0.7581 (\text{ZPTAX}) - 0.0171 (\text{WELL}) - 0.0282 (\text{HHPERTV}) - 0.0309 (\text{ROOF2}) + 0.0247 (\text{SHOP}) - 0.0406 (\text{LABOUR}) - 0.0051 (\text{RICE_PROD}) - 0.1270 (\text{FRE_RAISER}) - 0.5213 (\text{ZACTIVITY2}) - 0.0149 (\text{GEN_HEALTH2}) + 0.0313 (\text{WORK_FORCE})$.

Variables in the Equation							
Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
ZPTAX	.7581	.3113	5.9310	1	.0149*	.1614	2.1342
WELL	-.0171	.0097	3.1034	1	.0781	-.0855	.9830
HHPERTV	-.0282	.0119	5.6225	1	.0177*	-.1549	.9722
ROOF2	-.0309	.0173	3.1758	1	.0747	-.0883	.9696
SHOP	.0247	.0112	4.8795	1	.0272*	.1381	1.0250
LABOUR	-.0406	.0216	3.5166	1	.0608	-.1002	.9602
RICE PROD	-.0051	.0030	2.9327	1	.0868	-.0786	.9949
FRE RAISER	-.1270	.0669	3.6067	1	.0575*	-.1032	.8807
ZACTIVITY2	-.5213	.2570	4.1154	1	.0425*	-.1184	.5938
GEN HEALTH2	-.0149	.0089	2.7747	1	.0958	-.0716	.9852
WORK FORCE	.0313	.0122	6.5442	1	.0105*	.1735	1.0318
Constant	4.8812	1.9953	5.9846	1	.0144		

* Significant at $\alpha = .05$

Table 5-6: Parameter Estimates for the Logistic Regression Model 2

There are eleven independent variables (not including the constant) in this model. Six of the eleven variables have the Wald statistic values that are not statistically significant at the 0.05 level (shown in the column labelled Sig). However, if these six variables are removed, the overall percent correct is too low to be adequately useful, since the overall percent correct would be closer to 50 percent of the random chance of selecting correctly one of two choices.

The overall percent correct for the second model in Table 5-7 (73.04%) is lower than the overall percent correct in Model 1, but it is still at an acceptable level. However, the model appears to be more successful in predicting the indeterminate group (82.19% correctly predicted) than the failure group (only 57.14% correctly predicted). Thus, this classification table indicates that the model fits the data, but not as well as model 1. However, the normal probability plot of the standardised residuals should also be inspected in order to confirm the adequacy of Model 2 before any conclusion can be made.

Observed	Predicted		Percent Correct
	Failure (0)	Indeterminate (1)	
Failure (0)	24	18	57.14%
Indeterminate (1)	13	60	82.19%
Overall Percent Correct			73.04%

Table 5-7: Classification Table of the Predicted Indeterminate (1) and Failure (0)

The normal probability plot of the standardised residuals for this model is presented in Figure 5-3. It clearly demonstrates that there are some cases for which the model does not fit well. Some of the points do not cluster around a straight line, especially at the middle of the plot. Hence, the hypothesis of normality is violated to some degree.

From both the classification table (Table 5-7) and the normal probability plot of the standardised residuals (Figure 5-3), it can be concluded that Model 2 fits the data it was constructed from but not as well as Model 1. Therefore, it suggests that caution must be exercised in drawing any conclusions from this model. However, its usefulness is further assessed in the following section.

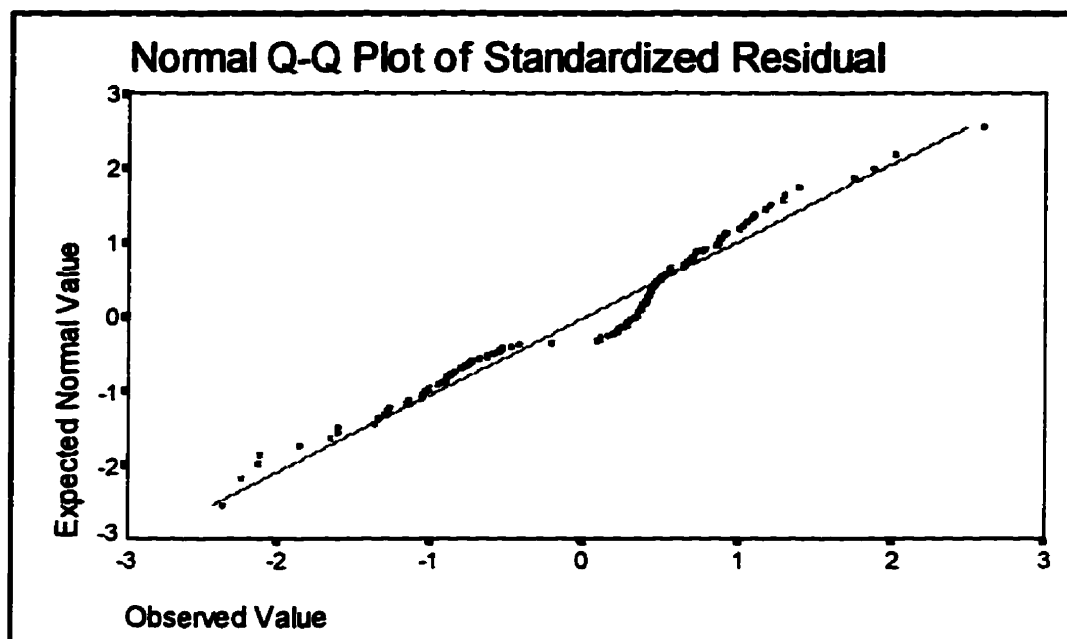


Figure 5-3: Normal Probability Plot of the Standardised Residual from Model 2

5.2.4 Results of Model 3: Success(2) versus Indeterminate (1)

In the third model, the dependent variable is coded as “2” and “1” (*Success* versus *Indeterminate*) in order to differentiate those villages which are continuing to practise the VFP but vary in the degree of success. Backward stepwise LRA yields only three independent variables in the final solution (shown in Appendix V) at step number 36. The estimated coefficients and related statistics are presented in Table 5-8.

Using the estimated coefficients from Table 5-8, the logistic regression equation for this model can be written as:

$$\text{Prob(event)} = \frac{1}{1+2.718^{-z}}, \quad \text{Equation 5.4}$$

where $z = -2.6649 + 0.0277 (\text{ROOF2}) + 0.0398 (\text{LABOUR}) - 0.0207 (\text{WORK_FORCE})$.

Variables in the Equation							
Variable	B	S.E.	Wald	df	Sig.	R	Exp(B)
ROOF2	.0277	.0157	3.1104	1	.0778	.0841	1.0281
LABOUR	.0398	.0227	3.0700	1	.0797	.0826	1.0406
WORK FORCE	-.0207	.0097	4.5365	1	.0332*	-.1272	.9795
Constant	-2.6649	1.4090	3.5771	1	.0586		

* Significant at $\alpha = .05$

Table 5-8: Parameter Estimates for the Logistic Regression Model 3

The classification table (Table 5-9) indicates unsatisfactory results. Similar to the second model, this model also appears to predict correctly one group (the indeterminate group) better than the other group (the success group). Although the model is extremely successful in predicting the indeterminate group, (its percent correctly predicted as high as 90.41%) the percent correctly predicted for the success group is too low to be acceptable (only 24.44%). Hence, this model does not adequately fit the data.

Observed	Predicted		Percent Correct
	Indeterminate (1)	Success (2)	
Indeterminate (1)	66	7	90.41%
Success (2)	34	11	24.44%
Overall Percent Correct			65.25%

Table 5-9: Classification Table of the Predicted Success(2) and Indeterminate (1)

Figure 5-4 shows the normal probability plot of the standardised residuals for this model which confirms the conclusion from the classification table (Table 5-9). The normal probability plot of the standardised residuals (Figure 5-4) of this model also indicates that the model does not fit the data well.

Indicated by both the classification table (Table 5-9) and the normal probability plot of the standardised residuals (Figure 5-4), Model 3 does not fit the data it was constructed from. It is recommended that Model 3 should not be used for VFP planning processes.

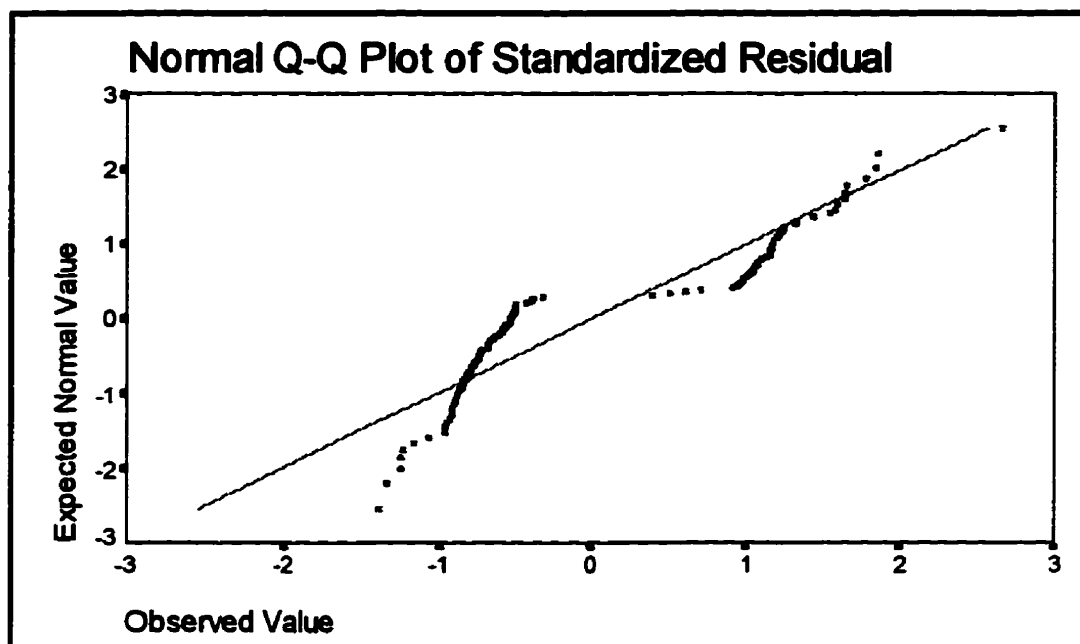


Figure 5-4: Normal Probability Plot of the Standardised Residual from Model 3

5.3. Model Validation

The success of the models developed from the logistic regression analysis (LRA) depends on their ability to predict known outcomes with acceptable accuracy. Using the models constructed on the 45 villages selected as the validating group, the outcomes illustrate how well the models predict beyond their original samples (the model-building samples). From the model and the data of the validation groups, the estimated probability of the event (using Equation 5.2, 5.3 and 5.4) for each village is calculated. By comparing the predicted and observed outcomes of the VFP in the model validation groups, the percent correct of the model prediction can be calculated.

5.3.1 Model 1: Success (2) versus Failure (0)

Observed data from the 24 validating sample villages (14 successes and 10 failures) were applied to the model 1 (Equation 5.2): $\text{Prob}(\text{event}) = \frac{1}{1+2.718^{-z}}$, where $z = 0.9625 + 1.0171$ (ZPTAX) - 0.0357 (WELL) - 0.0417 (HHPERTV) + 0.0206 (SHOP) - 0.1299 (FRE_RAISER) + 0.0227 (INDUSTRY1) + 0.9381 (SOIL_QUAL1) - 0.4413 (ZACTIVITY2) - 0.0245 (GEN_HEALTH2). The predicted and observed values of Model 1 are shown in Table 5-10.

Observed	Predicted		Percent Correct
	Failure (0)	Success (2)	
Failure (0)	7	3	70.00%
Success (2)	4	10	71.42%
Overall Percent Correct			70.83%

Table 5-10: Accuracy Table of Model 1

The model again appears to predict equally well on both success and failure groups. Its overall percent correct is also at an acceptable level, even though it is somewhat lower than the overall percent correct in the model-building sample. In general, Model 1 should be classified as a valid model. Therefore, it can be used with the observed independent variables from another group of subjects, which is the main objective of the predictive model and of this study.

5.3.2 Model 2: Indeterminate (1) versus Failure (0)

The second model (Equation 5.3): $\text{Prob}(\text{event}) = \frac{1}{1+2.718^{-z}}$, where $z = 4.8812 + 0.7581$ (ZPTAX) - 0.0171 (WELL) - 0.0282 (HHPERTV) - 0.0309 (ROOF2) + 0.0247 (SHOP) - 0.0406 (LABOUR) - 0.0051 (RICE_PROD) - 0.1270 (FRE_RAISER) - 0.5213 (ZACTIVITY2) - 0.0149 (GEN_HEALTH2) + 0.0313 (WORK_FORCE), is used to predict the outcomes of 31 villages

from the validating sample (21 indeterminate and 10 failure). The result of the validation process of this model is presented in Table 5-11.

Observed	Predicted		Percent Correct
	Failure (0)	Indeterminate (1)	
Failure (0)	4	6	40.00%
Indeterminate (1)	7	14	66.66%
Overall Percent Correct			58.06%

Table 5-11: Accuracy Table of Model 2

From Table 5-11, Model 2 comparatively predicts the validating sample with less accuracy than Model 1. Not only is its overall percent correct low, but also its percent correctly predicted of the failure group is lower than 50 percent. As Model 2 fits less well with the data used in its construction than Model 1 and its validation is unacceptably low, it should be concluded that Model 2 should be used with caution in its current form.

5.3.3 Model 3: Success (2) versus Indeterminate (1)

The result of applying model 3 (Equation 5.4): $\text{Prob}(\text{event}) = \frac{1}{1+2.718^{-z}}$, where $z = -2.6649 + 0.0277 (\text{ROOF2}) + 0.0398 (\text{LABOUR}) - 0.0207 (\text{WORK_FORCE})$, to the validating sample (14 success and 21 indeterminate) is presented in Table 5-12.

Observed	Predicted		Percent Correct
	Indeterminate (1)	Success (2)	
Indeterminate (1)	15	6	71.42%
Success (2)	12	2	14.28%
Overall Percent Correct			48.57%

Table 5-12: Accuracy Table of Model 3

The number of villages correctly classified is lower than 50 percent and this model is able to predict correctly the success group only at 14.28 percent. The accuracy table (Table 5-12) clearly indicates that Model 3 is invalid and should not be used. This also confirms the conclusion that the model does not adequately fit the data.

5.3.4 Conclusion

Backward stepwise logistic regression analysis was used to develop three models regarding the outcomes of the VFP in the model-building sample. Model 1 appears to be fit well with the data, while Model 2 fits less well and Model 3 is unsuccessful. These conclusions are confirmed by the validation procedures.

Table 5-13 shows the results of the validation procedures compared to those predicted by the model-building analysis. In general, all three models are less successful in predicting the validating sample than the model-building sample.

Models	Cases	Overall Percent Correct
Model 1 Success (2) versus Failure (0)	Model-building sample	78.16%
	Validating sample	70.83%
Model 2 Indeterminate (1) versus Failure (0)	Model-building sample	73.04%
	Validating sample	58.06%
Model 3 Success (2) versus Indeterminate (1)	Model-building sample	65.25%
	Validating sample	48.57%

Table 5-13: Summary of Predictive Accuracy Table of the Model-building Samples and the Validating Samples of All Three Models.

