WOMEN EMPOWERMENT IN WATERSHED MANAGEMENT OF THE KHWAI NOI UPPER RIVER, KANCHANABURI PROVINCE

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF SCIENCE
(TECHNOLOGY OF
ENVIRONMENTAL MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2004**

ISBN 974-04-5114-4

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ACKNOWLEDGEMENTS

I am deeply thankful for the help and support from all involved during months of my dissertation writing. The library staff of both Bangkok University and Mahidol University was very helpful; they were always willing to help me find what I was looking for.

My supervisor, Associate Professor Dr. Sura Pattanakiat, generously devoted his time giving me insightful ideas and comments from the beginning. His patience is highly appreciated. I was lucky enough to have met and learned from him how to write successfully and stylistically.

Professionally, I would like to thank my three advisory committee members whose assistance is obviously tremendous. First, I would like to thank Professor Dr. Nipon Tangtham for his time and knowledge, particularly in the watershed concepts about women's roles. Over the past two years, his suggestion of such watershed conceptual framework has dramatically encouraged me in such a way that this dissertation might not have been finished without it.

My gratitude also goes to Dr. Komon Pragthong for his advice in social survey and to Associate Professor Dr. Charlie Navanugraha for his kindness and understanding of the hardship a student may encounter in a new study program. Finally, I would like to thank Dr. Vanchai Viranant, an external examiner, who kindly rendered many and valuable suggestions.

Many thanks also go to the following individuals who guided, pushed and supported me during those stressful months of my dissertation writing—Khun Wilasinee Anomasiri, Khun Bancha Apai, Arjarn Weena Worapong from Bangkok University, Arjarn Udomsak Yudhamaraweesak from Hutchinsan Co., Ltd, and Assistant Professor Dr. Rujira Rojjanaprapayon from University of Minnesota, Morris, U.S.A. Khun Tatchai Sansana, thank you very much for helping me out with the demanding RS and GIS.

My heartfelt gratitude is for both of my dear bosses at Bangkok University —Dr. Quanchai Aungtrakul and Associate Professor Laksana Satawedin. They greatly enabled me to gain lots of things for my personal growth, strong determination, patience and prudence.

I am especially indebted to everyone who let me interview and provided me with the data and reports to be used in my analysis of women. The indebtedness also extends to NGO's and officers from Public Health Department, for their valuable information.

I would like to give special thanks to Bangkok University and the Asian and Development Bank for their financial support. Most important of all, I thank my dear mother and father who always believe in me and never fail to support me whenever needed. My success this time is dedicated to them.

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WOMEN EMPOWERMENT IN WATERSHED MANAGEMENT OF THE KHWAI NOI UPPER RIVER, KANCHANABURI PROVINCE.

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Abstract

Today women's role is more and more seen as the key for managing social interaction with nature and their role could be instrumental in dealing with the current crisis in the Khwai Noi upper river watershed. This study investigated women's participation in watershed management at the household level using a theoretical model based on a elements from gender socialization theory and empowerment theory to find out what women know, how they manage, and what factors are related to their empowerment. Data from questionnaires by 345 women in 31 villages were analyzed.

As regards women's knowledge about watershed ecological systems and their understanding of the watershed crisis, the study showed that women in the Khwai Noi upper river area perceive a change for the worse in their watershed, especially regarding soil fertility. Women in middle stream and downstream areas indicated that they believe soil quality to be slightly worse than five years earlier. This corresponded to data of spatial change derived from remote sensing and geographic information system techniques indicating that the soil loss area now constitutes three levels and that most of the upstream reach are at nature, while quarter of the middle stream and most of downstream area is in crisis. The study found that watershed management information is ordinarily conveyed through unofficial women group meetings and discussions with the heads of households. As to women's participation in management, no difference was found between women within and outside the household. Women's knowledge and understanding of the issue, their willingness to participate, their cooperation with others, their identifying as women, and their use of the communication approach were found to be predictors of effective participation in watershed management.

In short, women have the knowledge and can effectively participate and manage natural resource within watershed using traditional techniques learn from their ancestors if they get proper support from management agencies.

KEY WORDS: WOMEN PARTICIPATION / GENDER/ WATERSHED MANAGEMENT/ WOMEN AND DECISION MAKING / EMPOWERING PARTICIPATION/ WOMEN EMPOWERMENT

226 pp. ISBN 974-04-5114-4

การเสริมอำนาจสตรีในการมีส่วนร่วมต่อการจัดการลุ่มน้ำ แควน้อยตอนบน จังหวัดกาญจนบุรี
(WOMEN EMPOWERMENT IN WATERSHED MANAGEMENT OF THE KHWAI NOI UPPER RIVER, KANCHANABURI PROVINCE)

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บทคัดย่อ

ในปัจจุบันสตรีก้าวเข้ามามีบทบาทหลักในการจัดการกิจกรรมทางสังคมและทรัพยากรธรรมชาติ บทบาทเหล่านั้นเป็นเครื่องมือสำคัญต่อการจัดการวิกฤตการณ์ที่เกิดขึ้นในลุ่มน้ำแควน้อยตอนบน การศึกษาเชิงประจักษ์นี้ศึกษาการมีส่วนร่วมระดับครัวเรือนของสตรีต่อการจัดการลุ่มน้ำ โดยใช้กรอบแนวคิดจากทฤษฎีจิตวิทยาสังคมของเพศสภาวะและทฤษฎีการเสริมอำนาจ สำรวจ ความรู้ วิธีการจัดการ ตลอดจนปัจจัยที่มีอิทธิพลต่อการเสริมอำนาจในการมีส่วนร่วมต่อการจัดการลุ่มน้ำ แบบสอบถามจำนวน 345 ชุด ได้จัดส่งไปยังสตรีใน 31 หมู่บ้านคลอบคลุมพื้นที่ที่ศึกษาเพื่อรวบรวมข้อมูลสำรับการวิเคราะห์

ผลของการศึกษาพบว่า สตรีมีความรู้เกี่ยวกับระบบนิเวศน์ลุ่มน้ำและรับรู้ถึงสถานการณ์ที่เปลี่ยนแปลงของทรัพยากรที่เกิดขึ้นภายในลุ่มน้ำ โดยเฉพาะความอุดมสมบูรณ์ของดิน สตรีที่อาศัยในพื้นที่ตอนกลางและปลายน้ำรู้สึกว่าคุณภาพดินเลวลงกว่าเมื่อห้าปีที่แล้ว ซึ่งสอดคล้องกับผลการสำรวจเชิงพื้นที่จากเทคนิคการสำรวจระยะไกล/ ระบบภูมิศาสตร์สารสนเทศ ที่พบว่าภายในลุ่มน้ำมีพื้นที่ที่สูญเสียดินแบ่งออกเป็นสามระดับ พื้นที่ต้นน้ำส่วนใหญ่อยู่ในสภาวะธรรมชาติ ในขณะที่ส่วนหนึ่งของพื้นที่ตอนกลางและส่วนใหญ่ของพื้นที่ปลายน้ำอยู่ในสภาวะวิกฤติต่อการสูญเสียดิน นอกจากนี้ยังพบว่าการไหลของข้อมูลการจัดการลุ่มน้ำถูกส่งผ่านในการพบปะของสตรีในกลุ่มที่ไม่เป็นทางการและการพูดคุยกับหัวหน้าครัวเรือน สำหรับการมีส่วนร่วมในการจัดการลุ่มน้ำนั้นพบว่าไม่มีความแตกต่าง ระหว่างสตรีที่มีบทบาทในครัวเรือนกับนอกครัวเรือน ผลการศึกษายังพบว่า ความรู้ความเข้าใจในสถานการณ์ของลุ่มน้ำ ความเต็มใจที่จะร่วมกิจกรรม การร่วมมือในการทำงานกับหน่วยงานอื่นๆ อัตลักษณ์ และช่องทางการสื่อสาร มีอิทธิพลต่อการเสริมอำนาจ ในการมีส่วนร่วมต่อการจัดการลุ่มน้ำของสตรีทั้งสิ้น

กล่าวโดยสรุปสตรีมีความรู้และสามารถจัดการลุ่มน้ำได้อย่างมีประสิทธิภาพหากได้รับการสนับสนุนอย่างเต็มที่

226 หน้า ISBN 974-04-5114-4

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CHAPTER 1
INTRODUCTION

1.1 Background Justification

Since the early 1970s, attention has been directed toward the concept of Women in Development, especially United Nations plan. Women are considered as a vital agent in the development process through the gender division of labor in economic system. Later, in 1990 that discourse has been expanded to be a Gender and Development, which has the main issue on the differentials of gender. At that time, the idea of gender equity in economic, politic, social and culture aspects was lead to be one indicator of development level (United Nations, 1999; Melkote and Steeves, 2001: 189).

Ratification in Social Development Treaty at Copenhagen in 1992, the first international conference and Dublin Statement in 1995, the fourth one at Peking is the driving – force that Thailand revolutionized her policy and practice according to Sustainable Development arena – 1) Environmental Development; 2) Decreasing overpopulation; 3) Suitable Regional and local Development; 4) Establishing Suitable Development Criteria; and 5) Empowerment women in all level (UNESCO, 2002).

Statistic from Ministry of Finance, Thailand showed that there have been a considerable number of activities in the field of economic development in Thailand throughout centuries. A great amount of money has been spent by governments and by international agencies in the pursuit of economic growth (Exclusive Interview, 2002: 169-179). Every unit of land and its population were devoted to increase country's income, especially rural area, which is rich in natural resources. Moreover, several studies pointed in the same direction that the process of development has inevitable created uneven economic growth on the one hand, and problems of resource

management on the other hand, for example the master thesis entitled “Impact of economic and social factor to forest resources using in Thong Pha Phum district” by Piriyaphon (1998) and “Impact of land use to water quality: a case study of LinTin watershed in Thong Pha Phum district by Sivasen (1997). Therefore, problems of inappropriate land utilization, enormous deforestation, soil erosion, water resources declining etc., have been easily widespread everywhere in Thailand (World Bank, 2000: 2). In addition, it has led many forms of social conflict, for example head and tail watershed conflict between hill and lowland farmers or in case of property right in Mae Chaem watershed, Chaing Mai where is the battle field between ethnic groups who occupied land for generation and Royal Forestry Department (Vincent and Kaosa-ard, 1995).