The results of the validation procedure are clear in Model 1 and Model 3. While Model 1 can be classified as acceptable and valid, Model 3 is unacceptable and invalid. Model 2 needs more attention, because its overall percent correct in both the model-building sample and the validating sample have some meaningful value (73.04% and 58.06%). However, when the percent correct of the failure group in both the model-building and validating samples is considered, Model 2 is questionable. However, since Model 2 demonstrates high potential to be a successful

predictive model, it may be possible to construct an acceptable Model 2 with minor refinements of classification and measurement, especially by extending the evaluation period. Since the validation procedure confirms that Model 3 is not valid, the attempts to develop this model have failed and it should not be used without refinement of conceptual framework, classification, and measurement which is discussed in the next Chapter. Since Model 1 is the only model to be considered successful, it forms the main discussion in the following Chapter.

5.4 Summary

The evaluation of the VFP outcomes from the questionnaire survey classified the VFP villages into three groups and three predictive models were constructed. These three predictive models were constructed from the Northeast VFP sample and were validated by testing them with data randomly extracted for this purpose from the same sample.

The first model (Model 1) was effective for 78.16 percent of the cases in the model building sample, and for 70.83 percent of the cases from the validating sample, which are acceptable and satisfying results. However, Model 2 and Model 3 yield less satisfactory results and the results from the validation procedure indicated that Model 3 is not valid. Therefore, only Model 1 is considered further in Chapter VI. However, all Models are discussed in the concluding Chapter. The results of this study, especially with respect to Model 1, are discussed and evaluated in the following Chapter.

CHAPTER VI

RESEARCH DISCUSSION AND EVALUATION OF RESULTS

This Chapter focuses on the results presented in the previous Chapter. The Chapter is divided into three sections. First, Model 1 is discussed and examined in detail, since it is the only model considered to be fully successful in terms of the objective of this thesis. Second, Model 2 and Model 3, although yielding less satisfactory results are also considered, more in terms of why they failed to realise the thesis objective than in terms of their implications for use in fish farming policy and planning. Finally, the major findings of this study are stated.

6.1 Predictive Model 1

By using the backward elimination method in the LRA presented in Chapter V, a large number of independent variables with statistically insignificant relationships with the dependent variable were removed from the analysis. As a result, predictive Model 1, in its final form, consisted of only nine independent variables. The contribution of each variable is indicated by its *R* statistic which is used to determine the partial correlation¹⁷ between the dependent variable and each of the independent variables, as described in Chapter V. The *R* statistic indicates the effect that the variable has on the dependent variable. Its sign represents the direction of the effect within the range +1 and -1 and the magnitude toward each end of the range represents its strength. There are five independent variables in the model that have a negative *R* statistic, which means that when

¹⁷ Since the contribution of each variable depends on the other variables in the model, the contribution of individual variables in logistic regression is difficult to determine. In order to overcome this problem partial correlation is used by SPSS to measure the effect of each variable on the dependent variable, while holding the influences of all other variables constant (SPSS, 1993,5).

the variable increases in value, the dependent variable decreases, or vice versa. Table 6-1 shows the order of importance (*R* statistics) of the nine variables in Model 1.

Variable	Wald	Sig	R	Exp(B)
ZPTAX	6.7001	.0096*	.1975	2.7652
WELL	6.0520	.0139*	-.1834	.9650
HHPERTV	5.4995	.0190*	-.1704	.9591
SOIL_QUAL1	5.3580	.0206*	.1669	2.5551
GEN_HEALTH2	5.0681	.0244*	-.1596	.9758
INDUSTRY1	5.0154	.0251*	.1582	1.0229
ZACTIVITY2	2.7715	.0960	-.0800	.6432
FRE_RAISER	2.4913	.1145	-.0639	.8782
SHOP	2.4534	.1173	.0613	1.0208

* Significant at $\alpha = .05$

Table 6-1: Model 1 R statistics and Exp(B)

ZPTAX (Z score of the property tax) emerges as the most important variable in predicting the probability of success of the VFP, since it has the highest *R* statistic (Table 6-1). The result shows support for the hypothesised relationship between the variable and the success of the VFP, as stated in Chapter IV. Specifically, the amount of property tax (PTAX) is positively related to success of the VFP. The property tax is a yearly tax collected from villagers and is a function of the amount of land owned. This variable is included because it represents a surrogate of the amount of money that a village chief has at his/her disposal every year for expenditure on village affairs.

There were two reasons for using the property tax variable. First, communities with larger amounts of property tax possess greater resources and are therefore in a better position to assume the cost and risks associated with a project such as the VFP. Second, with more capital to invest in village affairs, the village chief, village committee, and villagers should be more familiar with community activities established by their property taxes. Hence, the ZPTAX variable reflects community experiences in establishing and managing both collective activities and the economic resources that the community can draw upon. Although the ZPTAX variable does not directly measure community cohesion and collective experience, like traditional collective activities such as

“long khack” and *“len chae”*, which do not exist in the village-level database, it functions as expected based on the literature discussed in Chapter III and IV.

The second most influential characteristic of the community for the successful adoption of the VFP indicated by the model is the WELL variable, which measures the number of households per tubewell and shallow well. The hypothesis for this variable asserts that the number of wells in a village (WELL) is significantly and positively related to the success of the VFP. The result supports this hypothesis as the negative R value of the WELL variable can be interpreted as the lower the number of households per well (the higher the number of wells), the higher the likelihood of the project's success. Since these wells are the main source of drinking water and domestic use, a small number of them in a village indicates either a water shortage problem or a social problem. With less potable water available, fish culture becomes a very low priority. The main concern is to keep water for drinking, domestic use and for animals. As an indication of social problems, a small number of wells in a village might be a consequence of the village's inability to dig more wells caused by social problems. RDI (1988, 11) indicates that the digging of shallow wells needs the co-operation of a number of households in the village and in a number of places this is difficult to achieve due to conflicts of interest and functional situations within the villages. Hence a lower number of wells may indicate conflicts or a less cohesive community.

Chapter IV indicated that the number of households per television set (HHPERTV) not only reflects a communication channel through which villagers get information, but also is an indicator of economic status of the village because a television set is very expensive relative to household income. The negative R value for this variable indicates that the lower the number of households per television set (the higher the number of television sets), the higher the chance of success, which supports the associated hypothesis 9.5 stated in Chapter IV. This result represents the ability of the village to receive new information from the outside. Further, if this variable is considered to indicate community economic status, the result also supports a general hypothesis observed from the literature that community economic status is significantly and positively related to the success of the VFP.

Agricultural land use (SOIL_QUAL1) is a variable related to land prosperity. This variable was classified as 0 when only 50% or less of village land was used for agriculture, and 1 when 75% or more of the land was used for agriculture. The variable represents the bio-physical conditions of the village, since it can be assumed that those villages using only 50% or less of their land for agriculture are located on poor soil or on land situated at high elevations which are less suitable for agriculture and fish culture. Soil quality and elevation affect the quality and/or quantity of water which, in turn, affects fish productivity. Furthermore, with a large proportion of land not suitable for agriculture, it is likely that a village is poor because agriculture forms the basis of the local economy in this region. As discussed in Chapters III and IV, it was hypothesised that villages most likely to succeed in the adoption of the VFP would use their land very intensely for agricultural purposes. Since the higher the proportion of village land used for agriculture the more likely it is that a village is located on land suitable for agriculture and fish culture, the more likely it has a higher community economic status, and the more likely it is that it can successfully sustain projects such as the VFP. The results support the hypothesis that VFP success is positively related to the amount of land used for agriculture, since the SOIL_QUAL1 variable has a positive and statistically significant partial correlation coefficient.

The fifth variable, percentage of houses in good sanitary condition (GEN_HEALTH2), produced an unexpected negative *R* statistic. GEN_HEALTH2 was intended to reflect the state of a village's general health and the villagers' attitude towards their living conditions. Based on the literature, it was hypothesised that success of the VFP is significantly and positively related to the percentage of houses in a village in good sanitary condition. It was assumed that if villagers are interested in keeping their houses clean or in good sanitary condition, they would be interested in having their village developed to improve their living conditions. With healthy bodies and positive attitudes toward good living conditions reflected by GEN_HEALTH2, the VFP should be more likely to succeed in villages with a higher percentage of houses in good sanitary condition. Murray (1977) notes that the house compounds in functional villages¹⁸ tend to be cleaner, neater, and

¹⁸ Murray (1977, 33) defines a functional village as a village that can provide a variety of supports to the individual villagers. The basic functions should be in the areas that have profound effects on the daily life of the villager such as maintenance of peace and order, and sponsorship of a few simple public goods.

generally better-kept than the compounds in non-functional villages. He suggests that a village's functional capacity could be inferred through visual observations of the house compounds. Hence, the GEN_HEALTH2 was assumed to represent the state of a village's general health and the village's functional capacity to develop.

However, the negative *R* statistic of the GEN_HEALTH2 variable suggests that the success of the VFP decreases with a higher percentage of houses in good sanitary condition. A possible explanation is that GEN_HEALTH2 does not, in fact, measure the state of a village's general health and the attitudes of villagers toward living conditions. Since other variables in the model indicate that the higher the community economic status of a village the higher the chance of the project's success, it is difficult to explain why poorer villages, which have less capital to invest and less time to work on their houses, have a higher percentage of houses in good sanitary condition than wealthy ones. However, since public health and sanitation is a priority in Thai rural development policy, there are several complimentary projects which aim to improve village public health and sanitation conditions, especially in the poorest villages where receipt of government-sponsored projects is highest. One of the common objectives among the complimentary projects is to promote sanitation. Hence, with a focus on the poorest villages, it may be possible that, by virtue of the impact of those development projects, the poor villages sampled in this study comprise a high percentage of houses in good sanitary condition relative to the economically advanced villages.

The INDUSTRY1 variable (percentage of households pursuing the most common industry) represents the diversification of the main source of income and potential sources of additional income for the households in the village. As noted earlier, agriculture is the primary economic base of the north-east rural communities in Thailand. Common industries, including handicrafts, provide economic diversification and additional income to enhance a village's economic status. Hence, the higher the percentage of households pursuing the most common industry, the better economic status they should have. As suggested in Chapter III, higher economic status is typically associated with a higher capacity to invest and the ability to take higher risks. Therefore, it was proposed that villages with a higher percentage of households

pursuing the most common industry should be more likely to succeed in the VFP than villages with less households pursuing the most common industry. The hypothesis is supported by the model as indicated by the positive *R* statistic and significant Wald statistic in Table 6-1.

The last three variables, namely ZACTIVITY2, FRE_RAISER and SHOP, are not statistically significantly related to project outcomes at the 95% confidence level, according to the Wald statistics as presented in Chapter V. These variables also have the lowest contribution to the model's predictive power since their *R* statistics (Table 6-1) are much lower than those for the other variables. However, according to the reasons described in Chapter V, it was decided to include these variables in the final model. The main reason is that they represent important factors indicated in the literature and they are also considered to have a degree of influence on the model even though they are not statistically significant at the 95% confidence level. However, since the coefficients of these variables are not statistically significant they need not be further discussed.

The small values for the *R* coefficients indicate that the variables have small partial contributions to the model (none greater than 0.2000). Despite this, the predictive power of Model 1 is satisfactory and acceptable, as noted in Chapter V. Overall of the variables examined, Model 1 is dominated by factors related to village economic conditions with bio-physical conditions also playing a role. Social issues seem to be the most difficult to interpret. A more precise explanation of the nine independent variables is required, especially for those contradicting the reviewed literature and research, and more information is needed respectively beyond that possible in or collected for this study. In-depth research is required to establish exactly what each of these variables in fact measures and its relationship with VFP outcomes. For example, in-depth qualitative research in VFP villages that have failed or succeeded in their activities may be able to determine exactly what the GEN_HEALTH2 variable represents and why it has a negative partial correlation coefficient. Furthermore, research of this type may provide a better or a more specific explanation of the nature of the relationships between community characteristics and the project outcomes evidenced by the model.

In addition to the R statistic, SPSS provides the $Exp(B)$ value for each variable in the model. This statistic is a parameter of change in the *odds of an event occurring* when the value of a given independent variable increases by one unit and the values of the other independent variables remain the same. SPSS (1993, 6) defines the odds of an event occurring as the ratio of the probability that it will occur to the probability that it will not. The logistic regression equation can be written in terms of odds as:

$$\text{Odds} = \frac{\text{Prob (event)}}{\text{Prob (no event)}} = e^{B_0 + B_1X_1 + \dots + B_pX_p} = e^{B_0} e^{B_1X_1} \dots e^{B_pX_p} \quad \text{Equation 6.1}$$

The $Exp(B)$ values are important for project planning because they reflect the sensitivity of change in the dependent variable values for each changes in independent variable values in the model. SPSS (1993, 6) describes the Equation 6.1 as follows:

“From the Equation, e raised to the power B_i (the logistic coefficients) is the factor by which the odds change when the i th independent variable increases by one unit. If B_i is positive, this factor will be greater than 1, which means that the odds are increased; if B_i is negative, the factor will be less than 1, which means that the odds are decreased. When B_i is 0, the factor equals 1, which leaves the odds unchanged.”

For example, by increasing the value of ZPTAX by one unit, the odds of the VFP success will increase by a factor of 2.76 which is the value of $Exp(B)$ for ZPTAX in Table 6-1. As a result, there are four variables (ZPTAX, SOIL_QUAL1, INDUSTRY1, SHOP) which need to be considered carefully, since a slight change will greatly impact the probability of success estimated by the model (a high value of the $Exp(B)$ in Table 6-1).

Although nine (and possibly only six, since ZACTIVITY2, FRE_RAISER and SHOP variables are not statistically significantly related to project outcomes at the 95% confidence level) independent variables are sufficient to predict reasonably the success or failure of the VFP in the north-east villages, they do not describe the success or failure of villages in general terms. For the purpose of describing successful or unsuccessful VFP villages, a Mann-Whitney two-sample test was applied to the predicted success and failure groups in order to test by how much or how significantly the two groups differ so that a general picture of the villages can be described. The Mann-Whitney two-sample test was selected because it is a non-parametric (distribution-free)

statistic that is applicable to small samples with unequal sizes that may not meet parametric assumptions (see Matthews, 1981). The results are presented in Table 6-2.