The so-called economic development was also affected gender roles in social structure. Rapid rural industrialization, for example not only increases family’s income but also place a heavy burden on each sex. Men, as the family’s leader who are vital role - player in public sphere were forced to expand their land to increase their productivity, due to Public/ Private Sphere Theory of Gender Studies. Whereas women worked harder for household survival or private sphere, for example stay longer in farmland or walk further to find wood fuel (Vandana, 1988; Agarwal, 1992; Kaowtep, 1992a, b; Panda, 1996; Sittirak, 1996, 1999). Moreover, the thesis of Shirk-Luckett (2001), “Changing Roles, Perceptions and Responses: Women and Environmental Change in Yuhang Country, Zhejiand”, found that the responsibility of women in nowadays expand more productive role due to the suffering from economic crisis.

Although both gender roles in the development process support each other, they do not have an equal voice. The social structure, namely culture norms and values, influence on gender patterns of behavior/ role and attitudes - Gender Socialization Theory. As a result, females are limited to exhibit in a nurturing, sensitive, emotional, and relatively passive manner (Wolfard, 1994:833-838). Moreover, they are discriminated as the second sex and have lesser opportunity to access better occupational option than men (due to the gender division of labor).

Thai women status has been uplifted throughout society, upon the United Nations declaration of the International Decade of women in 1992 (UNESCO, 1992). Women have more participation in all projects, which create society's fairness, as World Resources Institute call for; owing the fact that women have triple role in society, namely 1) as the national labor – productive role; 2) as the indirect income-supporter of household – productive role; and 3) as the motherhood who is caretaker their offspring from poverty problem by transferring self-reliant idea – reproductive role. Women are accepted and honored as the major agent in search of sustainability in making well-being family and community. (Corner, 1997; Gamble and Well, 1997; Padunchewit, 2002).

Yet, inequity in gender relations in eastern culture society and legal system are major constraint to empower women (UNICPD, 2003). The status of women is still in Muted Group and has no right in society. It is observed that many development programs, led by both international and local organization, always failed; as a result tradition belief that women's potential should fix in household area (Shestha, 1995: 12).

Hence, in the 8th Plan of National Economic and Social Development (1997-2001) which focus on human center and people's participation, and the 9th Plan (2002-2006) which focus on self – sufficient economic, Royal Thai Government tried to empower women and marginality groups, so they can have self – reliance in both spiritual and development. As a result, they revolutionized Law and Regulation (Article 30 in The New Constitution B.E. 2540) in order to releasing Gender Bias such as improving job opportunities, education networks and mesh works promotion, human right of women and so forth, which made all of them have more participation in decision making, especially in household well-being level (Pathranarakul, 2002: 13; Padunchewit, 2000: 394). It seems to be minimal regarding to sexual unacceptance in Thai social norms and culture, however. This study's framework is combination between Management Theory, which comprise of participation and empowerment ideologies and Feminism Theory (Gender Socialization Theory) in order to find

effective way to empower women in natural resource management participation within watershed boundary and its social's context.

1.2 Rationale of the Study

The Khwai Noi Upper River, the main tributaries of the Mae Klong River and the 1st class watershed classification, is in crisis. Physically, in 1999, the Office of Environmental Policy and Planning and Danish Cooperation on Environmental and Development (1999: 103-6) found that this protected area now faced rapid community expansion, 56 fauna's species extinction and shifting/swidden or 'slash and burn' farming problems. Survey data by Ministry of Interior also showed that there also has been severe political movement and national security problem. Most resident here are Thai and ethnic minority groups (Karen, Mon, Burma and Nepal) who mostly migrated for being illegal labor and was refugees (Mahidol University 1999:295-6; Boonrueng, 2001: 3). Most of them have been encroached protected - area and have occupied the upland catchment area for wet rice cultivation and commercial orchard (Office of Watershed Conservation and Management, 1999).

Moreover, Kanchanaburi Rajaphat Institute examined the quality of water in 1996 and found that the values of heavy metals, namely copper, zinc, lead, chromium, nickel and arsenic were high in rainy season, but not exceed surface water standard according to Ministry of Science Technology and Environment (Ungkanasayun, *et al*, 2000). Later in 1999, it found that water quality in Clity Creek is deteriorating due to the releasing of lead contamination from lead mining setting in the first class forest (Srisuwan, 2000: 24 – 42; Samaputti, 1999:35-6). After testing, Pollution Control Department (1999) supported that the lead value from sediment is 0.07-0.20 milligram/liter, which exceeds the standard value (0.2 milligram/liter). In 2000 World Bank also reported that the number of forest area severely decline, comparing to 1995 (World Bank, 2000).

However, change in ecosystem effects to way of people life. It found that behavior e.g. attitude, skill, aspiration and knowledge and way of people earning were changed such as the evident from Buadaeng, Krajangwonga and Pipoplab-anan's study (Buadaeng, 2001; Krajangwonga , 2001; Pipoplab-anan, 2002). Krajangwonga, found that land use pattern changes in Khao Laem Dam projects made traditional practices and life patterns of rural people change. In Thakanun district, Kanchanaburi former farmers used to plant upland rice as the major crop. After the completion of the dam, fruit trees were promote widespread. In addition, there have many conflicts in water usage at various levels, for example water scarcity problem in dry season (National Water Commission Office, 2002) and chemical fertilizer utilization (Office of Watershed Conservation and Management, 1999).

Despite the fact that several Royal Thai Government Programs, for example poverty development project by NESDB had established, the worse situation still remain (Kaowtep, 1992a). The output form Kanchanatawal, thesis, that used Laiwo district in Kanchanaburi as her study site, indicated that the blue print policy creates mistrust and affliction to rural people; moreover community's belief, culture and norms is the main factor to obstruct governmental program (Kanchanatawal, 1992). Moreover, the so-called socialization, which includes knowledge and attitude, influences villager's behavior – like attitude-behavior model.

Besides, Santasombat (2003, 78) and Launggaramsri (2002, 133-167) found that women are a great conservationist, but have limited right. In their research "Biodiversity Local Knowledge and Sustainable Development", and "Redefining Nature", respectively, it found that Karen women have an important role in rotational agriculture as experts in supervising and maintaining plant diversity and arranging the rotation swidden fields so as to not have adverse affect on the community and ecosystem. On the contrary, women's groups are not included in many projects because of tradition belief in patriarchy society (Vandana, 1988). It also found in study of Boonpinon (1997), Nawichai (1999) and Vichitporn (2001) that women's work in both productive and reproductive area are the basis of efficiency under self-

supporting conditions, which seems to support the self-reliance ideology, according to the 9th plan.

However, one part of their environmental consciousness were hidden through gender discrimination and women right's limitation, as ecofeminists always claim that they are natural caretaker (Vandana, 1988: 12; Shirk-Luckett, 2001; Moore, 2000). Empowerment process would enable women to participate effectively in the decision making process. Thus, the rationale of this study is focused on the study of women's role in watershed management and seeks a way to empower their participation underneath social structure. The natural resource inventory was undertaken within watershed boundary, and then women perception is measured. The outcome of this study is to find factor which empowered women participation in protection of natural resource deterioration, which lead to sustainable watershed management ideology.

1.3 Objectives

The broad objective of this study is to explore the role of women and suitable factor to empower women's participation in watershed management. The specific objectives of the research are:

1.) To investigate the conditions of the Khwai Noi Upper River sub watershed in terms of watershed situation, affected to local communities;

2.) To explore the role of women in watershed management;

3.) To identify factors affecting women empowerment in watershed management participation.

1.4 Research Questions and Hypothesis

Women's management behavior can be predicted based on the propositions of Gender Socialization Theory. In order to test which variables are better indicators of advocacy for participation, several hypotheses have been formulated in this study:

Question 1: Through the lens of gender, whether women know watershed condition near their habitat is, by which information flow – paths.

Hypothesis: Women perceive the situation of their watershed through women groups meeting within watershed site**.**

Rationale: According to a study in India, women were respected as manager of the nature; therefore, they have a good sense in knowing about their natural resource situation (Seeley, Batra and Sarin 2001). Moreover, based on type of participation used in IAPD (Integrated Approach to Participation Development Organization), Pretty (1995) described that in functional participation, people form groups to meet predetermined outcome related to their activities.

Question 2: How women manage natural resources in watershed through their role?

Hypothesis: Women manage natural resource through their household role.

Rationale: Based on knowledge of Gender Socialization Theory, women have a major role in household according to their physical, especially food providing. Because of their closing to the nature, it is believed that they always have consciousness in view of natural resources management (Bridges, 2001).

Question 3: What factors empower women participation in watershed management?

Hypothesis: Attitude, Partnership, Identity and Communication approach are related to women empowerment in support of watershed management participation.

Rational: Based on Participation and empower theory, women participation needs social equality or social acceptance. Participation, therefore should be supported from inside and outside, from individual to community. The way to empower them needs factors mentioned above.

1.5 Scope of the Study

The main finding in this study is to find factor affected participation in watershed management (forest, water and soil) beneath socio-cultural issue of ethnic minority women in Upper River Khwai Noi sub watershed. Sample respondents here is not included juvenile and child under 15 years old; due to the fact that they could not present any clear ideas about household burden and their real income. Moreover, according to the Constitution, people at the age of 15 have the right to do legal activity. In case of no target sample in each focus area, Village Leader, Religious Specialist, Village Priest and Pious laywomen are selected.

1.6 Conceptual Framework of the Study

Hypothesis and model are formulated by many concepts and theories, especially Feminism and Participation theory. Based on the study by Kaeotep (1992 a, b), the concept used in this study is women are the lowest unit of stakeholder who consume natural resource in watershed through their household role. How women currently manage watershed through their role - 1) acquisition and allocation water and food for their family; 2) teaching public consciousness to her offspring; 3) healing family's member; 4) organizing the family's expense. Thus, their behavior are affected watershed situation. In addition, their roles are still forced by community's culture, according to Gender Socialization Theory.

The second question was raised whether underneath culture, namely norms and belief; women's participation can be empowered in watershed management. And what factors influence on participation behavior, according to Participation and Empowerment Theory. If these factors, namely 1) Partnership, 2) Communication approach, 3) Attitude and 4) Identity were promoted to women, it will make women strong and should be an effective guideline for many agencies to manage particular watershed (Figure 1.1).

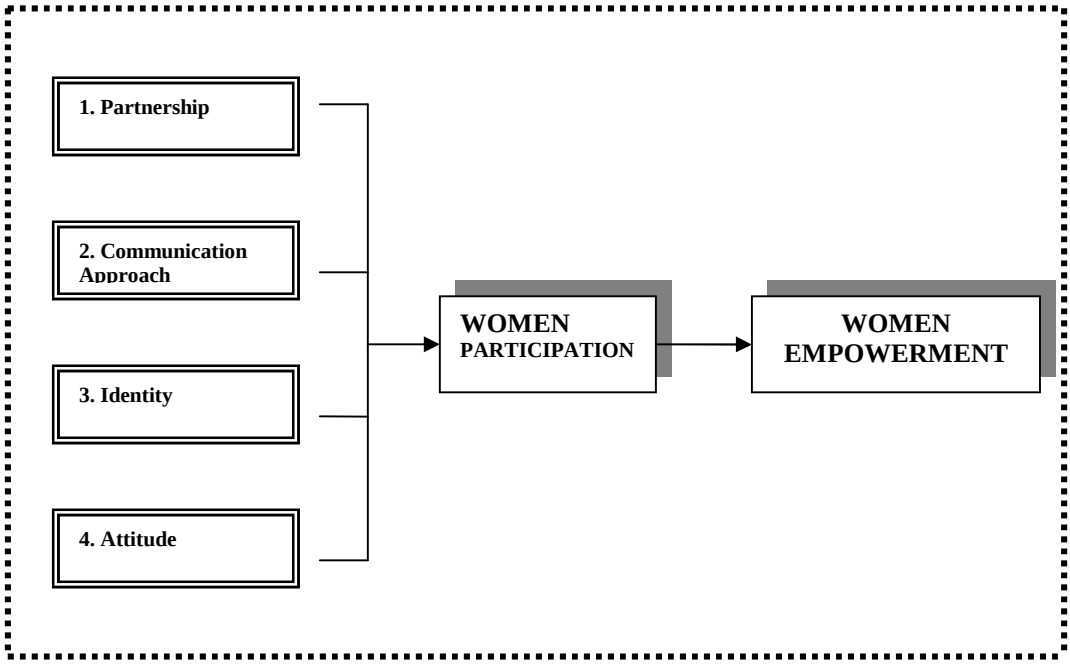


Figure 1.1: The Study Framework

1.7 Research Design of the Study

Several tools were used to complete this study. The first procedure was a search for factual details about the study site or the so-called physical data. The next step was a social survey of women's watershed management in the Khwai Noi Upper River or socio-economic data. Both types of data were integrated together in form of descriptive operations. Thus, visual display from GIS is described with an understandable manner of respondents in study site from social survey. The analysis at the household level was gained a better understanding of participatory of rural women concerning watershed management in study site.

1.7.1 Factual Survey or physical data. Spatial Inventory is a crucial step for acquiring physical pictures of the study area derived from satellite images and GIS coverage. The remote sensing data and data from geographic information system were

classified to monitor five variables to foster the construction of visible phenomena for the analyses as following:

1.) Forest area in three periods – 1) ten years ago, 1990, 2) five years ago, 1995 and 3) present day, 2000, which interpreted from LANDSAT Imaginary;

2.) Soil erosion rate, which comes from Universal Soil Loss Equation;

3.) Water quantity, which comes from volume of rainfall at meteorology station;

4.) Capacity of volume of people in watershed area comes from the calculation of number of people in watershed area;

5) Land use/ land cover changes.

1.7.2 Social survey or socio-economic data. A social survey aimed at collecting data of women's opinion on watershed management in the study site. Women were questioned their personal information, knowledge, attitude and participation level in watershed management, identity, partnership and communication approach, which comes from Gender Socialization Theory, Participation and Empowerment Theory. See Figure 1.2:

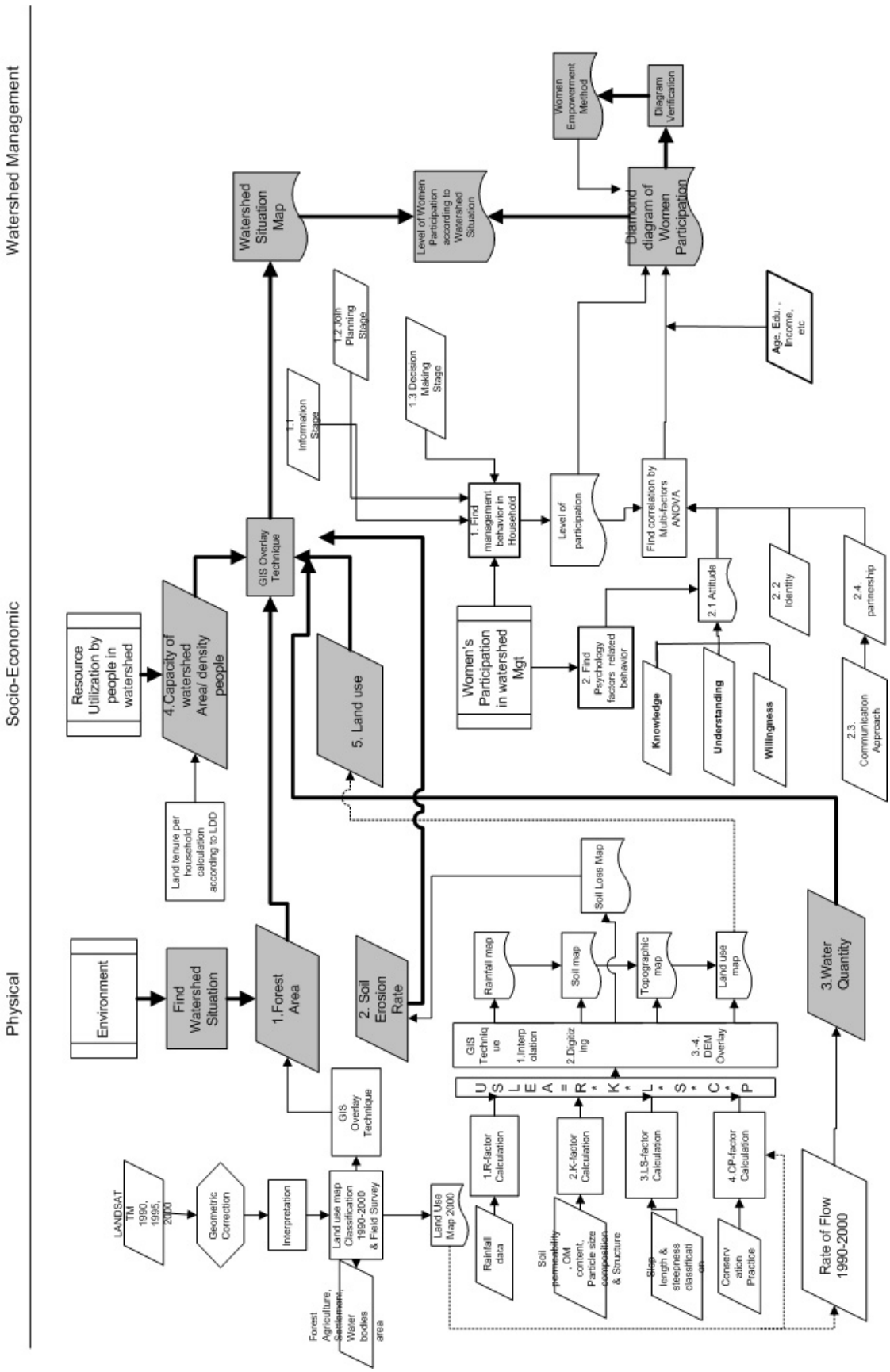


Figure 1.2: Research Design of the Study

1.8 Expected Outcome

1. To know the performed roles of women in natural resource management within watershed.
2. To know the factors influenced on the women empowerment in watershed management.
3. The result of this study can provide baseline data for the relevant agencies in supporting natural resource management.
4. The result of this study is capable of being utilized for a variety of other purpose.
5. This study will provide useful analysis and information for social and environmental scientists, scholars and planners to better understand how women behavior.

1.9 Definition of Terms

Attitude: Attitude toward watershed management in general refers to the part of the population regarding the management. Attitude scales are useful to locate persons holding positive and negative attitudes toward management.

Knowledge: It reflects a general awareness regarding areas affects potential benefit.

Participation: Participation refers to the degree to which members were able to participate in any decisions that may affect their future. In this study it means participation in watershed management.

Communication: It means media which transmit information to receiver i.e. radio, newspaper, group discussion meeting.

Empowerment: Empowerment is the process through which an individual perceives that s/he controls his or her situation. In this study it means the way which supported women in full participation.

Natural Resources: Natural resource means forest, water and soil resources.

Partnership: Partnership refers to women cooperation with agencies in all activities with both horizontal and vertical. The cooperation in this sense means work together following mutually agreed (Watershed Approach Committee, 1999).

Role: The pattern of behavior prescribed by one's status. Role can be that part of status which is duty but it can also determine the status if its pattern of behavior is changed. It is also dynamic process. Behavior of women, for example should focus in household nurturing. However, in this study role was divided into two parts – productive role, and household role.

Watershed management: The term used here copes with conservation in soil, water and forest, which related to human resource dimension in watershed area and environmental impacts.

1.10 Organization of the Study

This study is written in seven chapters. In Chapter 1, the study was introduced, and objectives and rationale was presented. Chapter 2 of this study provides a review watershed management concept, participation concept, empowerment theory, gender dimension as well as the factors affected empowerment. Chapter 3 presents the detailed methodological framework and introduces the specific approach used in this study. Chapter 4 begins with a detail in study area and review background of women in study area. The results and discussed within the context of theory and practice are reported in Chapter5. Chapter6 contains the major conclusions of study and proposes ideas for future research.

CHAPTER 2
LITERATURE REVIEW

Watershed geography is concerned with the interaction of biophysical and human phenomena. In this chapter the literature was reviewed into threefold: watershed management, participation concept, theory of empowerment and gender perspective, respectively. Firstly, it deals with concept in watershed management, natural resources and problem in watershed management. Secondly, concept of participation with example in many countries, pro and cons and meaning of empowerment with related factors, are presented. Finally, theory of gender and other variables are added. The details are below:

2.1 Watershed Management

Generally speaking, management is a set of activities designed to achieve an organization's objectives by using its resource effectively and efficiently in a changing environment. More specifically, particular management deals with resources, functions and objectives, based on different field. However, Peters and Waterman, the father of modern management theory, concluded that the core of management is **P**lan-**D**o-**C**heck-**A**ct cycle or Planning-Operation-Monitoring-Doing cycle (Gatewood, Taylor and Ferrell, 1995: 50).