Variables	Predicted Failure villages n = 41	Predicted Success villages n = 46	Mean Difference	P-value (2-Tailed)
Total number of households	118.68	133.34	-14.66	.2745
Average number of household members	5.91	5.76	.15	.3452
Amount of property tax	4065.53	6641.76	-2576.22	.0013**
Number of households per tubewell & shallow well	23.69	13.09	10.60	.3765
Number of village services	3.29	4.23	-.94	.0083**
Percentage of households with electricity	63.15	61.58	1.56	.9044
Number of households per one television set	16.04	7.28	8.75	.0039**
Percentage of households with motorcycles	10.70	9.27	1.43	.6099
Percentage of households with tin roof	91.44	90.75	.69	.4472
Percentage of households with toilet	40.38	38.83	1.54	.7660
Number of households per store	30.40	45.09	-14.69	.0251*
Number of types of agricultural credit institutions	1.90	2.17	.27	.3818
Total number of rice mills	2.41	2.73	-.32	.4118
Percentage of households whose members work as labour for hire	4.12	9.44	-5.31	.0499*
Percentage of households pursuing only agriculture	28.48	23.42	5.06	.8096
Average rice yield	287.26	259.36	27.89	.1730
Percentage of households using fertiliser in agriculture	72.30	79.14	-6.83	.6238
Percentage of households farming in the dry season	18.11	9.84	8.26	.1760
The size of public grazing land	73.29	74.47	-1.18	.2964
Percentage of households practising fresh water fishery	2.34	3.66	-1.32	.4608
Percentage of households pursuing fish culture	1.64	.65	.99	.9699
Percentage of households pursuing the most common industry	7.58	18.04	-10.45	.3532
Percentage of households with a small tractor	2.70	2.65	.05	.3834
Percentage of households who have enough land for farming	80.12	83.59	-3.47	.4464
The village area	2929.53	3274.26	-344.72	.0028**
Percentage of 14-50 year-old illiterate persons	1.97	4.30	-2.33	.4212
Total number of training courses held (in the past two years)	7.58	7.32	.25	.8880
Number of community cultural activities (in the past two years)	10.78	13.91	-3.13	.1033
Number of community sport activities (in the past two years)	4.53	1.97	2.55	.0145*
Percentage of children suffering malnutrition level 2	4.80	2.76	2.04	.0845
Percentage of 15-44 year-old couples using birth control services	74.07	68.73	5.33	.3425
Percentage of houses in good sanitary condition	50.02	46.63	3.39	.5684
Percentage of households whose members work outside sub-district	27.48	18.80	8.67	.0219*
Number of dispute and crime reports per 100 households	4.32	2.02	2.30	.1899

* Significant at 5 percent level, $P < .05$

** Significant at 1 percent level, $P < .01$

Table 6-2: Differences in the Predicted Groups Between Failure (0) and Success (2)

From Table 6-2, a predicted successful village is larger in terms of its population and area. Villages with a higher number of services may indicate that these communities have received greater attention than other villages from the government in the past. The economy of successful villages appears to be diversified, with fewer households pursuing only agriculture, more families with members working as labour for hire, and more households participating in common industries. It should be noted that villagers in a predicted successful village tend to remain in the village instead of seeking work outside sub-district. Also, the number of disputes and crime reports are lower than a predicted failure village. Furthermore, the percentage of children suffering malnutrition level 2 is also lower. Collectively, these factors suggest that a predicted successful village tends to be socially and economically well balanced and stable. On the other hand, villages where the VFP has failed are smaller, poorer, and have more problems. The economy of these villages appears to rely on agriculture and jobs outside the sub-district.

From the above analysis, the characteristics of the predicted successful village differ somewhat from those communities practising communal resource management systems, based on the literature discussed in Chapter III. While this study found that a larger, wealthier, and better connected village is more likely to succeed than a smaller, poorer, and more isolated one, the CRM literature indicates that the traditional management of common property resources usually is developed and successful in small communities with similar needs, clear boundaries, and a close relationship among community members. However, the results are consistent with the social aspect of community characteristics, since social harmony and community cohesion were found to be related to the success of CRM in both this study and the literature. One distinction that should be noted between the CRM research and the VFP is that, mostly, traditional CRM activities are developed in a community out of necessity or critical need, while the VFP was promoted and introduced to villages independent of necessity. Unlike the management of communal irrigation or public grazing land, the VFP is not critical to village life. Rather it is a form of investment or commitment to improve the standard of living in a village.

In general, predicted successful villages, compared to predicted failure villages, are characterised by larger population and territory, higher economic status, more peaceful relations

and with fewer migratory workers seeking work outside sub-district. These findings suggest that the VFP does not fit the definition of the poorest communities it was designed for, since the poorer communities have a lower chance of success in implementing and sustaining the project than wealthier villages. As a result, it can be concluded that even though all participating villages were willing to implement the VFP and all received the same standard of support from the DOF, only the better-off villages were able to implement and sustain the project successfully.

6.2 Predictive Model 2 and Model 3

Model 2 and Model 3 were found to be moderately valid and invalid respectively. However, they deserve some further discussion especially to speculate on why the research expectations were not met. The independent variables selected to be included in both Model 2 and Model 3 do not merit further discussion, since the predictive power of Model 2 was low and Model 3 was found to be invalid. The normal probability plot of standardised residuals (Figure 5-3 and Figure 5-4) and the classification table (Table 5-7 and 5-9) for each model indicate that they do not fit well with the data they were developed from.

Closer examination of the Model 2 normal probability plot of standardised residuals in Figure 6-1 indicates that most of the points do cluster around a straight line, except at the middle of the plot. The small square, in Figure 6-1, highlights an area in which the points cluster below the straight line and are cases for which the model does not fit well. Surprisingly, these points do not represent the incorrectly predicted villages, but they represent over-estimated predicted values for correctly predicted indeterminate villages. These over-estimated predicted values make the standardised residual values lower than expected, if the assumption of a normal distribution is true. In general, it seems that Model 2 almost fits the data, but it over-estimates the predicted values in some of the indeterminate villages. Hence, a reasonable explanation for the relative failure of Model 2 may be that there were problems with the indeterminate group classification procedure. This group was the largest, containing 45.8 percent (94 out of 205 villages) of all villages sampled. By itself, it merits attention and some discussion regarding its effect on model construction.

However, before discussing this group, Model 3 is discussed as its failure may also relate to the indeterminate group.

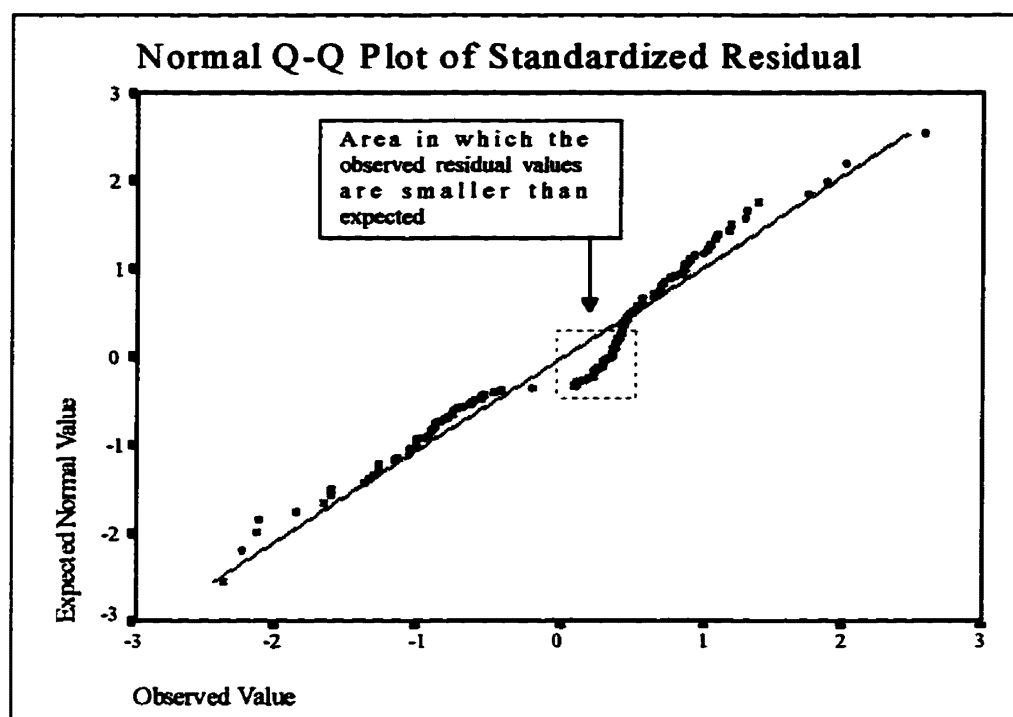


Figure 6-1: Repeated Model 2 Normal Probability Plot of Standardised Residuals

The normal probability plot of standardised residuals (Figure 6-2) for Model 3 also indicates that the model does not fit the data because the points do not cluster around a straight line. Careful examination of Figure 6-2 highlights two areas where the model actually predicts villages as belonging to the wrong group. The villages in these areas contain predicted probability values close to the cut-off value (0.5) which means they have very high probabilities of being assigned to the incorrect group. It implies that the characteristics of these two groups are too similar to be distinguished by the information available for the model building process.

There are two possible explanations for this. First, it is likely that this study is missing some key variables that should have been included in the analysis. Second, the classification

procedure used in this study may not be sufficiently rigorous to classify clearly the successful and the indeterminate categories. Looking at the overall pattern of results and possible explanations, it seems that the second reason is likely to be the most reasonable explanation. While Model 1 was successfully constructed without the indeterminate group present, Model 2 and Model 3 were not successfully constructed due to the problems related to the indeterminate group. Most likely the problems in both Model 2 and Model 3 are related and point to the indeterminate group as a possible reason for their relative failure in the overall modelling framework. First, Model 2 overestimates the predicted probability values in the indeterminate group. Second, Model 3 has difficulty in distinguishing the indeterminate villages from the successful villages. Since this indeterminate group contains villages that cannot be classified clearly as either a success or failure, it is possible that it may contain villages that have characteristics of both successful and failure groups.

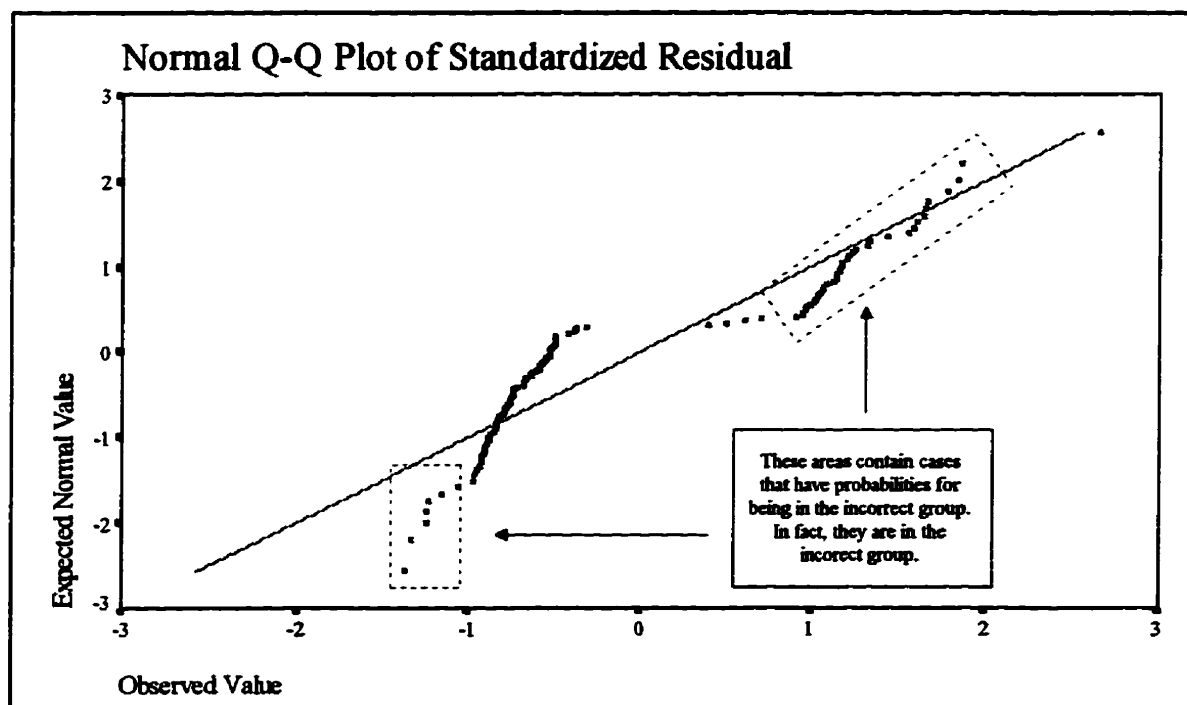


Figure 6-2: Repeated Model 3 Normal Probability Plot of the Standardised Residual

The problems related to the indeterminate category, discussed above, indicate a need to investigate this category. In general, a predictive model can be developed from the distinction between two different outcomes. However, if the groups are not clearly distinct from each other, the resulting model will fail to predict outcomes with an acceptable level of accuracy. This seems to be the case in Model 2 and Model 3 where the two outcomes are compounded by the inclusion of a third group that may contain aspects of both possibilities. The main questions to be asked here are: what, in reality, constitutes the indeterminate group?; does this group differ from the successful or the failure group due to its degree of independence?; or, is the indeterminate group in fact a mixture of the unclassifiable successful and failure villages, because the evaluation time period is too short?

Constrained by the short evaluation period, indeterminate group membership may contain some of the villages that later can be classified unambiguously into the successful or failure groups. The findings indicated in Chapter V support this conclusion, since 13 villages abandoned the VFP after the limited five year evaluation period. This clearly indicates that the evaluation time period used in the thesis is too short. In order to clarify this issue, a research study with a longer evaluation period and a larger number of sample villages is needed.

Although the indeterminate group may contain some of the successful or failure villages which cannot be classified yet, some villages may legitimately belong to this category since they are willing to continue the VFP, even though the project was not so successful. As noted earlier, since the capacity for community management is not well developed in all villages, it is possible that some villages may be willing to try to continue and sustain the VFP with a lesser degree of success. Due to their lower ability in community management, these villages should be distinguishable from both successful or failure groups, even though their characteristics may be closer to the successful group than the failure group. Similarly, Alves and Morrill (1975) noted that, in the adoption of an innovation, there are different levels of acceptance and degrees of commitment to an idea.

It is generally accepted that potential adopters can be divided into five categories: 1) *innovators*; 2) *early adopters*; 3) *early majority*; 4) *late majority*, and 5) *laggards*, according to their *innovativeness*, which is related to the degree an individual or other unit of adoption is able to adopt new ideas in relation to other members of the social system (Rogers, 1983). The five adopter categories clearly have specific characteristics that differ from each other. For example, more educated farmers seek and use new technologies to a greater degree than less educated ones and thus tend to be early adopters of innovations (Ilbery, 1985). Thus, some of the VFP villages should be classified into the indeterminate category according to their lesser degree of success and independence, even though predictive Model 2 and, especially, Model 3 were not successfully developed in this thesis.

6.3 Conclusions

The following are conclusions derived from the construction and validation of the prediction of VFP outcomes among the Northeast Thai communities studied in this thesis.

First, although the community, as such, is but one element in an explanation of the differences in the outcomes of the VFP, community characteristics, which are the focus of this thesis, remain critical as demonstrated by Model 1. With only nine community characteristic variables, Model 1 can correctly predict the likelihood of success or failure of the sampled villages with about 70-78% accuracy. The 20-30% not predicted correctly could be due to the limited amount of data available, which may exclude several relevant factors, and also the shortness of the evaluation period, as discussed above. However, it is clearly demonstrated that Model 1 can predict the success and failure of the VFP of the sampled villages at a level exceeding that which could be obtained by chance. In the Model 1, ZPTAX, representing community experiences in establishing and managing collective activities and community economic resources, is the most influential variable. In addition, WELL, HHPERTV, SOIL_QUAL1, GEN_HEALTH2, INDUSTRY1, ZACTIVITY2, FRE_RAISER, and SHOP have smaller contributions to the model. As a result, it can be concluded that it is possible, within limits of the knowledge obtained from

theoretical considerations and past research, to specify the factors that can reasonably predict success or failure of the VFP.