In natural resource management within watershed boundary, for example, is to manage its structure and function within system in the equilibrium status (Loucks, Stakhi, and Martin, 2000: 43). Thus, watershed management is an outgrowth of recognition of natural features of the landscape. It incorporates the plan, policies and activities used to control water and related resources with processes in a given watershed (Schaeffer, 2001). Moreover, Black (1996, 426) succinctly emphasizes that

watershed management should be in the terms of rehabilitation, protection resource and enhancement of the watershed capacity.

2.1.1 System's Structure and Function Concept

The concept of relation between structure and function originally is in General System Theory (GST). A system description of a situation is an assembly of elements related in an organized whole and a relationship of the whole element influence to each other in both positive and negative terms - function (Flood and Carson, 1988: 7). Moreover, the activities of a system are thought of as processes occurring in a structure- the way in which the elements are related to each other. Thus, relationship between each element would be change if the way they connected changes.

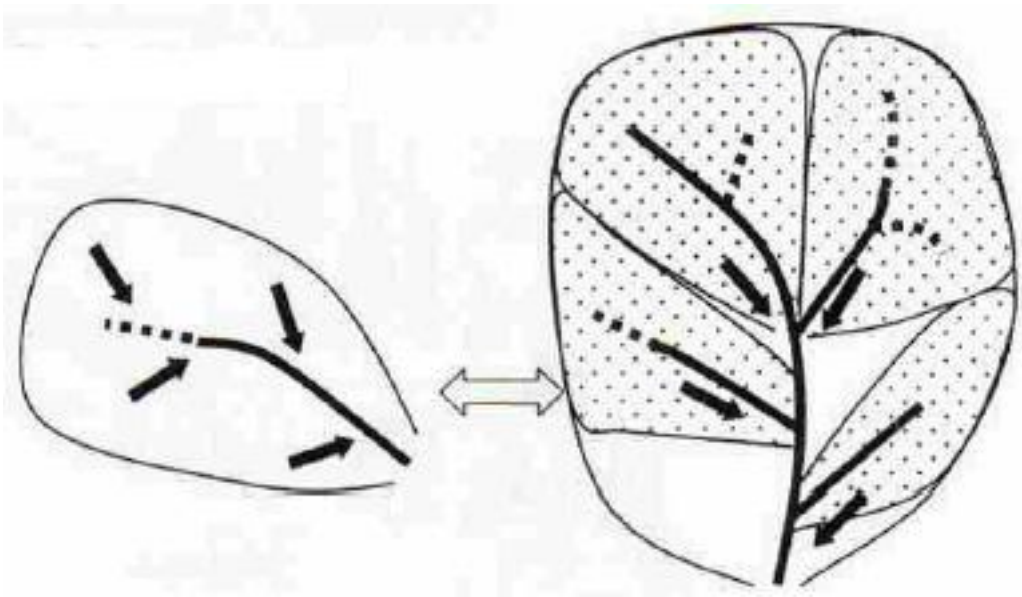
The full scale "structure and function" explanation of a system is often used in ecosystem. As Jorgensen and Muller (2000: 21) said that human gave significant to the visual pattern first, and then thought about dynamic action takes place. Adaptation in structure of system may obtain less flexibility for survival. Rachel Carson's book "Silent Spring" in 1962 is the example of the narration about structure's changes in natural system which effects human.

In terms of watershed management system, it can be said that natural input, namely land, water, soil and ecosystem should be maintained as a means of survival. According to Equilibrium Theory, human activities should have less impact to nature input, so the system is in homeostasis. Nevertheless, the way to connect natural system to human is more complexity; owing the fact that systems are situations as perceived by human and human have realized system by perception - the way to build up models in minds. To broaden picture dealing with all complexity, the relation of each resource was pencil sketch below.

2.1.2 The Relationship of Resource in Watershed

According to Structure-function theory, it can be said that principal factors influencing watershed operations is (Tideman, 2002: 13):

1.) Physiography of watershed such as size of watershed, shape, land slope and drainage density. All variables can be effected on volume of hydrology, especially slope and drainage density which has major implications for land use. Gomi and Sidle (2002: 905) studied the linkage of headwater that flow into downstream reaches in context of hydrologic, geomorphic and biological processes and found that connectivity of head water system affect both the cumulative and dispersed nature of material transport process within watershed system. Those impact nutrient dynamics and fauna – flora habitat which support downstream food web. Hence, the functional relationship of the activities here affects ecosystem's structure of downstream humanity (Figure 2.1).



Headwater System **Network System**

Figure 2.1: **Structural differences between headwater and network systems**. Arrows show the movement of sediment, water, nutrients, and organic material. Solid and broken lines show perennial and intermittent streams, respectively.
Source: Gomi, 2002: 907

2.) Soils and Geology. The soil character was determined as the amount of soil particulate which will be washed down into water harvesting structure. Geology of watershed was also determined as an agent which will percolate and corrective to watershed.

3.) Land use in watershed and vegetative cover. Indeed, land in a watershed has to be used for several purposes-crop and livestock production, housing, roads, etc. Land use affects rate of runoff, infiltration and types and quality of vegetative cover. Moreover, a dense cover of vegetation is a most powerful weapon for reducing erosion.

In most cases, it is found that land utilization for a particular purpose regular exceeds the actual suitability of the land. For example, in Thailand the area under paddy rice is equivalent to 14.7 m. ha whereas only 12.4 m. ha are suitable for paddy cultivation and so are the cases with the other crops (Shrestha, 1999: 13). This causes environmental problem. Besides, Sumrit (1993) also reported that 12 percent of the total eroded land of the country, which are primarily under field crops and shifting cultivation, has very severe hazard severity (Table 2.1):

Table 2.1: Land Use Affected to Soil Loss

Categories	Soil Loss Area		Land use in 1993
	Ton/rai/yr	'000 rai (x 10^2)	
Very slight	0.01-1.0	118,722	Forest, Paddy, Grass Land
Light	1.0-5.0	90,276	Forest, Rubber, Orchards, Paddy
Moderate	5.0-20.0	25,912	Rubber, Orchards, Field crops, Forest +field crops
Severe	20.0-100.0	42,621	" ..... Ditto ....."
Very severe	-	39,157	Field crop, Forest + shifting cultivation
Others	-	4,562	Coastal area, Mangrove, Shrimp farms, etc

Note: 1 ha = 6.25 rai

Source: Sumrit (1993).

4.) Socio-economic factors. In terms of social, way of people life effect natural resource in watershed. Buadaeng, (2001), Krajangwonga, (2001) and Pipoplab-anan, (2002) found that culture (belief, trust and value) is a catalyst agent in natural resource utilization, especially economic status. The Rich, for instance, consume wood and food more than the Poor two-three times because of they belief that luxury is the symbol of social status.

Throughout the century there are not only researches but also theses have studied about impact and relationship of watershed's component. All of them tried to confirm the idea that the changes are the best impacts to system's relationship (if the structure (land use and other physical resource) were be changed, the function (water flow, duration and quality) would be changed, as well). The study about biodiversity in watershed by Allen and Flecker is an example. They have identified six major factors

(landscape transformation, hydrologic changes to stream and river, land-use change, habitat alteration, and non point source pollution) threatening the destruction of river ecosystem (Allen and Flecker, 1993). Reimold (1998: 17) repeated that test and concluded that land-use change is the single greatest factor affecting ecological resources.

In his study" Watershed Management: Guidelines for Indian Condition", Tideman (2002) described that people is the vital factor affect watershed in terms of water quality and quantity, erosion and sedimentation, floods and droughts and vegetation cover. From that point of view it can be addressed that the relation of watershed's component both physical aspect and human aspect are closely related within boundary. A watershed affects the people in every sphere of life. The sustained productivity of food, fuel, forage, fiber, fruit and water by the management of vital resources of water, soil, vegetation and phenomena like floods and droughts are determined by the nature of watershed functioning. For example, in terms of vegetation, production from all lands is dependent upon the availability of the right quality and quantity of water at the right time which in turn is dependent upon the conditions of the watershed; production is also dependent upon the erosion rate and the deposition that takes place in the watershed.

2.1.3 Conceptual Premises in Watershed Management

According to the structure-function theory, Maitra (2001: 4-9) concluded that there were three concepts in watershed management:

1.) Technical approach: the application of technical solutions to most problems of natural resource management, for example in large-scale measurement of soil and water conservation within the nature boundary of a watershed, it needs vegetation measures (growing of trees). This method consumes more budgets and less participation; as a result, it needs Resource Inventory - it is a collection of data on the existing status of the natural resource base – forest area, water, soil, land use and so forth. GIS were used in this stage to compute volume of resources.

2.) Empowerment approach: based on development philosophy, disadvantage groups in rural area were capacity–built and empowered according to various social, cultural, political and economic changes, for example Hill tribe group (*ChipKo*) empowerment in forest conservation in India.

3.) Conservation approach: this approach allows community manages natural resource. It opposes uncontrolled exploitation and strives to reduce the existing imbalances between the demand and supply of natural resources through community driven mechanisms. Restoration and conservation of the degrading resource base is the trust area, for example community forest. Another example is soil conservation program; people need to sacrifice their resource to participate a project, which cannot immediately see benefits. Let say in case of farmer, they need to sacrifice part of the cropping land for changing traditional and cultural practices. They must grow a green manure crop during the rainy season and clean cultivation during the rest of the year.

2.1.4 Type of Watershed Management

Watershed management covers a wide range of activities to do with land units through flows of water management. The approach may be over reliant on an idealized. Consequently, there are numerous Best Management Practices (BMPs) used in many countries both in western and eastern country:

1.**) Conservation Program**. Conservation is a concept that has been broadly defined as ‘prolonging the useful life of resource’. Depleting natural resources are said to be the prime reason for environmental problems. In addition to this, the availability of resources is certainly decreased in a faster rate, eventually resulting into very low productive ecosystem. Deforestation has eroded biological resources diversity, which is very much prone to maximal environmental stress. Hence, the purpose of this type of program is to promote public awareness – attitudes and behavior with regard to the theory of planned behavior in order to conserve the valuable biological resources which ultimately can be utilized for the sustainability (Cordano, 1998: 63):

- Soil conservation. Soil is also included land use and covers. Soil conservation is defined as 'the positive task of devising and implementing system of land use and management so that there shall be no loss of stability, productivity, or usefulness for the chosen purpose'. Measures for soil conservation help increase infiltration. However, most of this case had happen in agricultural fields in order to control runoff and reduce the erosion as well as transport of sediment. These practices include conservation tillage, contour strip-cropping, terraces, filter strips, sediment retention ponds, and grade stabilization structures etc.

- Water conservation. Conservation of water is to increase the amount of water stored in the soil profile by trapping or holding rain where it falls, or where there is some small movement as surface runoff. According to United Nations guideline for water conservation, it refers to action taken to use water wisely and efficiently and has two parts: water resource conservation – efficient management, storage, allocation and transfer of raw water; and water supply conservation – distribution with minimal losses and consumption without wastage (United Nations, 2001: xi).

- Forest conservation. Biodiversity and Community forest issues were the main focus in forest conservation. In order to maintain biodiversity, the forest management in Finland, for example, has used silvicultural practice aiming at maximization of wood production (Mielikäinen and Hynynen, 2003: 47-54).

2.**) Monitoring Program**. To maintain conservation, it is necessary to monitor inputs and outputs of the program in terms of results achieved. The results require the conditions that existed before the program was commenced from historic data and the action from the program:

- Soil monitoring. Najim (2000: 14) described that in Canada and the United States regulatory agencies have assessed soil conservation by monitoring water quality strategies including rate of soil erosion. Besides, there are many approaches to evaluate the quality of soil such as land use change rate and plant species control.

- Water monitoring. In reductions of water usage which exceed the real needs, it needs to change level of awareness, attitudes and behavior of user and convince water users to save water by using it more efficiently. Moreover, it should protect water resources from depletion and pollution. If the consumption is reduced, it can say that supply side conservation success. However, the evaluation should be in a baseline sio-economic. On the contrary, in water resource side, the most common and effective way is use performance indicator – quantitative measures of an output, performance and year-by-year changes monitoring. It show that whether nowadays approach can improve water performance in better way.

- Forest monitoring. Increasing of forest area and degradation of the remaining stands were indicator to evaluate the progress of management project.

3.**) Rehabilitation Program.** The rehabilitation of soil, water and forest resource goes hand in hand with conservation program. For example, rain - fed agriculture in Nepal is the government policy to solve water problem as the same time it helps farmer keep more nutrient in soil more than irrigation agriculture. CLM or Community Based Land Use Planning and Local Watershed Management by TG-HLD are another rehabilitation program of land, forest and water in watershed area (Puginier, 2002: 37).

Besides, In Panda's dissertation "Forest Degradation, Changing Livelihood and Gender Relation: a study of two tribal communities in Orissa, India" she suggested that there are five factor related rehabilitation, namely: access to resources, ownership of resources, control over resources, access to alternative opportunities, social decision-making power (Panda 1996).

2.1.5 Experience in Watershed Management

Experience from many countries show that watershed are managed at various social and spatial scales. The impacts from biophysical attributes of watershed as well as the policies shape human interaction. Most of watershed management success is seen only in side of physical or spatial scale; on the other hand in terms of sio-economic, it seems blurred scenario. Due to the fact that social difference of culture e.g. norm, belief, and attitude is called for special methodologies for undertaking in each area. The System-wide Program on Collection Action and Property Rights (CAPRi) suggest that there are key issues in watershed management, namely (Knox, Swallow and Johnson 2001: 1-4):

1.) Communal action and property rights. It found that attempts to organize community without social boundaries has failed; as a result that the management on the level of existing community does not link to its social culture, that is, the strength of the norms, belief and social relations (someone called social capital) that enable people to work together to achieve their goals. An example for successful comes from Zimbabwe (McIvor, 1999: 22-24). She tries to bridge the social and communication gaps that separate groups within the boundaries of a watershed and then used horizontal line of management among groups. In side of property right, it found that insecure property rights to cropland do not help land improvements. Hence, rules for sharing resources comprise property right, which are often useful in resolving conflicts and creating incentives for investing watershed development.

In Kenya, collective management was organized by each small focal area or catchment committees and the outstanding point is the Ministry of Agriculture and Rural Development provide technical and organizational support this issue. The success of Kenya can reduce land tenure security, yet it leaves the question about what is the proper size of focal area it should be for people in take caring.

Experience from Southeast Asia illustrates the problems that arise when property rights are ill-defined. In Thailand, ethnic groups have occupied the upland

catchment area of the Mae Chaem watershed for generations. Yet, they are allowed only weak rights to land and resources because their land use is perceived to be at odds with the management plans of the Royal Forest Department (Chaiveerapattana, Pornsri, 2001). In contrast, in the Sumber Jaya catchment area of Indonesia, the management of upper watershed areas is still dominated by the state. Conflict over property rights provides incentives for farmers who clears primary forest land and adopts farming practices that generate short-term returns.

2.) Social spatial scale linkage. Holistic picture in watershed management system need to be considered social – spatial scale. Fully account for diversity of land use within administrative boundaries that existing in a watershed and other resources should link with human interaction both within and between communities in order to effectively manage. However, social mechanism is the hard part to deal with as mention a little bit above. The social culture system has its own ways, and traditionally leads to social structure. The over centuries evolution of social structure had been through the adoption of an indigenous knowledge base. Moreover, the changes in social structure, due to increased migration, land tenure changes, and livelihood also changes in terms of living. Change of land ownership due to increased sales of land to non-farm social groups, for example had a negative impact on environment, productivity and social structure. As the emerging middle and rich classes had little knowledge of agriculture or land management, this contributed the agriculture sector weaknesses in soil conservation, increased poverty and distress.

Nevertheless, social capital in community is vital factor for the success of management. In case of India, Nepal and Bangladesh, social caste and culture is the big constraint in watershed development. The low percent of women in lowest class were allowed enter primary school; as a result, the spread of information in watershed management project to the whole village is limited. Kenya, on the other hand, the elite is the core center to widespread information in society.

In Southeast Asia, traditional belief system, norm and network are center concept in natural resources conservation and management. Study by Shoemaker, Baird and Baird in Suvannakhet province, Lao PDR is example (Shoemaker, Baird and Baird, 2001: 63). Regarding to river-based livelihoods, people around the Xe Bang Fai River Basin manage their forest, river and other resources upon their food security idea. They prohibit fishing in the pools of water located in caves (***khoun***) at the base of limestone karst formations because they believe that cave is protected by spirits who protect bank of fish species for next generation. There are other natural resources protected by belief systems of communities. For example, cutting of large trees in forest of Thailand are prohibited according to supernatural belief in order to protect soil erosion in stream.

3.) Stakeholder participation in watershed management. Michigan State University (2003) describe that effective water management requires coordination from stakeholders to develop systems of sharing the responsibilities and benefits associated with watershed management. If all stakeholders do not have an opportunity to participate, more powerful stakeholders are likely to control watershed resource and undertake use practices without regard for their impact on less powerful individuals. Recent evident suggests that participatory watershed development projects are more successful than externally managed top-down projects. In the Colombia, Honduras and Nicaragua, CIAT (the International Center for Tropical Agriculture) has adopted interests - participatory methodology by dividing stakeholders into diverse group e.g. farmers, policy makers, and others. Those groups share idea, information and resources in watershed management from problem identification to solution. Finally, the effective plan was established.

In Southeast Asia, that concept was used in community forest and up stream-down stream habitat protection, for example case in Thailand.

4.) Assessment of the impacts of watershed management. Evaluating the impacts of watershed management is especially challenging because the indicators must be identified biophysical components and social outcome such as the capacity of community groups to work in managing sustainable resources.

However, it is vital to summarize that most of watershed development projects are still based on conventional approach emphasize physical study without attention to local, economic, social and ecological condition, for example 99 percent of Indian projects. Thus, the outcome from project has been failed into lowest level success. Crucial factor related to omitting social context is the complexity, which is hard to find set of indicators to evaluate within a baseline sio-economic. Even so Thailand is different from those other country in class, age, ethnicity, race, caste and culture system, watershed management approach still has problem in empowerment the collective-action institutes, especially the quality of watershed. Participatory approaches to watershed management not only ensure the development of appropriate technologies, but also can strengthen the capacity and self-determination of watershed residents.

2.2 Participation in Watershed Management

One of the hardships of management system is effectiveness, fair, and efficiency. If the management process is fair and effective, it is sustained. On the contrary, if the management process is considered unfair and ineffective, it is unstained. However, based on existing study “Case Study of people’s participation in Watershed Management in Asia” by Sharma and Wayley (1997) watershed management likely requires participatory from all stakeholders —including users, policymakers, researchers, and others. The concept, type and constraint of participation will be present in this part:

2.2.1 Concept of Participation

Participation approaches have become increasingly widespread in the past year due to the failure of previous development paradigm that generally assigned a passive role to the people who were intended to benefit, and to alleviate conditions of poverty and inequality. The failure of the past decade have made all countries realized that the measure of development is not so much the abundance of wealth but the quality of life. This in turn drives United Nation focus to participation approach. Actually, Participation means different things to different people and has many forms. It appears to offer everybody what they would like to understand it to mean. For example, participation based on the government side, it is known as “the local people are supposed to participate in the implementation of plans made by the government”. Hence, people are hesitated to participate, since most plans do not reflect the needs and priorities of the people. While local people understand that it is a warm sense of togetherness, common purpose and mutual understanding, so all stakeholders should work together. So, participation can be presented in many forms related to who is going to take it (Table 2.2).

Table 2.2: Participatory Approaches Meaning by Sectors

Form	What' participation' means to the implementing agency	What' participation' means for those on the receiving end	What' participation' is for developer
Nominal	Legitimating – to show they are doing something	Inclusion – to retain some access to potential benefits	Display
Instrumental	Efficiency – to limit funder's input, draw on community contributions and make projects more cost-effective	Cost – of time spent on project-related labor and other activities	As a means to achieving cost-effectiveness and local facilities
Representative	Sustainability – to avoid creating dependency	Leverage – to influence the shape the project takes and its management	To give people a voice in determining their own development
Transformative	**Empowerment** – to strengthen people's capabilities to take decisions and act for themselves	**Empowerment** – to be able to decide and act for themselves	Both as a means and an ends, a continuing dynamic

Source: Cornwall (2000: 9).

Tracing participation root, Narayan (1995), Paul (1998) and Cornwall (2000) mentioned that it come from development mainstreaming. In addition, because of world's limiting resource, any development practices such as planning, monitoring and evaluation should based on people participation. So, participation is one of the most essential principles in development cooperation among people who live in community

because participation is a process that leads to corrective action by involving all stakeholders in shared decision making.