Second, although predictive accuracy dropped when applied to the validating sample, the predictive accuracy of Model 1 remains relatively high and at an acceptable level. However, whether or not this accuracy will remain relatively constant across different samples is a question for more study with much larger sample size and other possibly relevant bio-physical variables.

Third, the indeterminate category is a major problem in developing Model 2 and Model 3. Further investigation of the definition of project outcome classifications used in this thesis and a longer evaluation period is required. Although its role cannot be confirmed by Model 2 and Model 3, it is theoretically reasonable to expect some villages to fall into an intermediate category, between complete success and complete failure (discontinuance). The problem of developing Model 2 and Model 3 seems to be in the shortness of the evaluation period used in this study. Since the indeterminate group is relatively large (94 villages or 46% of 205 villages) and contains some villages which might be classified as a success or failure in the future, it is recommended a longer evaluation period be used. With a longer evaluation period, if there is another group that falls in between the success and failure groups as discussed, this group should stand out clearly.

Fourth, considering the characteristics of the most-likely-to-succeed villages, the results of this study indicate that the VFP is not suitable for every village, especially the poorest ones. While the new rural planning system implemented in Thailand is well intentioned in giving the poorest villages the first priority for development, the development projects available for them must be properly designed to suit specific conditions and needs of the village. This result calls for an assessment of the suitability of all projects and for new ways to plan and design projects such as the VFP.

Fifth, since the VFP represents CRM activities/projects, the results of this study can be generalised to state that only some villages (communities) are suitable for or are able to adopt and sustain a particular CRM project. In addition, many of these villages need a lot of support to sustain project activities, even though they are willing to adopt or need the project.

The findings of this study are limited in several ways. A major limitation of the study is the small number of cases. The measurement of project success and the need for model validation divided the sample into smaller sub-samples. A second limitation is the limited number of independent variables used in the three models. The conceptual framework discussed in Chapter III and past research indicate more relevant independent variables should intentionally be included but they were not available from secondary sources in Thailand or may be very difficult to measure quantitatively in the field. The third limitation is the shortness of the evaluation period. However, as noted earlier, this study could not extend the evaluation period, since to do so would have reduced the number of sampled villages further. A limitation in interpreting the relationship between community characteristics and the dependent variable is that the community-oriented variables do not assess the community's ability to manage collective action by themselves, but rather they indirectly reflect the factors affecting that ability.

Despite these limitations, the findings bolster the argument that community characteristics can be used to predict the success or failure of development projects such as the VFP.

6.5 Summary

The results presented in Chapter V were reviewed and discussed. The most important result is Model 1 which serves as the objective of this thesis. Nine community characteristics were determined as the key factors in correctly predicting villages pre-classified as a success or failure in adopting the VFP. However, four of these variables affected the model in an unexpected direction.

Although the other two models were less than successful in predicting outcomes within reliable confidence limits, they suggest that the evaluation period is too short. The indeterminate group contains too many villages which later could be identified as either successes or failures. A longer evaluation period and closer attention to definition of and membership in the indeterminate group was recommended for future research in order to confirm its role.

In the next Chapter, the major findings are summarised and their implications for the DOF, rural development planning, and future research are discussed.

CHAPTER VII

CONCLUSIONS AND IMPLICATIONS

The data analyses reported and discussed in Chapters V and VI were concerned chiefly with the construction of three predictive models and the identification of community characteristics which contribute to the success, failure or mixed outcome of the VFP in north-east Thailand. In this concluding Chapter, it is appropriate to restate the major objective of the present study, to summarise briefly and conclude the major findings of the study, and to indicate some implications for future communal fish culture and rural development planning. Further, suggestions for future research based upon the results are provided. This Chapter is divided into three sections. In the first section, the major findings of the study are summarised. The second section focuses on the policy implications of the results with respect to the successful adoption of communal fish culture in particular and collective resource management in general. Finally, the conclusions of this thesis are stated.

7.1 Summary of the Study's Findings

The purpose of this study was to develop and test a predictive model that allows the identification of community characteristics which contribute to the success, failure or mixed outcomes of the VFP in north-east Thailand. With this specific objective in mind, the study examined how characteristics of the communities participating in the VFP affect the outcomes of the project.

The conceptual framework that served as the basis for this study was based on a CRM model of rural development, community studies and adoption of innovations theory, as discussed in

Chapter III. Several factors were determined that influence project outcomes. However, in considering their utility for predictive purposes, community characteristics were identified as the most important variables to be used in the predictive model. By using community characteristics as independent variables and project outcomes as the dependent variable, a backward stepwise logistic analysis was applied to test the model.

The study was based on 1986 and 1989 village-level data from the *Institute for the Processing of Information for Education and Development* (IPIED) at Thammasat University in Bangkok and primary VFP data collected by a questionnaire survey in 1993 from VFP villages established during the period of 1986 to 1989. A total sample of 205 villages was available for this study and 38 independent variables were selected from the village-level database. The following sub-sections summarise the major results.

7.1.1 *Classification of Outcomes of the VFP*

In order to predict the success or failure of a development project, first, acceptable definitions of project success and failure were established. At a first pass, evaluating the VFP project in the villages may seem to involve standard procedures, since almost every rural development project needs to be evaluated at one time or another. However, there are several evaluation approaches and each approach emphasises a different objective and proposes a somewhat different means of measuring success of a specific project. The success of the VFP in this study was defined as the degree to which a village actually practices and independently sustains the project. The underlining assumption of this definition is that the project is sustained independently by the beneficiaries, because the beneficiaries perceive that the project's social and economic impacts are positive and preferable. This is consistent with the community resource management literature discussed in Chapter II and III. Thus, in this study, the continuance and independence of project operations by the beneficiaries was selected as the main criteria for project evaluation.

As a result, 205 VFP villages in the Northeast of Thailand were classified into three categories according to their continuance in implementing the VFP and their ability to sustain independently the project's activities. The first category was the "Failure" category which contained 52 villages (out of 205 villages), or 25.4%, of the sample VFP village, that abandoned the VFP within the five year evaluation period. The "Success" category was assigned to those villages which demonstrated regularity in implementing the VFP and the ability to independently sustain the project's activities. There were 59 villages, or 28.8%, which were classified as a success. The remaining 94 villages or about 45.8% were classified into an "Indeterminate" category since they demonstrated an inability to sustain the project independently and because of their irregularity in performing project activities.

Usually, evaluation research aims to measure project performance and to determine factors affecting the success or failure of a project. As a result, the project can be improved to help it to be implemented more successfully. However, the primary objective of this study was to group the VFP villages according to their degree of success in order to construct a predictive model with project outcomes as the dependent variable.

7.1.2 The Predictive Models

Since the dependent variable is a categorical variable, logistic regression analysis (LRA) was selected for statistical analysis. In order to keep the data analysis and the interpretation of the results as clear as possible, this variable was divided into three dichotomous dependent variables (success/failure; success/indeterminate; and failure/indeterminate). As a result, three independent predictive models needed to be analysed. The main focus of this thesis was on the first model, which represents the prediction of which villages are more likely to succeed in implementing the VFP and which ones are more likely to fail. The second and third predictive models were constructed to predict the likelihood of being in the indeterminate or failure category and being in the indeterminate or success category respectively.

Out of 205 sample villages, 20% were randomly selected to be used as a validating sample in order to ensure that the resulting predictive models could be used effectively across samples other than the original one. This left 160 villages to be used as the model building sample. From the nationally collected Thai village-level database, 38 independent variables were selected according to the relevance of each variable to the factors affecting the project outcomes identified from the literature. Most of the independent variables were standardised to make them comparable for analysis purposes. By applying backward stepwise logistic regression analysis with the known dependent variables from the questionnaire survey and observed independent variables from the village-level database (for the same villages), the three predictive models were constructed.

From the statistical analysis, only the first predictive model satisfactorily fitted the data it was developed from. Supported by the validation procedure, the model is valid with a 70.83 percent level of accuracy. The other two models, which respectively fit the data they were constructed from less well for both the model building and the validating samples, were less successful. It was suggested in Chapter VI that predictive Model 2 and Model 3 failed because of complications in the nature of the indeterminate group. Since the evaluation period was too short, the indeterminate group may contain many villages which later could be classified unambiguously into the success or failure categories.

The results for Model 1 can be written in the following form of logistic regression:

$$\text{Prob(event)} = \frac{1}{1+2.718^{-z}} , \quad \text{Equation 7.1}$$

where $z = 0.9625 + 1.0171 (\text{ZPTAX}) - 0.0357 (\text{WELL}) - 0.0417 (\text{HHPERTV}) + 0.0206 (\text{SHOP}) - 0.1299 (\text{FRE_RAISER}) + 0.0227 (\text{INDUSTRY1}) + 0.9381 (\text{SOIL_QUAL1}) - 0.4413 (\text{ZACTIVITY2}) - 0.0245 (\text{GEN_HEALTH2})$. This model contains nine community characteristics. The most influential variable is the ZPTAX which presumably represents the community's experiences in establishing and managing collective activities and community economic resources. The other variables are: WELL, HHPERTV, SOIL_QUAL1, GEN_HEALTH2, INDUSTRY1, ZACTIVITY2, FRE_RAISER, and SHOP which are in descending order according to their contribution to the model.

With only nine community characteristics in Model 1, the model correctly predicted 78.16 percent in the model building sample and 70.83 percent in the validating sample. Although the predictive power of this model is also somewhat modest, it is sufficient for pre-project screening of candidate villages and for being used in conjunction with other possible project assessment procedures. It should be noted that this predictive model was developed within the limitations of existing available data. Hence, its real advantage is that it does not require a survey or other data gathering techniques which may not be affordable or possible for a development agency in implementing a project on this scale with very limited time and resources. Results from the model construction and validation suggest that this model should be able to help planners reduce the risk of project failure and increase the probability of success of the VFP and other similar projects.

7.2 Implications and Recommendations

This study reveals a number of findings which have important implications in three areas: communal aquaculture development in Northeast Thailand, rural development strategy (in particular with respect to CRM), and research on community development and collective actions. Although the experience gained in one case may not be totally transferable or entirely relevant to another, there are many lessons that can be learned from the research presented in this thesis. The following are several specific suggestions and recommendations for policy-makers and development officers concerned with similar community-based development projects.

7.2.1 Implications and Recommendations for the Royal Thai Department of Fisheries

The most obvious contribution of this study is that it provides a methodology for the DOF to improve their VFP success rate. In this context, the present study provides a useful framework for developing a pre-screening method in the project approval process. It may also stimulate the DOF to design different kinds of projects or strategies for those villages that are unable to implement, or are unsuitable for, the VFP. As for other communal fish culture and CRM projects

elsewhere, the research approach used in this study should be applicable as a conceptual framework for models suitable for each of those projects. However, since the same community characteristics cannot be used interchangeably among countries or different projects. There may be variations in detail, but the concept should be applicable everywhere. In this context, one of the main contributions of the thesis may be in the area of project design rather than in the area of project approval. The results indicate that only a specific group of communities is able to adopt and sustain a specific community-based development project. Hence, target communities should be identified before designing a community development project and a capability strengthening strategy may be included in project implementation for those communities with lower ability to adopt and sustain the project.

In Chapter V, the classification of success indicated that only 28.8% or 59 out of 205 villages of the 1986-1989 VFP villages can be classified as successes. If the resulting predictive model were applied to select only those villages predicted to be more likely to succeed before the project started, there is a probability that 78.26% of them will succeed (Table 7-1). Therefore, the success rate would be doubled by using this predictive model. However, it should be noted that the predicted success group contains 21.74% of the failure villages which were incorrectly predicted as successful. An implication of this predictive model as a planning tool is that correctly predicting successful villages is the objective in applying this model. However, it needs to be recognised that the incorrectly predicted villages in the predicted success group comprise a limitation.

Observed	Predicted	
	Failure (0)	Success (2)
Failure (0)	32	10
Success (2)	9	36
Percent Correct	78.05	78.26

Table 7-1: Classification Table of the Predicted Success (2) and Failure(0)

Another consideration in using Model 1 is that the predicted failure villages contain 10.34% (9 villages) of the success villages which were incorrectly predicted as failure cases (Table 7-1). If only Model 1 were used in the project approval process, 10.34% of the villages with a

high probability of success will be rejected because the model wrongly predicts those villages as failure cases. Those villages will lose their chance for getting their project approved, even though they can successfully adopt and sustain the project. Planners need to recognise these limitations in using this predictive model. These limitations also indicate that Model 1 should incorporate other site selection procedures to be used together with the statistical analysis.

Although this predictive model is certainly a useful tool, it is not intended to replace face-to-face contact and dialogue between villagers and field workers in project planning activities or to replace other site assessment studies. However, it will help field workers identify target areas and give them some guidelines into what they should look for. By using this predictive model to reduce the number of candidate villages, other site assessment procedures, especially technical feasibility studies, can be used more effectively.

Generally, the use of a mathematical model indicating a relationship between two or more variables or parameters which allow prediction of one of the variables when the other(s) are known (such as the fish yield model) is not unfamiliar in fisheries research. However, a model that focuses on the socio-economic characteristics of the user is new in communal fisheries. As user ability is often given less consideration than the technical aspects of a project, research concerning the ability of the villagers to use and sustain fisheries technology is needed. Cernea (1986) noted that while many technologies are available for the “hardware” components of development projects, most often this is not the case for the institutional components and the socio-cultural aspects of these projects, which in no way are less important for the project’s ultimate success. In order to be effective in designing and implementing rural development projects, the DOF needs to add a social research component into its predominately technical research approach.

Although this study was aimed at developing a predictive model that can be used as a pre-screening tool for project approval, its contribution may be more important in terms of its impact on project design and implementation.

First, research results suggest that the present VFP does not appear to be suitable for very poor villages, since they will have a lower chance of success than wealthier villages. Therefore, promoting the VFP to the very poor and unsuitable villages may do them more harm than being without the project. Besides wasting both the village's and the government's time and resources, it potentially creates a bad impression among the poor toward the government and its development projects. Hence, if the needs of the poorest villages are to be served, a new form of fisheries development project, designed specifically for them, is required.

Second, by clearly defining the success of the VFP as the degree to which a village actually practices and independently sustains the project, it implies that to be successful the project activities need to become routine and self-perpetuating for community members. Hence, the most important strategy is to facilitate collective decision-making and subsequent performance rather than to induce the performance of project activities, which seem to be over emphasised in most community development projects sponsored by the government.

Third, because there are so many villages in the indeterminate category, even after five years of operation, the DOF should give more attention to these villages, especially during the second and third year of operation, before project support ends. Some methods of dialogue between the village and the DOF field workers should be established to identify problems or needs that the village must overcome to be able to manage the VFP independently. This means more work and higher cost for the DOF, but in the long run this will save the DOF money and the problems that will result if a village fails. Hence, it is recommended that the DOF should reduce the number of new projects established each year in order to reduce the work load and increase the institutional strengthening strategy in the second and the third year for those already established VFP villages.

7.2.2 *Implications and Recommendations for Rural Development Strategy*

Continuing difficulties with technical assistance projects in rural development suggest that a formidable gap remains between social research findings and the problems of planning and implementation. Studies on community responses to development projects have the potential for generating ideas and concepts that are valuable in designing projects for effective community development. Bromley (1971) criticises research on effective and efficient policy formulation because it seems that much less research has been conducted on what is feasible for a community to achieve than has been conducted on what the residents of that community *want* to achieve. While an evaluation of what they need is necessary, it is not sufficient. Their ability to achieve what they want with support from a development project becomes essential and should be assessed before the project is even started in order to minimise the chance of failure. This study supports Bromley's idea by demonstrating that even though villagers feel they need a project and they receive considerable support from the government, not all the villages are able to sustain the project's activities on their own. With specific respect to CRM, the feasibility of the promotion of the CRM model to rural communities depends heavily on the ability of community members to work together collectively. A recognition of differences in this ability among communities and a way to assess this ability becomes critical in promoting the CRM approach.

Since the main strategy of the present Thai national rural development policy and programme described in Chapter II is to achieve "goodness of fit" between people's needs and projects supplied by development agencies, it is assumed that the selected villages are the same and should be able to adopt every development project they need. As a result of the undifferentiated model of villages, only some villages will be able to take advantage of those projects and many other villages will fail, which is the case of the VFP, as stated in Chapter I.

The results of this study suggest that rural villages need to be differentiated on the basis of their ability to carry on development efforts by means other than just how poor they are or what they need. Therefore, every rural development project should be assessed on whether it is suitable for its

target group or not. The most important implication of this is that the differences among villages in their ability to carry on community-based development projects must be recognised as an integral part of rural development policy and strategy. Furthermore, experience has shown that development projects and new technologies generally tend to benefit better-off people who have the knowledge and resources to exploit opportunities and this increases the gap between the rich and the poor. Therefore, a method to identify who can and will adopt and also benefit from the introduced technologies and projects is greatly needed and becomes one of the essential components of rural planning and development.

Another contribution of this study is in the area of project evaluation. As long as the project is the basic instrument of development intervention, evaluation is crucial to understanding the results of this intervention. Oakley (1990) notes that evaluation has to do with measurement, judgement, and analysis, and is critical in terms of ensuring that any project is moving towards and accomplishing its intended objectives. However, a practical aspect of project evaluation is largely determined by the different interpretations ascribed to development. How development is understood or conceived will, in turn, have an effect on how it is put into practice, and therefore how it should be evaluated. Since new development paradigms place their emphasis on project sustainability and self-reliance, evaluation studies need to be adjusted in order to measure these concepts rather than matching project results with objectives or measuring its socio-economic impact on the target population.

As discussed in Chapter III, a development project must bring not just an improvement in physical and social conditions but also durable gains in people's abilities to control and sustain these conditions. By linking the concepts of development to project success, a new approach in evaluating a development project is aimed at measuring the performance of rural people (participants) in implementing and sustaining a project independently. This study demonstrates a relatively simple way of evaluating a community-based development project in achieving sustainability and self-reliance.

The findings of this study also have implications for public policy-makers and decision-makers in the development assistance community regarding resource management (CRM) and community development. Zekeri *et al.* (1994) note that although community action is a central theme in rural development policy in many developing countries, it remains a relatively neglected topic in comparative research and much remains to be learned about how and why rural communities vary in their extent of mobilisation to achieve development goals. This study has established the linkage between community characteristics and the community's ability to achieve sustainable development and self-reliance. This community collective ability becomes prominent because much of present rural development research and the CRM approach require this ability if communities are to survive and develop. As noted earlier, the experience gained from this thesis may not be totally transferable or entirely relevant to other areas. However, it is a step forward in establishing a conceptual framework and identifying an effective way to promote or replicate community resource management projects and collective actions required for rural development.

In another aspect of rural resource management, many projects have concentrated on developing a resource inventory and evaluation system, such as the development of remote sensing and *Geographic Information System* (GIS), in order to assess and determine the potential for development. Ngowi (1989) specifically indicates that assessing the suitability of land for specified purposes is increasingly being recognised as an essential part of land use planning and agricultural development. Nijkamp and Lojenga (1981) indicate that the recent emphasis of developing countries on their own development resources requires a methodology taking into account the spatial heterogeneity in development potentials of the successive regions in such countries. However, most of those suitability or potential assessment systems are concentrated only on bio-physical and economic aspects and lack the social aspect such as cultural constraints or ability/capability of the farmers or local institutions in using these resources. The result of this research may suggest a way to incorporate into the resource inventory and evaluation system a method in which the potential of the user can be assessed along with the resource potential.

Generally, planners and researchers require information and data that are simply not available and may take considerable time and resources to collect. But collecting more data and

information has not by itself overcome the recurring problems of project planning and implementation. Nor has it necessarily made planning and implementation more rational and systematic (Rondinelli, 1993). The data and information thought to be useful needs theory and methodology with which analyse and interpret them in order to be useful. In Thailand, there is much speculation on what the village-level database can be useful for, but there are very few applications developed to be used in the day-to-day operation of development agencies. The use of the village-level database in this study does not only demonstrate the usefulness of the existing database, but also shows/paves other ways to use it. This is particularly important as the government has already invested a great deal of time and effort in producing the data.

7.2.3 Implications and Recommendations for Future Research

Although this study successfully achieved its objective in developing a model to predict outcomes of the VFP in the Northeast villages, it is far from complete. Since the development of Model 2 and Model 3 failed in relative terms, compared to Model 1, and the issue of the indeterminate category is still unresolved, it was suggested that a longer evaluation period is needed to make the classification of the complete success, the complete failure, and the less successful (indeterminate category) outcome of the project more clear. Furthermore, a larger sample size and more independent variables may also help improve the study and the model's predictive power. As data on bio-physical and cultural aspects were not directly examined in this study, if possible, they should be included in future work. In addition, the accuracy and reliability of the secondary data (village-level database) used in the study can be assessed by collecting more detailed information in the questionnaire survey to verify or cross-check the secondary data. However, researchers need to know exactly what independent variables will be used in the analysis in order to design a questionnaire to collect appropriate information for verifying the secondary data without collecting unnecessary information.

This study provides some basic recommendations for further research and more general conceptual synthesis in future work on inducing collective actions in villages. First, if possible,

selected independent variables should be designed and collected before the project starts. In this study, the independent variables utilised were selected on an *a posteriori* basis. Consequently, they were limited to what was available, not to what should be included. Furthermore, the format of the available variables may not directly represent what the theory suggests is relevant. By designing the study and collecting the selected independent variables before the project even starts, these problems will be solved. This is similar to the recommendation made by Katz (1962) for the prediction of innovativeness. He suggested at that time that future efforts were needed to select independent variables for the prediction of innovativeness or adoption with more attention to theoretical considerations. However, this suggestion not followed extensively. A major step forward would be an *a priori* selection of variables to be utilised in model estimation.

A further step forward would be an integrated study of different collective activities or community-based development projects. Since this study was based on only one community-based development project (the VFP), the findings and the predictive model cannot be generalised to other projects. In order to generalise the community-level predictive model, further research should consider different types of community-based development projects.

From another perspective, it might be useful to examine the relationship between the government classification of rural villages (progressive, moderate and lagging) and the research classification of project outcomes (success, failure, and indeterminate) used in this thesis, since the results indicate that wealthier villages are more likely to succeed than poorer villages. Unfortunately, the classification of village data was not included in the village-level data obtained from the *Institute for the Processing of Information for Education and Development* (IPIED). Hence, this study cannot examine the relationship between the government classification of villages and the research classification of the project outcomes. Since a simple crosstabulation analysis should be able to analyse this relationship, the DOF should be able to performe the analysis easily after obtaining appropriate data.

An additional analysis that might improve the usefulness of this study is an use of the multinomial logit model. By using a polychotomous dependent variable of three categories

(success, failure, and indeterminate), the resulting model will include all three possibilities of the dependent variable into only one predictive model. If this three class model is successfully developed, it may be more useful than Model 1, since the three class model does not exclude the indeterminate group (as in the case of Model 1). The three class model in principle is more realistic than Model 1 and it may clarify the nature of indeterminate group. However, the multinomial logit model is more difficult to use and its results are also very difficult to interpret. Another aspect that should be taken into a consideration is the complication of the indeterminate group which led to the failure of Model 2 and Model 3. Since the characteristics of villages in the indeterminate group are very difficult to discriminate from the success and failure groups, as indicated in Chapter VI, the three class model may not yield a satisfactory result.

Although this study is mainly quantitative in its approach, it suggests the differences in a community's capability in implementing a development project and the need for the "community diagnosis" by planners and villagers be defined in both quantitative *and* qualitative terms. Plans for economic and social development are merely a paper exercise if community members lack the desire and the ability to implement those plans. Much more work is required to investigate the relationship between community characteristics and the community's ability in implementing development projects so that the community diagnosis can be developed.

7.3 Conclusion

Village-level management of natural resources and development efforts is clearly possible. Within the community, the necessary leadership and management skills exist and are waiting to be used. However, the promotion of community development and community-based resource management projects have failed in many instances. One of the problems identified by this study is that rural communities are often considered homogeneous when, in fact, they are generally heterogeneous. Differences in local history, ecology, resource base and production systems result in considerable heterogeneity in local forms of social organisation. These false assumptions of community homogeneity can make development initiatives confused and misguided. As a result, the

failure of community-based development projects in many villages is partly due to use of a uniform strategy for the whole region or even the country, without regard to the inter-community differences in the incidence of their ability and the nature of the environment in which the project was implemented.

In this thesis, an attempt has been made to develop an empirical predictive model using an available village-level database and field data to predict the success or failure of a community-based development project. Although the study sought to develop a predictive model to identify communities with high or low potential to successfully implement VFPs initiated by the Royal Thai Department of Fisheries, it was not intended only to provide a means to increase the project success rate. Rather, it was intended to explain why some villages fail to adopt and sustain the project successfully and thereby raise the concern of how community development should be targeted. Often in development efforts the poor are identified as the primary target group for development projects. However, this study demonstrates that poverty alone is not necessarily a sufficient basis upon which to build development efforts and different approaches are needed to solve the same problem.

An underlying assumption of the present study is that predicting the success or failure of community development projects before they start is a worthwhile effort for planners and policy makers. The research has proved that community factors play as important a role in the success of community development projects as technical and economic factors. This prediction has utility for planners who wish to know which communities in their target areas are most likely to implement successfully and sustain a project they are about to promote. There is also great practical utility in prediction for change agents (or field workers) who wish to understand more clearly the independent factors related to innovativeness, and the interrelationships among these independent variables. Although this prediction alone cannot guarantee a successful project, attention to important community characteristics associated with the success of the project can help match the project with the appropriate communities who are more likely to succeed.

Although the models developed in this study cannot be transferred exactly to other settings with the expectation of producing the same results, the principles and techniques involved may prove useful to others seeking to promote community management elsewhere. A lesson learned from this study is that more attention needs to be given to the way in which community members make decisions and work together as a whole unit to achieve their common goals or development. Greater emphasis is also required on research for improving planning techniques and strategies to promote community-based development projects. From information and experiences gained from this study, development efforts can be effectively channelled to arrive at a more systematic understanding of a community's behaviour. There is also an urgent need for adjusting the present VFP project planning process in Thailand in order to reduce project failures. Knowledge gained from this study or similar research should not only be used for the pre-screening of communities to participate in the VFP and similar development initiatives. It also should be used in project formulation and design in order to craft development projects that are suitable to their target communities.

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APPENDICES

APPENDIX I: TRANSLATION OF THE CLASSIFICATION QUESTIONNAIRE

Village Identification Number _____
VFP Identification Number _____
Pond Name _____
Village Name _____ Village Number _____
Sub-district _____ District _____
Province _____
Date _____

Section I.

1. Location of the pond?

_____ in the village
_____ outside the village (distance _____ meters)

2. Dike condition

_____ no dike
_____ good condition
_____ small damage but still workable
_____ damage (unworkable)

3. Water inlet and outlet

_____ no inlet and/or outlet
_____ good condition
_____ small damage but still workable
_____ damage (unworkable)

4. Water storage duration

- ☐ cannot store water
☐ less than 6 months
☐ 6-11 months
☐ year-round

5. Water colour

- ☐ green ☐ green and turbid
☐ muddy ☐ red brown
☐ clear ☐ others ()

6. Aquatic weed

- ☐ no aquatic weed
☐ less than 30%
☐ more than 30%

7. Depth

1. at the moment ____ meter
 2. in dry season ____ meter
 3. in rainy season ____ meter

8. Pond size ____ rai,

1. at the moment ____ rai,
 2. in dry season ____ rai,
 3. in rainy season ____ rai

9. Currently, is there fish culture in the pond or not?

- ☐ Yes ☐ No

10. If yes. What type of fish culture activity is taking place?

- ☐ fish introduced
☐ weed and predator fish removed
☐ fertiliser and/or manure applied
☐ fish and small animal integrated
☐ others ()
-

Section II.

1. How many villages own this pond? _____

1.1 Is there any problem related to the ownership?

☐ Yes ☐ No

1.2 If yes. What is it? _____

2. How many villages regularly use this pond? _____

2.1 Is there any problem related to the use of the pond?

☐ Yes ☐ No

2.2 If yes. What is it? _____

3. In your village area, are there other public ponds large enough for fish culture?

☐ Yes ☐ No

If, Yes. Answer the followed questions.

1. Pond name _____ Size _____ Fish culture _____

2. Pond name _____ Size _____ Fish culture _____

3. Pond name _____ Size _____ Fish culture _____

4. Is there fish culture in the pond?

☐ Yes ☐ No (When did you stop _____)

If no. Why?