Due to complex meaning of participation, numerous studies count number of joining projects as the indicator of participation level, for instance Participation in Community Forest by Agrawal (2001: 12-15) and Participation in Irrigated Agriculture by Bastidas (1999). Nevertheless, there is no standard pattern informing that how many times should indicate level of participation, which it should be. It is, consequently up to scale which researcher set and interprets. Moreover, it seems that they determine kind or level of participation more than degree of participation (FAO 2003).

2.2.2 Types of Participation

Pretty (1995), expert from Integrated Approach to Participation Development organization (IAPD), concludes that there are different types of participation (Table 2.3).

Table 2.3: Participation Type and Its Components

Typology	Components of Each Type
Passive participation	People participate by being told what is going to happen or what has already happened. It is unilateral announcement by an administration or by project management; people's responses are not taken into account. The information being shared belongs only to external professionals.
Participation in information- giving	People participate by answering questions posed by extractive researchers and project managers using questionnaire surveys or similar approaches. People do not have the opportunity to influence proceedings, as the findings of the research or project design are neither shared nor checked for accuracy
Participation by consultation	People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions, and may modify these in the light of people's responses. Such a consultative process does not concede any share in decision-making and professionals are under no obligation to take on board people's views.
Participation for material incentives	People participate by providing resources, for example labour, in return for food, cash or other material incentives. Much *in-situ* research and bio-prospecting fall in this category, as rural people provide the resources but are not involved in the experimentation or the process of learning. It is very common to see this called participation, yet people have no stake in prolonging activities when the incentives end.
Functional participation	People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organization. Such involvement does not tend to be at early stages of project cycles or planning, but rather after major decisions have been made. These institutions tend to be dependent on external initiators and facilitators, but may become self-dependent.
Interactive participation	People participate in joint analysis, which leads to action plans and the formation of new local groups or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple perspectives and make use of systematic and structured learning processes. These groups take control over local decisions, and so people have a stake in maintaining structures or practices.
Self- mobilization	People participate by taking initiatives independent of external institutions to change systems. Such self initiated mobilization and collective action may or may not challenge existing inequitable distributions of wealth and power.

Source: Pretty (1995).

2.2.3 Measurement of Participation

Amstein (1995: 358-373) divided participation types into three levels, however. Full participation means highly decision making in activities; Partial participation means joining activities; on the other hand, No participation, the other name doing nothing, means doing underneath Government policy but not joining and making decision (Figure 2.2). In this study, questionnaires are designed to evaluate those three levels of participation in the watershed management, namely no participation, joint planning and decision making. In addition, each participation level accords with participation behavior from Amstein's concept (Amstein, 1995).

8.	**Citizen Control** (People themselves have power to make any decision)
7.	**Delegated Power** (People is the representation of group and join decision making process)
6.	**Partnership** (People is consultant/ negotiator in working group)
5.	**Placation** (People express their idea – no decision)
4.	**Consultation** (People join in consultation – no decision)
3.	**Informing** (People are informed data)
2.	**Therapy** (People come to join activities but not make decision. It decreases public pressure)
1.	**Manipulation** (People act underneath Government controlling)

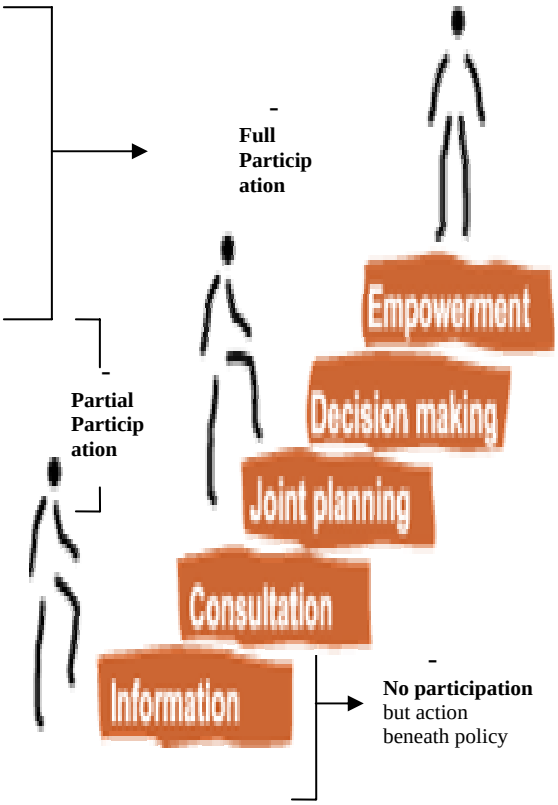


Figure 2.2: Level of Participation

Source: Adapted from Amstein (1995) and FAO (2003)

According to participation objective, Social Research and Environmental Research Institute (2001: 2-5) divided participation into:

1.) Participation in Planning, namely togetherness in problem analysis, goal setting, evaluating and decision making.

2.) Participation in Implementation, namely togetherness in working, e.g. resource supporting and cooperating.

3.) Participation in Utilization this step means using activities increase more benefits which is self reliance and social control mechanism.

4.) Participation in Benefit Sharing, namely fairly distribute benefit from development project to others.

5.) Participation in Evaluation, to tell problem, and constraint for finding the good solution.

1.) Participatory Methodologies

Participatory methodologies are now commonly used in development projects. One of the better known methodologies is Participatory Rural Appraisal (PRA) which is used widely for development planning.

PRA draws on Freire's legacy of critical reflection and other, earlier participatory research methods to develop a set of practices, tools and methodologies which facilitate critical reflection, analysis and action by marginal groups. The aim is for local people to be able to represent and analyze information about their livelihoods or other issues, and make their own plans. This learning process is enhanced by the use of visual graphics and can motivate those involved – researchers, development practitioners, local people and policy makers, to behave differently and to undertake different kinds of action (Noochdumrong, Noochdumrong, and Emphandhu, 1999 30-37; Guijt and Cornwall, 1995: 3).

Even in GIS dimension, it also needs participation approach. P3DM (Participatory 3 - Dimensional modeling) is an approach which allow layman in community share information and concerns by conducting a relief map model. Old people share history with young people, passing on legends and religious beliefs, sacred rites and places so essential to conserving tradition.

It aims at full participation of people who are in the process of learning about their needs and opportunities and ready to take action to address (Rambaldi and Callosa-Tarr, 2000: 3).

However, in Thailand, P3DM was used in Upper Nan Watershed Management Project between 1998. 45 villages was investigated and found that P3DM is most useful for hilly area, but less useful in flatter land (Hoare et al, 2002: 16).

2.) Lesson Learned from Participation

A common mistake of participation approaches is the failure to be aware of conflicting interests between groups. Hidden benefit of stakeholder has many forms. Reward from participation may be high status in community society, which means that more acceptance in social and get more benefit from individual activity, for example right in water allocation from head to tail in irrigation canal. In case study of tribal women in Vidarbha, (1998: 527-534) showed that constraint in tribal participation in India is backward civilization of village e.g. less literary, starvation, unemployment and lack of political awareness and influence. Another problem is illegally lost their land to non-tribal and belief which based on social organization.

3.) Participation and Gender

Agarwal (1992), Sittirak (1999) and Bridges (2001) doubtless agreed that the concepts of participation and gender have been a part of development discourse and practices for the last decade. Advocates of these concepts have claimed that they allow gender as the representation of the most marginal groups share their equity cooperation

in development dimension. Moreover, they still pointed that both approaches have had to encounter a similar set of questions from critics, such as: To what extent can gender take account not only of the differences between men and women, but also of differences between women, and between men, along the axes of class, age, ethnicity, race, caste, sexuality etc.? And to what extent have participatory methods allowed expression of divergent voices along the lines of gender, as well as other differences? Those questions posed in both cases have now led people using both approaches to take a critical note of and learn from each other.

4.) Empowerment Theory and Participation

Rooted from human development management and community psychology, Fatterman (2000, 10) described that Empower Theory is a way to enhance a person's performance to its full potential, especially people who lack power themselves (Kabeer, 1999: 437); in easy terms, to empower is to give someone power, which is done by individuals, and have authority to make decision to contribute their ideas to exert influence and to be responsible. It copes with concepts of self-regulation and self-determination behavior (Pathranarakul, Pairote 2002).

Melkote and Steeves (2001:36) further added that empowerment deal with "power" which is in social relations. There are several kinds of relational power in social, namely: power over (controlling power or access to decision making process); power to (generate new possibilities without domination); power with (collective power, power created by group process); and power from within (spiritual strength that inspires and energizes others).

Indeed, concept of empowerment is very complicate and means different things to different people. In recent years, much has been written about alternative, highly participatory, empowerment-oriented approaches to development. Rowlands (1998) review the literature of empowerment, dividing it into three overlapping dimensions: personal empowerment (developing individual consciousness and confidence to confront oppression), relational empowerment (an increased ability to

negotiate and influence relational decisions), and collective empowerment (collective action at the local or higher level to change oppressive social structure) (Figure2.3).

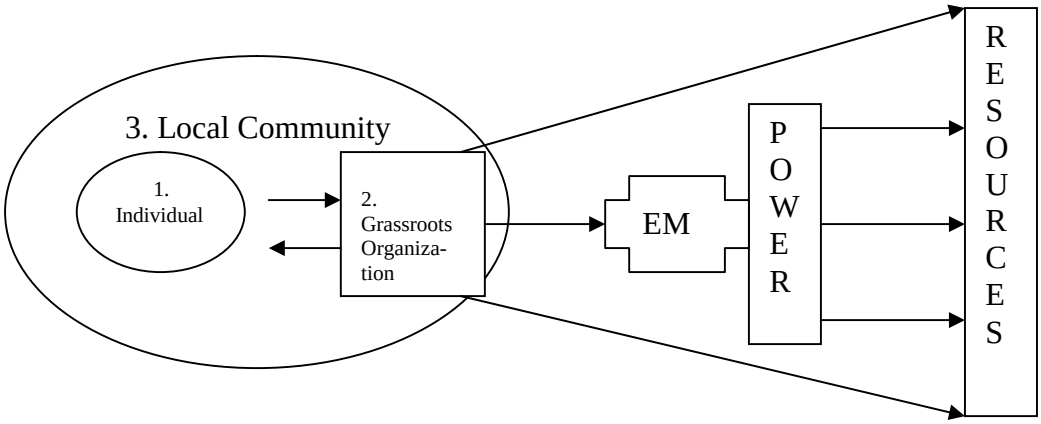


Figure 2.3: Overlapping Dimensions of Empowerment in Resource Controlling

Source: Adapted from Melkote and Steeves (2001: 364)

Tracing the history of the empowerment concept, Melkote and Steeves (2001:36) divides empowerment into two primary models: one model is based on empowering the individual, not on encouraging collective social action by the oppressed (liberation or free and self-reliant) and the other model emphasized conscientization and radical social action. It can say that in macro scale it means that excluded people i.e. handicap or women should have right to participate and accept from social. While in micro scale, besides giving right, excluded people should change their social structure according to their judgments. In this paper, macro scale was studied by giving the power to women until they gain control and mastery over resource management.