- ☐ pond is dry
- ☐ not enough water
- ☐ people are not interested or do not want it
- ☐ have enough natural fish around
- ☐ others (_____)

4.1 Has your village ever thought about trying it again?

☐ Yes ☐ No

4.2 If no. Why? _____

4.3 If yes. What type of support would you like to have?

- ☐ pond excavation
- ☐ training
- ☐ fish food and fingerlings (fry)
- ☐ others (_____)

5. Before the VFP project started, how many households had private fish ponds? _____, and how many households have private fish ponds now? _____

6. Before the VFP project started, had this pond ever been used for fish culture?

☐ Yes (How long? _____ years) ☐ No

7. Who is the communal fish culture operator?

- | | |
|--|---|
| ☐ head of sub-district, | ☐ village chief, |
| ☐ village committee, | ☐ teacher, |
| ☐ monk, | ☐ senior, |
| ☐ nobody, | ☐ others (_____) |

8. What are peoples' attitudes toward the VFP project?

8.1 Before the project started.

_____ unaware _____ not interested _____ interested

8.2 When the project started.

_____ didn't participate _____ participated

8.3 Now.

_____ dissatisfied _____ neutral _____ satisfied

9. Please provides the following information of fish culture activities since the VFP was established.

9.1 How many fingerling (seed fish) was introduced each year?

9.2 How much it cost?

9.3 How do you harvest your fish?

9.4 How much money your village get from the pond each year?

Year	Number of Fish Introduced	Cost of Seed fish	Harvesting Methods	Income from the VFP
1986				
1987				
1988				
1989				
1990				
1991				
1992				
1993				

Table A-1: Information on Aquaculture Activities during 1986-1993

Section III. Interviewer's Conclusion

1. Is this pond adequate for fish culture, or not?

____ Adequate. Why _____

____ Inadequate. Why _____

2. Is there communal fish culture in the pond?

____ Yes.

____ No.

APPENDIX II: CORRELATION MATRIX BETWEEN INDEPENDENT VARIABLES

Variable Name	ZHH	MEMBERS	ZPTAX	WELL	ZVILL SERV	ELECTRIC
ZHH	1.0000 P= .	-.0023 P= .974	.5077 P= .000**	.3066 P= .000**	.3535 P= .000**	.0786 P= .263
MEMBERS	-.0023 P= .974	1.0000 P= .	-.0053 P= .940	.0179 P= .799	-.1061 P= .130	-.1422 P= .042
ZPTAX	.5077 P= .000**	-.0053 P= .940	1.0000 P= .	.1377 P= .049	.1986 P= .004**	.1786 P= .010
WELL	.3066 P= .000**	.0179 P= .799	.1377 P= .049	1.0000 P= .	.0922 P= .189	-.1006 P= .151
ZVILL_SERV	.3535 P= .000**	-.1061 P= .130	.1986 P= .004**	.0922 P= .189	1.0000 P= .	.0653 P= .353
ELECTRIC	.0786 P= .263	-.1422 P= .042	.1786 P= .010	-.1006 P= .151	.0653 P= .353	1.0000 P= .
HHPERTV	.0136 P= .846	-.0355 P= .613	-.0588 P= .402	.0414 P= .555	-.1675 P= .016	-.3556 P= .000**
VEHICLE2	.0559 P= .426	-.1266 P= .071	.1125 P= .108	.0203 P= .773	.0163 P= .816	.2575 P= .000**
ROOF2	.0237 P= .736	.0183 P= .795	.1376 P= .049	-.0726 P= .301	-.0804 P= .252	.2039 P= .003**
LATRINE1	.0706 P= .314	-.0859 P= .221	.2856 P= .000**	-.0846 P= .228	.0406 P= .563	.5020 P= .000**
SHOP	.2015 P= .004**	.0088 P= .901	.1763 P= .011	-.0353 P= .615	.2071 P= .003**	-.1549 P= .027
ZAGCREDIT	.2423 P= .000**	-.2105 P= .002**	.2253 P= .001**	.0876 P= .212	.1801 P= .010	.2401 P= .001**
ZMILL	.5483 P= .000**	.0196 P= .780	.3052 P= .000**	.0588 P= .403	.1880 P= .007**	.0974 P= .165
LABOUR	.0229 P= .745	.0635 P= .366	.0144 P= .837	.0038 P= .956	-.0707 P= .314	.0351 P= .617
AGJOB	-.1193 P= .088	.1555 P= .026	-.1506 P= .031	-.0617 P= .380	-.2213 P= .001**	-.0434 P= .537
RICE_PROD	.0886 P= .206	-.1150 P= .101	-.0493 P= .483	.0767 P= .275	.1451 P= .038	.1251 P= .074
FERTILIZ	-.0513 P= .465	.1574 P= .024	.0278 P= .692	-.1320 P= .059	-.0406 P= .563	.0714 P= .309
DRY_AGR	.0385 P= .584	-.0758 P= .280	-.0008 P= .991	-.0016 P= .982	.0888 P= .205	.1739 P= .013
ZPUB_FIELD2	.1253 P= .074	.0274 P= .696	.0981 P= .162	.1623 P= .020	.0170 P= .808	-.0294 P= .676

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZHH	MEMBERS	ZPTAX	WELL	ZVILL SERV	ELECTRIC
FRE_FISHER	.0120 P= .865	.0888 P= .206	.0204 P= .771	-.0692 P= .324	.0350 P= .619	.0867 P= .216
FRE_RAISER	.0268 P= .703	-.0480 P= .495	.0324 P= .645	-.0969 P= .167	.0528 P= .452	.0644 P= .359
INDUSTRY1	.0848 P= .227	-.0682 P= .331	.0908 P= .195	-.0180 P= .798	.0305 P= .664	.0241 P= .731
AGRTOOL3	.1238 P= .077	-.0827 P= .238	.2957 P= .000**	.0668 P= .341	-.0289 P= .681	.0991 P= .158
LAND1	.0173 P= .806	-.0006 P= .993	.0215 P= .760	.0448 P= .524	-.0552 P= .432	-.0728 P= .299
ZAREA	.5204 P= .000**	-.0356 P= .612	.4062 P= .000**	.2694 P= .000**	.2250 P= .001**	.0651 P= .354
SCHOOLING	-.0429 P= .542	-.0170 P= .809	.0607 P= .387	-.0021 P= .976	-.0091 P= .896	-.0336 P= .633
ZTRAINING	.1957 P= .005**	-.0755 P= .282	.1874 P= .007**	.0273 P= .697	.1843 P= .008**	.0131 P= .852
ZACTIVITY1	.0530 P= .451	.0136 P= .846	.1658 P= .018	-.0336 P= .632	.0846 P= .228	.2047 P= .003**
ZACTIVITY2	.1775 P= .011	.2149 P= .002**	.1735 P= .013	.0032 P= .964	.0106 P= .880	.0943 P= .179
STARV2	-.1479 P= .034	.1856 P= .008**	-.1606 P= .021	.0510 P= .468	-.1536 P= .028	-.2102 P= .002**
GEN_HEALTH1	.0205 P= .771	.0150 P= .831	.1130 P= .107	.0294 P= .676	.0438 P= .533	.2368 P= .001**
GEN_HEALTH2	.1530 P= .028	-.0358 P= .611	.2528 P= .000**	-.0849 P= .226	.0787 P= .262	.2450 P= .000**
WORK_FORCE	-.1597 P= .022	.1424 P= .042	-.0920 P= .189	-.0629 P= .370	-.1557 P= .026	-.0324 P= .644
LAW	-.0352 P= .617	.1005 P= .151	-.0356 P= .613	.0043 P= .951	-.0965 P= .169	-.0288 P= .682

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	HHPERTV	VEHICLE2	ROOF2	LATRINE1	SHOP	ZAGCREDIT
ZHH	.0136 P= .846	.0559 P= .426	.0237 P= .736	.0706 P= .314	.2015 P= .004**	.2423 P= .000**
MEMBERS	-.0355 P= .613	-.1266 P= .071	.0183 P= .795	-.0859 P= .221	.0088 P= .901	-.2105 P= .002**
ZPTAX	-.0588 P= .402	.1125 P= .108	.1376 P= .049	.2856 P= .000**	.1763 P= .011	.2253 P= .001**
WELL	.0414 P= .555	.0203 P= .773	-.0726 P= .301	-.0846 P= .228	-.0353 P= .615	.0876 P= .212
ZVILL_SERV	-.1675 P= .016	.0163 P= .816	-.0804 P= .252	.0406 P= .563	.2071 P= .003**	.1801 P= .010
ELECTRIC	-.3556 P= .000**	.2575 P= .000**	.2039 P= .003**	.5020 P= .000**	-.1549 P= .027	.2401 P= .001**
HHPERTV	1.0000 P= .	-.1695 P= .015	.0285 P= .685	-.2493 P= .000**	.1807 P= .010	-.1224 P= .080
VEHICLE2	-.1695 P= .015	1.0000 P= .	.1311 P= .061	.3159 P= .000**	-.0985 P= .160	.2147 P= .002**
ROOF2	.0285 P= .685	.1311 P= .061	1.0000 P= .	.1658 P= .018	-.0023 P= .974	.1245 P= .075
LATRINE1	-.2493 P= .000**	.3159 P= .000**	.1658 P= .018	1.0000 P= .	-.1108 P= .114	.1652 P= .018
SHOP	.1807 P= .010	-.0985 P= .160	-.0023 P= .974	-.1108 P= .114	1.0000 P= .	-.0180 P= .797
ZAGCREDIT	-.1224 P= .080	.2147 P= .002**	.1245 P= .075	.1652 P= .018	-.0180 P= .797	1.0000 P= .
ZMILL	-.0380 P= .589	.1172 P= .094	.0976 P= .164	.0622 P= .375	.0675 P= .336	.1739 P= .013
LABOUR	-.0601 P= .392	.0656 P= .350	-.0455 P= .518	-.0610 P= .385	.0707 P= .314	.0191 P= .785
AGJOB	.1188 P= .090	-.1320 P= .059	.1715 P= .014	-.1707 P= .014	.0721 P= .304	-.0422 P= .548
RICE_PROD	-.0881 P= .209	.1311 P= .061	-.2143 P= .002**	.0907 P= .196	.0311 P= .658	.1182 P= .091
FERTILIZ	.0333 P= .635	-.0504 P= .473	.3500 P= .000**	.0157 P= .823	.0489 P= .486	-.0149 P= .832
DRY_AGR	-.0315 P= .654	.1259 P= .072	.0320 P= .649	.1785 P= .010	.0507 P= .470	.0797 P= .256
ZPUB_FIELD2	.0386 P= .583	.0122 P= .862	.0448 P= .524	-.096 P= .171	.0606 P= .388	-.0418 P= .552
FRE_FISHER	.0559 P= .426	-.0287 P= .683	.1182 P= .091	.0690 P= .326	.0327 P= .642	-.0040 P= .955
FRE_RAISER	-.0794 P= .258	.1091 P= .119	.0474 P= .500	.1419 P= .042	.0521 P= .458	.0168 P= .812

(Coefficient / 2-tailed Significance)

"." is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	HHPERTV	VEHICLE2	ROOF2	LATRINE1	SHOP	ZAGCREDIT
INDUSTRY1	.0849 P= .226	-.0308 P= .661	-.0370 P= .599	-.0041 P= .954	-.1086 P= .121	.0904 P= .197
AGRTOOL3	-.0699 P= .319	.2809 P= .000**	.1030 P= .142	.2269 P= .001**	-.1136 P= .105	.2001 P= .004**
LAND1	.0604 P= .389	.0049 P= .945	.1440 P= .039	-.0048 P= .946	.1171 P= .095	.0098 P= .889
ZAREA	-.0349 P= .619	.0787 P= .262	-.0774 P= .270	.1194 P= .088	.0488 P= .487	.1670 P= .017
SCHOOLING	-.0322 P= .646	-.0333 P= .636	-.1206 P= .085	-.0980 P= .162	-.0216 P= .759	-.0775 P= .269
ZTRAINING	.0491 P= .485	-.0033 P= .962	.0214 P= .760	.1374 P= .049	.1944 P= .005**	.0823 P= .241
ZACTIVITY1	-.1428 P= .041	.1053 P= .133	.0928 P= .186	.1396 P= .046	-.0977 P= .163	.1576 P= .024
ZACTIVITY2	-.0054 P= .938	-.0251 P= .721	.0863 P= .218	.0611 P= .385	-.0069 P= .922	.1107 P= .114
STARV2	.0679 P= .333	-.0664 P= .344	-.0543 P= .440	-.1017 P= .147	-.0116 P= .868	-.0695 P= .322
GEN_HEALTH1	-.0958 P= .172	.0152 P= .829	.1112 P= .112	.2894 P= .000**	-.1121 P= .110	.0264 P= .707
GEN_HEALTH2	-.1277 P= .068	.0959 P= .172	.1453 P= .038	.4251 P= .000**	.0295 P= .674	.1382 P= .048
WORK_FORCE	.0522 P= .458	-.0031 P= .965	.3361 P= .000**	.1455 P= .037	-.1666 P= .017	.0450 P= .522
LAW	.0114 P= .871	.0269 P= .702	.0620 P= .377	-.1252 P= .074	.0081 P= .909	.0489 P= .486

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZMILL	LABOR	AGJOB	RICE PRO	FERTILIZ	DRY AGR
ZHH	.5483 P= .000**	.0229 P= .745	-.1193 P= .088	.0886 P= .206	-.0513 P= .465	.0385 P= .584
MEMBERS	.0196 P= .780	.0635 P= .366	.1555 P= .026	-.1150 P= .101	.1574 P= .024	-.0758 P= .280
ZPTAX	.3052 P= .000**	.0144 P= .837	-.1506 P= .031	-.0493 P= .482	.0278 P= .692	-.0008 P= .991
WELL	.0588 P= .403	.0038 P= .956	-.0617 P= .380	.0767 P= .275	-.1320 P= .059	-.0016 P= .982
ZVILL_SERV	.1880 P= .007**	-.0707 P= .314	-.2213 P= .001**	.1451 P= .038	-.0406 P= .563	.0888 P= .205
ELECTRIC	.0974 P= .165	.0351 P= .617	-.0434 P= .537	.1251 P= .074	.0714 P= .309	.1739 P= .013
HHPERTV	-.0380 P= .589	-.0601 P= .392	.1188 P= .090	-.0881 P= .209	.0333 P= .635	-.0315 P= .654
VEHICLE2	.1172 P= .094	.0656 P= .350	-.1320 P= .059	.1311 P= .061	-.0504 P= .473	.1259 P= .072
ROOF2	.0976 P= .164	-.0455 P= .518	.1715 P= .014	-.2143 P= .002**	.3500 P= .000**	.0320 P= .649
LATRINE1	.0622 P= .375	-.0610 P= .385	-.1707 P= .014	.0907 P= .196	.0157 P= .823	.1785 P= .010
SHOP	.0675 P= .336	.0707 P= .314	.0721 P= .304	.0311 P= .658	.0489 P= .486	.0507 P= .470
ZAGCREDIT	.1739 P= .013	.0191 P= .785	-.0422 P= .548	.1182 P= .091	-.0149 P= .832	.0797 P= .256
ZMILL	1.0000 P= .	.0259 P= .712	-.0188 P= .789	.0209 P= .766	.1777 P= .011	-.0915 P= .192
LABOUR	.0259 P= .712	1.0000 P= .	-.1643 P= .019	-.0985 P= .160	-.1514 P= .030	-.1246 P= .075
AGJOB	-.0188 P= .789	-.1643 P= .019	1.0000 P= .	-.1457 P= .037	.1860 P= .008**	-.0790 P= .260
RICE_PROD	.0209 P= .766	-.0985 P= .160	-.1457 P= .037	1.0000 P= .	-.1732 P= .013	.0325 P= .644
FERTILIZ	.1777 P= .011	-.1514 P= .030	.1860 P= .008**	-.1732 P= .013	1.0000 P= .	.0018 P= .979
DRY_AGR	-.0915 P= .192	-.1246 P= .075	-.0790 P= .260	.0325 P= .644	.0018 P= .979	1.0000 P= .
ZPUB_FIELD2	.1311 P= .061	-.0249 P= .724	.0271 P= .700	-.0476 P= .498	.0232 P= .741	.0420 P= .550
FRE_FISHER	.0783 P= .264	-.0804 P= .252	-.0058 P= .935	.0469 P= .504	.1335 P= .056	.1084 P= .122
FRE_RAISER	.0141 P= .841	.0535 P= .446	-.0661 P= .346	.0222 P= .752	-.1243 P= .076	-.0141 P= .841

(Coefficient / 2-tailed Significance)

"." is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZMILL	LABOR	AGJOB	RICE PRO	FERTILIZ	DRY AGR
INDUSTRY1	.0200 P= .776	.0096 P= .891	.0249 P= .723	-.0793 P= .259	.0547 P= .436	.1633 P= .019
AGRTOOL3	.0453 P= .519	-.0458 P= .514	-.1700 P= .015	.0839 P= .232	-.1120 P= .110	.0721 P= .304
LAND1	.0658 P= .348	-.1618 P= .020	.1053 P= .133	-.0437 P= .534	.0819 P= .243	.0739 P= .292
ZAREA	.2699 P= .000**	-.0598 P= .394	-.2034 P= .003**	.1480 P= .034	-.1874 P= .007**	-.0271 P= .699
SCHOOLING	.0240 P= .733	.0071 P= .920	-.0061 P= .931	.0557 P= .427	-.0363 P= .605	.0040 P= .955
ZTRAINING	.0852 P= .225	-.0570 P= .417	-.0692 P= .324	.0339 P= .630	.0183 P= .795	.0200 P= .776
ZACTIVITY1	.0909 P= .195	.0346 P= .622	-.0450 P= .521	-.1023 P= .144	.0915 P= .192	-.0417 P= .553
ZACTIVITY2	.1185 P= .091	-.0829 P= .237	-.0830 P= .237	-.0403 P= .566	.0891 P= .204	.0157 P= .823
STARV2	-.1472 P= .035	.0099 P= .888	.0753 P= .283	-.0945 P= .178	.0510 P= .468	-.0275 P= .695
GEN_HEALTH1	.0205 P= .771	-.1365 P= .051	-.0651 P= .353	-.0862 P= .219	.0537 P= .445	.1608 P= .021
GEN_HEALTH2	.0907 P= .196	.0623 P= .375	-.0610 P= .385	-.0854 P= .223	.1980 P= .004**	.0537 P= .444
WORK_FORCE	-.0166 P= .813	-.0189 P= .788	.0925 P= .187	-.1340 P= .056	.2702 P= .000**	-.0763 P= .277
LAW	-.0733 P= .296	-.0746 P= .288	.1161 P= .097	.0280 P= .690	-.0421 P= .549	-.0380 P= .588

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZPUB F12	FRE FISH	FRE RAIS	INDUSTRY1	AGRTOOL3	LAND1
ZHH	.1253 P= .074	.0120 P= .865	.0268 P= .703	.0848 P= .227	.1238 P= .077	.0173 P= .806
MEMBERS	.0274 P= .696	.0888 P= .206	-.0480 P= .495	-.0682 P= .331	-.0827 P= .238	-.0006 P= .993
ZPTAX	.0981 P= .162	.0204 P= .771	.0324 P= .645	.0908 P= .195	.2957 P= .000**	.0215 P= .760
WELL	.1623 P= .020	-.0692 P= .324	-.0969 P= .167	-.0180 P= .798	.0668 P= .341	.0448 P= .524
ZVILL_SERV	.0170 P= .808	.0350 P= .619	.0528 P= .452	.0305 P= .664	-.0289 P= .681	-.0552 P= .432
ELECTRIC	-.0294 P= .676	.0867 P= .216	.0644 P= .359	.0241 P= .731	.0991 P= .158	-.0728 P= .299
HHPERTV	.0386 P= .583	.0559 P= .426	-.0794 P= .258	.0849 P= .226	-.0699 P= .319	.0604 P= .389
VEHICLE2	.0122 P= .862	-.0287 P= .683	.1091 P= .119	-.0308 P= .661	.2809 P= .000**	.0049 P= .945
ROOF2	.0448 P= .524	.0082 P= .091	.0474 P= .500	-.0370 P= .599	.1030 P= .142	.1440 P= .039
LATRINE1	-.0960 P= .171	.0690 P= .326	.1419 P= .042	-.0041 P= .954	.2269 P= .001**	-.0048 P= .946
SHOP	.0606 P= .388	.0327 P= .642	.0521 P= .458	-.1086 P= .121	-.1136 P= .105	.1171 P= .095
ZAGCREDIT	-.0418 P= .552	-.0040 P= .955	.0168 P= .812	.0904 P= .197	.2001 P= .004**	.0098 P= .889
ZMILL	.1311 P= .061	.0783 P= .264	.0141 P= .841	.0200 P= .776	.0453 P= .519	.0658 P= .348
LABOUR	-.0249 P= .724	-.0804 P= .252	.0535 P= .446	.0096 P= .891	-.0458 P= .514	-.1618 P= .020
AGJOB	.0271 P= .700	-.0058 P= .935	-.0661 P= .346	.0249 P= .723	-.1700 P= .015	.1053 P= .133
RICE_PROD	-.0476 P= .498	.0469 P= .504	.0222 P= .752	-.0793 P= .259	.0839 P= .232	-.0437 P= .534
FERTILIZ	.0232 P= .741	.1335 P= .056	-.1243 P= .076	.0547 P= .436	-.1120 P= .110	.0819 P= .243
DRY_AGR	.0420 P= .550	.1084 P= .122	-.0141 P= .841	.1633 P= .019	.0721 P= .304	.0739 P= .292
ZPUB_FIELD2	1.0000 P= .	-.0298 P= .671	.1098 P= .117	-.0726 P= .301	.0294 P= .675	-.0240 P= .733
FRE_FISHER	-.0298 P= .671	1.0000 P= .	-.004 P= .954	.0598 P= .394	-.0540 P= .442	.0481 P= .493
FRE_RAISER	.1098 P= .117	-.0040 P= .954	1.0000 P= .	-.0067 P= .924	-.0165 P= .814	.0210 P= .765

(Coefficient / 2-tailed Significance)

"." is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZPUB F12	FRE FISH	FRE RAIS	INDUSTRY1	AGRTOOL3	LAND1
INDUSTRY1	-.0726 P= .301	.0598 P= .394	-.0067 P= .924	1.0000 P= .	.0033 P= .962	.0516 P= .462
AGRTOOL3	.0294 P= .675	-.0540 P= .442	-.0165 P= .814	.0033 P= .962	1.0000 P= .	-.0197 P= .779
LAND1	-.0240 P= .733	.0481 P= .493	.0210 P= .765	.0516 P= .462	-.0197 P= .779	.10000 P= .
ZAREA	.2462 P= .000**	.0216 P= .759	.1284 P= .067	-.0230 P= .743	.0916 P= .191	.0080 P= .909
SCHOOLING	-.0406 P= .563	-.0340 P= .628	-.0389 P= .579	-.0066 P= .925	.0484 P= .491	-.1250 P= .074
ZTRAINING	.0250 P= .722	-.0314 P= .655	-.0183 P= .795	.0215 P= .760	.0895 P= .202	.1107 P= .114
ZACTIVITY1	.0045 P= .950	-.0850 P= .225	-.0217 P= .757	.0896 P= .201	.0691 P= .325	.0624 P= .374
ZACTIVITY2	.0945 P= .178	.0045 P= .949	-.0027 P= .970	.0086 P= .903	.0433 P= .537	-.0233 P= .740
STARV2	-.0164 P= .815	-.0459 P= .513	-.0753 P= .284	.0565 P= .421	.0184 P= .793	-.0218 P= .756
GEN_HEALTH1	-.0682 P= .331	.0690 P= .326	.0164 P= .815	.1179 P= .092	.0454 P= .518	-.0736 P= .295
GEN_HEALTH2	-.1595 P= .022	-.0052 P= .941	.0043 P= .951	.1853 P= .008**	.1071 P= .126	-.0309 P= .660
WORK_FORCE	.0154 P= .826	.1241 P= .076	.0478 P= .496	.0080 P= .910	-.0093 P= .895	.0110 P= .876
LAW	.0692 P= .324	-.0170 P= .809	-.0478 P= .496	-.0751 P= .285	.1705 P= .015	.0458 P= .515

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZAREA	SCHOOLING	ZTRAINING	ZACTIVITY1	ZACTIVITY2
ZHH	.5204 P= .000**	-.0429 P= .542	.1957 P= .005**	.0530 P= .451	.1775 P= .011
MEMBERS	-.0356 P= .612	-.0170 P= .809	-.0755 P= .282	.0136 P= .846	.2149 P= .002**
ZPTAX	.4062 P= .000**	.0607 P= .387	.1874 P= .007**	.1658 P= .018	.1735 P= .013
WELL	.2694 P= .000**	-.0021 P= .976	.0273 P= .697	-.0336 P= .632	.0032 P= .964
ZVILL_SERV	.2250 P= .001**	-.0091 P= .896	.1843 P= .008**	.0846 P= .228	.0106 P= .880
ELECTRIC	.0651 P= .354	-.0336 P= .633	.0131 P= .852	.2047 P= .003**	.0946 P= .179
HHPERTV	-.0349 P= .619	-.0322 P= .646	.0491 P= .485	-.1428 P= .041	-.0054 P= .938
VEHICLE2	.0787 P= .262	-.0333 P= .636	-.0033 P= .962	.1053 P= .133	-.0251 P= .721
ROOF2	-.0774 P= .270	-.1206 P= .085	.0214 P= .760	.0928 P= .186	.0863 P= .218
LATRINE1	.1194 P= .088	-.0980 P= .162	.1374 P= .049	.1396 P= .046	.0611 P= .385
SHOP	.0488 P= .487	-.0216 P= .759	.1944 P= .005**	-.0977 P= .163	-.0069 P= .922
ZAGCREDIT	.1670 P= .017	-.0775 P= .269	.0823 P= .241	.1576 P= .024	.1107 P= .114
ZMILL	.2699 P= .000**	.0240 P= .733	.0852 P= .225	.0909 P= .195	.1185 P= .091
LABOUR	-.0598 P= .394	.0071 P= .920	-.0570 P= .417	.0346 P= .622	-.0829 P= .237
AGJOB	-.2034 P= .003**	-.0061 P= .931	-.0692 P= .324	-.0450 P= .521	-.0830 P= .237
RICE_PROD	.1480 P= .034	.0557 P= .427	.0339 P= .630	-.1023 P= .144	-.0403 P= .566
FERTILIZ	-.1874 P= .007**	-.0363 P= .605	.0183 P= .795	.0915 P= .192	.0891 P= .204
DRY_AGR	-.0271 P= .699	.0040 P= .955	.0200 P= .776	-.0417 P= .533	.0157 P= .823
ZPUB_FIELD2	.2462 P= .000**	-.0406 P= .563	.0250 P= .722	.0045 P= .950	.0945 P= .178
FRE_FISHER	.0216 P= .759	-.0340 P= .628	-.0314 P= .655	-.0850 P= .225	.0045 P= .949
FRE_RAISER	.1284 P= .067	-.0389 P= .579	-.0183 P= .795	-.0217 P= .757	-.0027 P= .970

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	ZAREA	SCHOOLING	ZTRAINING	ZACTIVITY1	ZACTIVITY2
INDUSTRY1	-.0230 P= .743	-.0066 P= .925	.0215 P= .760	.0896 P= .201	.0086 P= .903
AGRTOOL3	.0916 P= .191	.0484 P= .491	.0895 P= .202	.0691 P= .325	.0433 P= .537
LAND1	.0080 P= .909	-.1250 P= .074	.1107 P= .114	.0624 P= .374	-.0233 P= .740
ZAREA	1.0000 P= .	-.0077 P= .913	.0927 P= .186	.0103 P= .883	.1566 P= .025
SCHOOLING	-.0077 P= .913	1.0000 P= .	-.0687 P= .328	-.0044 P= .950	-.0645 P= .358
ZTRAINING	.0927 P= .186	-.0687 P= .328	1.0000 P= .	.2078 P= .003**	.3772 P= .000**
ZACTIVITY1	.0103 P= .883	-.0044 P= .950	.2078 P= .003**	1.0000 P= .	.1959 P= .005**
ZACTIVITY2	.1566 P= .025	-.0645 P= .358	.3772 P= .000**	.1959 P= .005**	1.0000 P= .
STARV2	-.1279 P= .068	.0058 P= .935	.0791 P= .260	-.0171 P= .808	-.0106 P= .880
GEN_HEALTH1	-.0208 P= .767	-.0356 P= .612	-.0404 P= .565	.1462 P= .037	.0552 P= .432
GEN_HEALTH2	-.0827 P= .238	-.0113 P= .873	.0961 P= .170	.0626 P= .372	.0409 P= .561
WORK_FORCE	-.1576 P= .024	-.0613 P= .382	-.0313 P= .656	.0612 P= .383	.1476 P= .035
LAW	.0212 P= .763	-.0475 P= .499	.0333 P= .636	-.0722 P= .304	.0251 P= .721

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	STARV2	GEN HEALTH1	GEN HEALTH2	WORK FORCE	LAW
ZHH	-.1479 P= .034	.0205 P= .771	.1530 P= .028	-.1597 P= .022	-.0352 P= .617
MEMBERS	.1856 P= .008**	.0150 P= .831	-.0358 P= .611	.1424 P= .042	.1005 P= .151
ZPTAX	-.1606 P= .021	.1130 P= .107	.2528 P= .000**	-.0920 P= .189	-.0356 P= .613
WELL	.0510 P= .468	.0294 P= .676	-.0849 P= .226	-.0629 P= .370	.0043 P= .951
ZVILL_SERV	-.1536 P= .028	.0438 P= .533	.0787 P= .262	-.1557 P= .026	-.0965 P= .169
ELECTRIC	-.2102 P= .002**	.2368 P= .001**	.2450 P= .000**	-.0324 P= .644	-.0288 P= .682
HHPERTV	.0679 P= .333	-.0958 P= .172	-.1277 P= .068	.0522 P= .458	.0114 P= .871
VEHICLE2	-.0664 P= .344	.0152 P= .829	.0959 P= .172	-.0031 P= .965	.0269 P= .702
ROOF2	-.0543 P= .440	.1112 P= .112	.1453 P= .038	.3361 P= .000**	.0620 P= .377
LATRINE1	-.1017 P= .147	.2894 P= .000**	.4251 P= .000**	.1455 P= .037	-.1252 P= .074
SHOP	-.0116 P= .868	-.1121 P= .110	.0295 P= .674	-.1666 P= .017	.0081 P= .909
ZAGCREDIT	-.0695 P= .322	.0264 P= .707	.1382 P= .048	.0450 P= .522	.0489 P= .486
ZMILL	-.1472 P= .035	.0205 P= .771	.0907 P= .196	-.0166 P= .813	-.0733 P= .296
LABOUR	.0099 P= .888	-.1365 P= .051	.0623 P= .375	-.0189 P= .788	-.0746 P= .288
AGJOB	.0753 P= .283	-.0651 P= .353	-.0610 P= .385	.0925 P= .187	.1161 P= .097
RICE_PROD	-.0945 P= .178	-.0862 P= .219	-.0854 P= .223	-.1340 P= .056	.0280 P= .690
FERTILIZ	.0510 P= .468	.0537 P= .445	.1980 P= .004**	.2702 P= .000**	-.0421 P= .549
DRY_AGR	-.0275 P= .695	.1608 P= .021	.0537 P= .444	-.0763 P= .277	-.0380 P= .588
ZPUB_FIELD2	-.0164 P= .815	-.0682 P= .331	-.1595 P= .022	.0154 P= .826	.0692 P= .324
FRE_FISHER	-.0459 P= .513	.0690 P= .326	-.0052 P= .941	.1241 P= .076	-.0170 P= .809
FRE_RAISER	-.0753 P= .284	.0164 P= .815	.0043 P= .951	.0478 P= .496	-.0478 P= .496

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

Variable Name	STARV2	GEN HEALTH1	GEN HEALTH2	WORK FORCE	LAW
INDUSTRY1	.0565 P= .421	.1179 P= .092	.1853 P= .008**	.0080 P= .910	-.0751 P= .285
AGRTOOL3	.0184 P= .793	.0454 P= .518	.1071 P= .126	-.0093 P= .895	.1705 P= .015
LAND1	-.0218 P= .756	-.0736 P= .295	-.0309 P= .660	.0110 P= .876	.0458 P= .515
ZAREA	-.1279 P= .068	-.0208 P= .767	-.0827 P= .238	-.1576 P= .024	.0212 P= .763
SCHOOLING	.0058 P= .935	-.0356 P= .612	-.0113 P= .873	-.0613 P= .382	-.0475 P= .499
ZTRAINING	.0791 P= .260	-.0404 P= .565	.0961 P= .170	-.0313 P= .656	.0333 P= .636
ZACTIVITY1	-.0171 P= .808	.1462 P= .037	.0626 P= .372	.0612 P= .383	-.0722 P= .304
ZACTIVITY2	-.0106 P= .880	.0552 P= .432	.0490 P= .561	.1476 P= .035	.0251 P= .721
STARV2	1.0000 P= .	-.1419 P= .042	-.2376 P= .001**	-.0121 P= .864	.2449 P= .000**
GEN_HEALTH1	-.1419 P= .042	1.0000 P= .	.2759 P= .000**	.0351 P= .618	.0449 P= .523
GEN_HEALTH2	-.2376 P= .001**	.2759 P= .000**	1.0000 P= .	.0618 P= .3798	-.0604 P= .389
WORK_FORCE	-.0121 P= .864	.0351 P= .618	.0618 P= .379	1.0000 P= .	-.0577 P= .411
LAW	.2449 P= .000**	.0449 P= .523	-.0604 P= .389	-.0577 P= .411	1.0000 P= .