However, participation, a powerful tool of management ideology is essential for the achievement of empowerment; owing the fact that it increases power in decision – making process without changing basic structure of people status. Increased participation and empowerment have always been central goals and fundamental value of management (Blanchard, Carlos, and Randolph, 2002: 12). Moreover, participation

is an especially effective form of empowerment (see detail in Table 4). Participation produces better solution to problems and greatly enhance acceptance of decision and enhances empowerment. Empowerment, in turn enhances performance and well-beings, which is the key issue of sustainable development; therefore, empowerments go hand in hand with participation and make sustainability.

Toopgrajank (2001, 10) and Padunchewit (2002: 395) mentioned that the process of empowerment related to these factors:

1.) Multi-Partnership, it referred people's cooperation with various organizations, so multiple parties are engaged. Number of network and alliances such as civil society organization were evaluated to be the indicator. This approach is believed that it can help people easily voice their needs i.e. through brainstorming of group gathering with manager at sub district level.

2.) Communication Approach, in scope of human being system, communication was treated to be interaction in system through expressing form of behavior or Communication = Interaction = Behavior (Kennedy, 2000: 52). So, vital role of communication is transmitting message to receiver in order to make better understanding, for instance knowledge, attitude, law and regulation. Thus, the quality of communications has an important impact on the success or otherwise of a change or communication is a component of decision-making. There are three types of communication used, namely oral communication (through face-to-face, meetings, presentations, telephone and voice mail), nonverbal communication (body language, picture-poster, setting), and written communication (newspaper, memos, report, and poster).

Among them, the ordinary way used in human society is oral communication, which comprises of inter-personal communication and intra- personal communication. Inter-personal communication is important; a person might communicate certain things to a colleague on the basis of trust and interpersonal relation more than stranger, while intra-personal communication uses channel such as written communication via hard copy. However, there are many barriers in communication between sender and receiver

e.g. perception, information overloading, channel selection, trust and credibility, not listening, emotions, noise and filtering (Lussier, 1996: 327)

The study of Padunchewit (2002: 395), which studied communication used by women as agent of development revealed that women can be empowered by using communication strategies: Determine preferred outcomes, Field of Experience, Abilities, Situation Context, Perceived Costs and Rewards, Communication type, and Harmony with Communalistic Culture, especially eastern culture which explicitly respect social role, culture, ethic and religious. Those seven strategies affect ignorance or acceptance message in communication of women who were treated as co-cultural or muted group.

3.) Conflict / Benefit Sharing, it refers to non-agreement issue, dissatisfaction, fight for benefit and power, which comprise of hidden - overt conflict, conflict within individual (common conflict), interpersonal conflict (occurs between two people who disagree), Conflict between an individual and a group or intra-personal (when group member breaks the group's norm). In the case of benefit, it related to allocation on the basis of fairness, for example fairness access to water utilization in case of irrigation area. Lussier (1996: 464) reported that there are five sources of conflict – 1) diversity of people; 2) interpretation different information; 3) different objectives; 4) changes; 5) scarcity resource.

4.) Learning and Problem Solving, is the process that learner can obtain knowledge. It is essential for people to develop learning skill both in formal and formal education for upgrading their competitiveness. Bowler, Kaiser and Hartig studied university student's behavior in environmental course. Using controlled class with field trip and ordinary class during 10-weeks courses, he found that student who had experience with environment trip gained positive environment attitudes and ecological behavior - action which contribute towards environmental conservation (Bowler, Kaiser and Hartig 1999: 19-26). Moreover, they suggested that, according to Attention Restoration Theory used in their study, environmental knowledge can

initiate and sustain a person's orientation to protect and participate in environmental issue.

5.) Regulation and Guidance by public sector, it coach people to follow and control their responsibility in the right way. In addition, it leads to budget and any kind of support from within and outside organization.

6.) Self – Reliance, self-reliance refers to all activities conducted by individual in order to become self-fulfillment. Individual should have autonomy and self-determination. This belief shall transfer to next generation by household learning process.

However, Natsupha (1994:95-107) identified that Thai culture has its own identity; self-reliance in Thai culture style may differ from others, namely: 1) have sense of public awareness and freedom to determine destiny; 2) positive relationship with other social group or good attitude on social interaction; 3) self-ability or local knowledge to manage its own affaire; 4) cultural harmonization (norms, value and moral); 5) transmission that sense to off spring ; 6) network supports from both public and private sector i.e. elder cohort; 7) sufficiency income.

In addition, Putnam, who established famous "Social Capital" ideology (Putnam, 2001) and Harvard University (2002) survey the benchmark of social capital community in United States and found that civic engagement (cooperating, network and trust), which come from people's consciousness and institutional respond are other important factors affected to self-reliance.

7.) Network / Relationship, relationship established connection power (the ability to influence others' behavior) and help people get the resources they need. The right connection, however can give the perception of having power, as well. Expansion network brings more bargaining power to people from both within and outside, especially in political network. Moreover, strong group help more participation.

However, Blanchard, Carlos and Randolph (2002) also said that empowerment should deal with **P-E-R-F-O-R-M** diagram that is P means purpose; E means empowerment in using self-ability; R means relationship; F means flexibility in decision making; O means optimal performance; R means re cognitive which is one component of consciousness (cognition, affection and conation) and M means motivation. Kar (1999) applied some variables underneath quality of life domain in health science. In his study "A Meta-Analysis of Multi-Dimensional Models of Empowerment of Women" he found that beside media, education, partnership and support, the way to empower women is leadership training, work training and rights protection. Finally he proposed empowerment methods, that is:

E. = Empowerment Training/ Leadership Development;

M. = Media Use (Support/ Advocacy);

P. = Public Education and Participation;

O. = Organizing Partnership (Associations, Cooperatives and Unions);

W. = Work/ Job Training and Micro Enterprise;

E. = Enabling Service and Assistance;

R. = Rights Protection and Social Action/ Reform

Thus, the way to empower women depends on the basis of relational context. Understanding role, responsibility, gender inequity increase women's participation and have more right in decision making.

2.3 Gender Dimension

The term "gender" or "gender relation" in feminist literature refers to the economic, social, political and cultural attributes and opportunities associated with being male and female (Kaowtep Kanchana1992a, 1992b, Sittirak, Sinit 1996, 1999). In fact, biological differences between men and women do not change, but the social roles that they are required to play vary from one society to another and fluctuate over time. In most societies, men and women differ in the activities they undertake, in access and control of resources, and in participation of decision-making. Within this context, four of the major resources include:

- Employment / wage labor – the primary asset of the poor in all countries;

- Human capital – including health and education, which has implications for the returns to labor;

- Physical assets – such as housing, tools, means of transport, etc.; and

- Social capital – the resource inherent in the social structure of a community, which facilitates certain types of actions among the various actors of the community that enable the community to be self-sustaining.

Experience indicates that in many parts of the world, resources, opportunities and decision-making possibilities are less available to women than men. These inequalities are a constraint to country's growth because they limit the ability of women to develop and exercise their full capabilities, not only for their own benefit but also for that of society as a whole. The nature of gender definitions (what it means to be male or female) and patterns of inequality vary among cultures and change over time. A recognition of this variability assists in the analysis of socio-economic contexts and relationships and the possibilities for change. This is so mainly because there is inadequate gender awareness in the policy and planning process for national development, as women's roles are always stereotyped by social values. Thus women who account for half of the country's human resources are unavoidably devalued and overlooked (Wongthed, 1991: 55). Although the difference between man and women according to physical matter, women was respected to be mother centric in kinship system. As a result, women effectively play mother role as nurturing and family decision.

2.3.1 Gender Approach and Sustainability

Since the publication of the Brundtland commission report in 1987, and with an added emphasis after Agenda 21 in 1992, sustainable development concept has become a subject of discussion and debates through out the world (WCED 1987). The word sustainability which means “meets the needs of the present with compromising the ability of future generations to meet their own needs”. The principal idea includes a consideration of the future and how people act today affect the future generation. The discourse of suitable combination between development, economic and ecological issue has become a permanent fixture on the international agenda. However, the ways to put it into action need clearly understand between development theory and practical efforts, participate among stakeholders as well. In addition sustainable development cannot be separated from sustainable economic development, as sustainability depends on the interaction of economic changes with social, cultural and ecological transformations (Ellis 2000, 15).

However, Counsell (1999: 22) criticized that the limitation of Agenda 21 is the blueprint for sustainable development which focuses about future but plans in general and no enforcement to country’s member. In 2000 World Summit on Sustainable Development (WSSD) was held in Johannesburg. There is wide critique that enforcement and funding is the main constraint of Agenda 21, for example in case of no ratification from United Stated in GHG treaty. All nations believe that it decline, rather than increase, development assistance. Finally, the Johannesburg’s agreement called for "a strong program of action" and “identification specific targets, especially country’s name” for which can concrete results in form of both measures and firm commitment (Gustave, 2003).

Likewise, the basis of Gender approach deals about the inequity between each sex and tries to empower the right of women in society. It believed that if both of men and women are equity in decision making, and social status, natural resource in watershed boundary was sustained; due to the fact that their basic role in community

level deal with natural resource consumption. To empower the equity between genders is meant promotion of natural resource's sustainability.

2.3.2 Theory of Gender in Watershed Management

1.) Concept of Gender Mainstreaming. Indeed, 'gender' expresses the socially constructed categories of characteristics and roles that are associated with masculinity and femininity. It can be informed the trends in relation in social and political issue. However, it was the World Bank who realized that gender is a major social factor in promoting economic efficiency and for reducing poverty, therefore, after the year 1992 projects supported by World Bank need to mainstream gender.

Women and Environmental Development Organization (1997) described that it is the process of assessing the implications for women and men of any planned action, including legislation policies or programs, in all areas at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programs in all political, economic and societal spheres, so that women and men benefit equally and inequality is not perpetuated. However, the ultimate goal of this concept is to achieve gender equality.