(Coefficient / 2-tailed Significance)

“.” is printed if a coefficient cannot be computed

** Significant at 1 percent level, $P < .01$

APPENDIX III: ORIGINAL 41 VARIABLES SELECTED FROM THE

VILLAGE-LEVEL DATABASE

Variable Name	Content
HH	Total number of households (houses)
MEMBERS	An average household members (persons/household)
PTAX	Property tax (Baht)
WELL	Number of Tubewell & Shallow well (wells)
VILL SERV	Number of village services (facilities)
ELECTRIC	Number of households with electricity (households)
TV	Number of television sets (TV sets)
YES ROAD1	Public transportation to district town (Yes/No)
VEHICLE2	Number of households with motorcycles (households)
ROOF2	Number of households with tin roof (households)
LATRINE1	Number of households with toilet (households)
SHOP	Number of stores (stores)
AGCREDIT	Types of agricultural credit used (types)
MILL	Total number of rice mills (mills)
LABOUR	Number of households whose members work as labour for hire (households)
AGJOB	Number of households pursuing only agriculture (households)
RICE_PROD	Average rice yield (Kg/rai)
FERTILIZ	Number of households using fertiliser in agriculture (households)
DRY_AGR	Number of households farm in dry season (households)
PUB_FIELD2	Area of community grazing land (rai)
FRE FISHER	Number of households practising fresh water fishery (households)
FRE RAISER	Number of households pursuing Fish culture
INDUSTRY1	Number of households pursuing the most common industry (households)
AGRTOOL3	Number of households with small tractor (households)
SOIL_QUAL1	Agricultural land use
SOIL_QUIL2	Soil problems
LAND1	Number of households who have enough land for farming (households)
AREA	Total village area (rai)
SCHOOLING	Number of 14-50 years old illiterate persons (persons)
TRAINING	Total number of training courses held (times)
ACTIVITY1	Total number of community cultural activities (times)
ACTIVITY2	Total number of community sport activities (times)
STARV2	Number of 1 day to 5 years old children suffering malnutrition level 2
GEN_HEALTH1	Percentage of 15-44 year old couples use birth control service (%)
GEN_HEALTH2	Percentage of houses in a good sanitary condition (%)
GEN_HEALTH3	Types of health facilities (types)
WORK_FORCE	Number of households whose members work outside sub-district (households)
LAW	Number of disputes and crimes reported (times)

APPENDIX IV: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC ANALYSIS FOR MODEL 1

Variable(s) Removed on Step Number 30: AGRTOOL3

Estimation terminated at iteration number 4 because Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 89.678

Goodness of Fit 79.675

	Chi-Square	df	Significance
Model Chi-Square	30.826	9	.0003
Improvement	-1.378	1	.2404

Note: A negative Chi-Square value indicates that the Chi-Square value has decreased from the previous step.

Classification Table for NCLASS

Observed	Predicted		Percent Correct
	Failure (0)	Success (2)	
Failure (0)	32	10	76.19%
Success (2)	9	36	80.00%
Overall Percent Correct			78.16%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
ZPTAX	1.0171	.3929	6.7001	1	.0096	.1975	2.7652
WELL	-.0357	.0145	6.0520	1	.0139	-.1834	.9650

HHPERTV	-.0417	.0178	5.4995	1	.0190	-.1704	.9591
SHOP	.0206	.0131	2.4534	1	.1173	.0613	1.0208
FRE_RAIS	-.1299	.0823	2.4913	1	.1145	-.0639	.8782
INDUSTRY	.0227	.0101	5.0154	1	.0251	.1582	1.0229
SOIL_Q1(1)	.9381	.4053	5.3580	1	.0206	.1669	2.5551
ZACTIVI2	-.4413	.2651	2.7715	1	.0960	-.0800	.6432
GEN_H2	-.0245	.0109	5.0681	1	.0244	-.1596	.9758
Constant	.9625	.9071	1.1260	1	.2886		

----- Model if Term Removed -----

Term Removed	Log Likelihood	-2 Log LR	df	Significance of Log LR
ZPTAX	-48.943	8.208	1	.0042
WELL	-48.528	7.379	1	.0066
HHPERTV	-47.654	5.629	1	.0177
SHOP	-46.298	2.918	1	.0876
FRE_RAIS	-46.622	3.566	1	.0590
INDUSTRY	-47.571	5.463	1	.0194
SOIL_Q1	-48.015	6.351	1	.0117
ZACTIVI2	-46.403	3.128	1	.0770
GEN_H2	-47.654	5.630	1	.0177

----- Variables not in the Equation -----

Residual Chi Square = 15.465 with 29 df Sig = .9810

Variable	Score	df	Sig	R
ZHH	.3478	1	.5554	.0000
MEMBERS	1.0555	1	.3042	.0000
ZVILL_SE	1.1078	1	.2926	.0000
ELECTRIC	1.4620	1	.2266	.0000

YES_ROAD(1)	.3485	1	.5550	.0000
VEHICLE2	.1112	1	.7387	.0000
ROOF2	.1812	1	.6704	.0000
LATRINE1	.1036	1	.7475	.0000
ZAGCREDI	.0004	1	.9848	.0000
ZMILL	.3735	1	.5411	.0000
LABOR	.7121	1	.3987	.0000
AGJOB	1.3296	1	.2489	.0000
RICE_PRO	.6620	1	.4159	.0000
FERTILIZ	.0418	1	.8379	.0000
DRY_AGR	.1540	1	.6947	.0000
ZPUB_FI2	.0132	1	.9085	.0000
FRE_FISH	.0222	1	.8816	.0000
AGRTOOL3	1.3821	1	.2397	.0000
SOIL_Q2(1)	.1909	1	.6622	.0000
LAND1	1.2993	1	.2543	.0000
ZAREA	.1172	1	.7321	.0000
SCHOOLIN	.1438	1	.7045	.0000
ZTRAININ	.0167	1	.8971	.0000
ZACTIVI1	.1055	1	.7453	.0000
STARV2	.0248	1	.8749	.0000
GEN_H1	.0145	1	.9040	.0000
GEN_H3(1)	.0041	1	.9487	.0000
WORK_FOR	.2030	1	.6523	.0000
LAW	.5950	1	.4405	.0000

No more variables can be deleted or added.

**APPENDIX V: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC
ANALYSIS FOR MODEL 2**

Variable(s) Removed on Step Number 28 : VEHICLE2

Estimation terminated at iteration number 4 because Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 119.754
Goodness of Fit 105.465

	Chi-Square	df	Significance
Model Chi-Square	31.209	11	.0010
Improvement	-2.577	1	.1084

Note: A negative Chi-Square value indicates that the Chi-Square value has decreased from the previous step.

Classification Table for NCLASS

Observed	Predicted		Percent Correct
	Failure (0)	Indetermined (1)	
Failure (0)	24	18	57.14%
Indetermined (1)	13	60	82.19%
Overall Percent Correct			73.04%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
ZPTAX	.7581	.3113	5.9310	1	.0149	.1614	2.1342
WELL	-.0171	.0097	3.1034	1	.0781	-.0855	.9830

HHPERTV	-.0282	.0119	5.6225	1	.0177	-.1549	.9722
ROOF2	-.0309	.0173	3.1758	1	.0747	-.0883	.9696
SHOP	.0247	.0112	4.8795	1	.0272	.1381	1.0250
LABOR	-.0406	.0216	3.5166	1	.0608	-.1002	.9602
RICE_PRO	-.0051	.0030	2.9327	1	.0868	-.0786	.9949
FRE_RAIS	-.1270	.0669	3.6067	1	.0575	-.1032	.8807
ZACTIVI2	-.5213	.2570	4.1154	1	.0425	-.1184	.5938
GEN_H2	-.0149	.0089	2.7747	1	.0958	-.0716	.9852
WORK_FOR	.0313	.0122	6.5442	1	.0105	.1735	1.0318
Constant	4.8812	1.9953	5.9846	1	.0144		

----- Model if Term Removed -----

Term Removed	Log Likelihood	-2 Log LR	df	Significance of Log LR
ZPTAX	-63.495	7.236	1	.0071
WELL	-61.451	3.147	1	.0760
HHPERTV	-62.816	5.877	1	.0153
ROOF2	-61.860	3.966	1	.0464
SHOP	-63.554	7.354	1	.0067
LABOR	-62.012	4.269	1	.0388
RICE_PRO	-61.441	3.128	1	.0769
FRE_RAIS	-61.867	3.980	1	.0460
ZACTIVI2	-61.994	4.234	1	.0396
GEN_H2	-61.342	2.931	1	.0869
WORK_FOR	-63.832	7.911	1	.0049

----- Variables not in the Equation -----

Residual Chi Square 15.978 with 27 df Sig = .9534

Variable	Score	df	Sig	R
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ZHH	.3785	1	.5384	.0000
MEMBERS	.2971	1	.5857	.0000
ZVILL_SE	.9448	1	.3311	.0000
ELECTRIC	.1420	1	.7063	.0000
YES_ROAD(1)	.0505	1	.8223	.0000
VEHICLE2	2.2257	1	.1357	.0387
LATRINE1	2.2844	1	.1307	.0434
ZAGCREDI	.0633	1	.8014	.0000
ZMILL	.2976	1	.5854	.0000
AGJOB	.3542	1	.5518	.0000
FERTILIZ	.2936	1	.5879	.0000
DRY_AGR	.1594	1	.6897	.0000
ZPUB_FI2	.0192	1	.8897	.0000
FRE_FISH	1.0533	1	.3048	.0000
INDUSTRY	.1541	1	.6947	.0000
AGRTOOL3	2.2943	1	.1298	.0442
SOIL_Q1(1)	.4312	1	.5114	.0000
SOIL_Q2(1)	.2672	1	.6052	.0000
LAND1	1.0092	1	.3151	.0000
ZAREA	.9959	1	.3183	.0000
SCHOOLIN	1.0845	1	.2977	.0000
ZTRAININ	.5047	1	.4774	.0000
ZACTIVI1	.0516	1	.8203	.0000
STARV2	.0592	1	.8078	.0000
GEN_H1	.0081	1	.9284	.0000
GEN_H3(1)	1.2892	1	.2562	.0000
LAW	.1039	1	.7472	.0000

No more variables can be deleted or added.

**APPENDIX VI: FINAL SOLUTION OF BACKWARD STEPWISE LOGISTIC
ANALYSIS FOR MODEL 3**

Variable(s) Removed on Step Number 36: SOIL_Q1

Estimation terminated at iteration number 3 because Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 146.736
Goodness of Fit 117.847

	Chi-Square	df	Significance
Model Chi-Square	10.139	3	.0174
Improvement	-1.930	1	.1647

Note: A negative Chi-Square value indicates that the Chi-Square value has decreased from the previous step.

Classification Table for NCLASS

Observed	Predicted		Percent Correct
	Indetermined (1)	Success (2)	
Indetermined (1)	66	7	90.41%
Success (2)	34	11	24.44%
Overall Percent Correct			65.25%

----- Variables in the Equation -----

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
ROOF2	.0277	.0157	3.1104	1	.0778	.0841	1.0281
LABOR	.0398	.0227	3.0700	1	.0797	.0826	1.0406

WORK_FOR	-.0207	.0097	4.5365	1	.0332	-.1272	.9795
Constant	-2.6649	1.4090	3.5771	1	.0586		

----- Model if Term Removed -----

Term Removed	Log Likelihood	-2 Log LR	df	Significance of Log LR
ROOF2	-75.329	3.922	1	.0477
LABOR	-75.100	3.464	1	.0627
WORK_FOR	-75.871	5.007	1	.0252

----- Variables not in the Equation -----

Residual Chi Square = 23.446 with 35 df Sig = .9318

Variable	Score	df	Sig	R
ZHH	2.4434	1	.1180	.0532
MEMBERS	.1166	1	.7327	.0000
ZPTAX	.1912	1	.6620	.0000
WELL	.1365	1	.7118	.0000
ZVILL_SE	.0093	1	.9233	.0000
ELECTRIC	.5024	1	.4784	.0000
HHPERTV	.2117	1	.6454	.0000
YES_ROAD(1)	.3324	1	.5642	.0000
VEHICLE2	1.3709	1	.2417	.0000
LATRINE1	1.5476	1	.2135	.0000
SHOP	.1523	1	.6963	.0000
ZAGCREDI	.0004	1	.9841	.0000
ZMILL	1.0891	1	.2967	.0000
AGJOB	.0062	1	.9373	.0000
RICE_PRO	.7082	1	.4000	.0000

FERTILIZ	1.6147	1	.2038	.0000
DRY_AGR	.1165	1	.7329	.0000
ZPUB_FI2	.8425	1	.3587	.0000
FRE_FISH	1.2698	1	.2598	.0000
FRE_RAIS	.1453	1	.7030	.0000
INDUSTRY	1.6986	1	.1925	.0000
AGRTOOL3	.1664	1	.6833	.0000
SOIL_Q1(1)	1.8355	1	.1755	.0000
SOIL_Q2(1)	.5525	1	.4573	.0000
LAND1	.7458	1	.3878	.0000
ZAREA	.8888	1	.3458	.0000
SCHOOLIN	1.2316	1	.2671	.0000
ZTRAININ	.2533	1	.6148	.0000
ZACTIVI1	.1285	1	.7200	.0000
ZACTIVI2	.0007	1	.9791	.0000
STARV2	.8606	1	.3536	.0000
GEN_H1	1.0241	1	.3115	.0000
GEN_H2	.0158	1	.9000	.0000
GEN_H3(1)	2.3512	1	.1252	.0473
LAW	.4313	1	.5113	.0000

No more variables can be deleted or added.