This concept helps demolish stereotypes and persuade policy makers to change policies, give a basis for formulation of policies effective for both women and men. Beside, monitoring tool and policies evaluation can be measure by country' gender statistics.

2.) Concept of Gender Role. Gender role is the ways for each sex to behave, which vary among different culture and eras. Pattern of behavior of each sex was exhibited by social expectation. Women, for example is social - expected to be maternity or nurturing, sensitive, emotion and relatively passive manner. That so-called gender identity was unique and established though social processes such as

parental modeling and feminine pattern imitating. Moreover, each sex has to correctly identify themselves in relation to the world around them or as part of a community.

Gender's behavior play provides the right perception of women and men in social reality or power relation in social. They help understand the actual situation of women and men in society. Difference roles of men and women result in distinct patterns of behavior. For example in resource requirements and use, Sharma (1994: 5-11) reported that women have often placed in the private sphere and men in public sphere because of family traditional responsibility. She also portrayed that women's reproductive role require direct daily interactions with the environment as they gather water or wood, or participate in agriculture. It is, therefore different from men's experience; owing to the gendered division of labor. This division exists when there is a substantial and accepted difference between the labor done by men and by women.

However, Moser (1989) mentioned that male and female roles are categorized as productive, reproductive, and community management, although the boundaries between productive and reproductive spheres are not always clear:

1.) Productive roles. These refer to activities that generate income. Related activities are also included in this category. Although subsistence farming is essentially production for use, it displays similarities to income-generating agricultural activities and, in times of surplus, becomes production for exchange or trade for other products or resources like labor. However, in developing countries, this responsible provides employment opportunities for men, while women become increasingly involved in household agriculture. It ignores the realities of women who work at home or also require access to natural areas. Owing the fact that a gendered division of labor forms the basis for women's responses to the natural resource like water; the division of labor, however is often unequal, affecting the conditions of women's lives.

2.) Reproductive roles. These involve the daily domestic activities (related to child bearing and rearing responsibilities) like cooking, cleaning, washing, healing, teaching and so on. They also include the transformation of goods and services for

household use and welfare. However, critics of ecofeminism claim that by highlighting women's reproductive roles, women may not consider the other role which makes them inadequate in right to manage efficient environment. Moreover, women's reproductive work mediates between men and nature which is undervalued (Shirk-Luckett, 2001: 13). Women's positions as mothers and care-givers lead to a high environmental consciousness, so the desire for a better life may lead women to make decisions that are not detrimental to the environment.

3.) Community management roles. These cover the collective aspect of production, community organization, and the provision of items of collective consumption. It is up to what type of society, which gender is in. For example, in South-east Asia where patriarchal societies were dominated, women were hierarchically placed below men. So, they were not allowed to join community activities.

3. Gender Socialization Theory. Sociology theory describes how and why human behave, interact and organize in particular ways. Gender socialization is the process where people learn and internalize society's value and expectation for each sex. This theory has been useful for explaining the repercussions associated with gender socialization, especially the adverse impact rigid gender socialization can have on female. Moreover, it also addresses the effects of socializing males and females in a different manner. Based on Social Learning Theory which deal**s** with human behaviors occurring regard to cognitive factor such as though or felling and environmental variable such as stimuli – rewards and avoid punishments in social interaction, Gender Socialization Theory was developed to fulfill the weakness of understanding gender differences in adults and social structure (Howard and Hollander, 1997). It can say that Social Learning Theory do not address the fact that the organization of certain institutes, such as family, education or religion promotes differential reinforcement for males and females that exhibit similar behaviors.

The core concept of Gender Socialization is social structure has influence on the development and persistence of gendered patterns of behavior and attitudes. It is

easily described that societal and culture norms and values influenced gendered patterns of behavior (Howard and Hollander, 1997). It is the crucial reasons make males and females differently function in every issue, for example distinct occupation chosen, type of family role. Female is portrayed to be nurse, where as male is solder. Indeed, they serve as models and providers of such rewards and sanctions in Social Learning Theory (Figure 2.4).

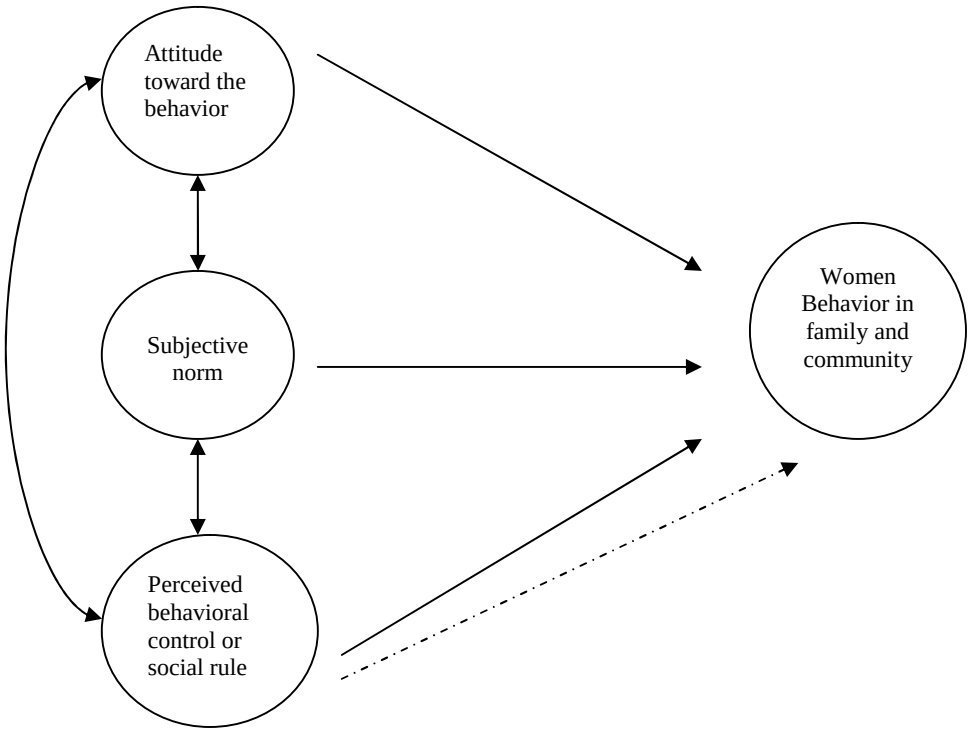


Figure 2.4: Impact of Socialization to Human Behavior

Source: Adapted from Waranusantikul (2003: 122) and Smith (2000: 16)

There are three variables that determine behavior – attitude, subjective norms and perceived behavioral control or social rule. The attitude captures a person's disposition toward a behavior. Attitudes toward a behavior are determined by a person's beliefs about the consequences resulting from the performance of a behavior and the person's affective response to those consequences.

The subjective norms measure attributes of a person's social environment. Subject norms are a function of a person's perception of importance referents' evaluation of a behavior and a person's motivation to conform to those evaluations. It is the social pressure to perform or not perform a behavior.

The perceived behavioral control captures variation in a person's ability to control the performance of a behavior. It measures a person's perceived ease or difficulty in performing a behavior. In summary, it can easily say that person's intention to perform a behavior will increase as his or her attitudes, subject norm and social control toward a behavior become more favorable. For example, male was labeled and symbolic as strong, aggressive and even domineering behaviors exhibition Thus, social labeled male as agents of gender socialization. On the contrary, females should behave in a nurturing, sensitive, emotional, and relatively passive manner as agents of gender socialization. Hence, women themselves was focused in take care activities i.e. house works.

However, in terms of gender, there is so few study simultaneously examined gender and behavior. Kelly and Breinlinger (1995), in their study "Attitude, Intention and Behavior: a study of women's participation in collective action" found that there are relationship between the attitudes, subjective norms, perceived behavioral control and behavior. After testing three variables, they found that attitude variable was the strongest correlation with behavior. It produced significant result with coefficient (R) = 0.51. Moreover, they analyzed that attitudes establish norms. These norms define the boundaries of acceptable behavior and strongly influence people's decision to behave and attitudes were the result of people's belief.

Davidson and Freudenberg (1996 cited in Bridges, 2001: 38) investigated the relationship between and gender's environmental concern and behavior by asking attitudes toward environment through 24 telephone interviews and qualitative analysis. Although the works of Davidson and Freudenberg did not provide quantitative findings, the result revealed that the difference in both genders' attitude toward environmental concern is:

1) Knowledge. It is surprising that men's attitude toward environmental risk is less than women, although males typically receive greater acknowledgement for society standards that have more environmental knowledge and stay in the first rank to get training by any agency.

2) Trust by society. Women are found more distrust of institutions than men, but have more environmental concern. As the matter of fact that females are commonly engaged in stereotypical feminine behavior. As a result of being in a private sphere, female have developed different responses to social institutions. Male have tended to be more trustful of institutions such as science and technology, because they have had a long history of involvement with them. On the contrary, female are more likely to distrust such institutions as science and technology, since they have been less involved in them.

3) Concern over more economy. Men are more likely to be concerned about economy than women, especially those who work for pay outside the home. They found a negative relationship between economic concern and environmental concern. If men perceive environmental concern as being too economically costly, they are not likely to do.

4) Safety concern. It found that women are more likely to have health and safety concerns than men, especially environmental risk

5) Parental roles. Fathers tend to focus on economic factors because of traditional obligations to economically support their family, while mothers have a tendency to be concerned about health and safety issue based on their traditional roles as nurturers and caretakers.

By the time of 1998, Burger, Sanchez, Gibbons and Gochfeld (1998) repeated those studies. The relationship between environmental attitudes, gender and environmental behavior investigated. Not similar to previous study, they asked

respondents to indicate on questionnaires their perceptions of the severity of selected global environmental problems and their willingness for the allocation of federal funds to solve or mitigate selected environmental problems. The result showed that there is statistically significant relationship at the 0.05 level between gender's behavior and environmental attitudes. Moreover, the result also reported that women were significantly more concerned over radon in homes, the use of pesticides and supportive of federal spending for rain forest preservation and safe drinking water. According to the analyses of Sachs (1996), she addressed that rural women were the first to recognized and organize on the basis of local environmental issues, such as limiting the use of toxic chemicals in agriculture, diversification of crops and the efficient utilization of on-farm resources to preserve the land. Besides, she believed that the daily activities of rural women, particularly their care-taking responsibilities for their families, were the basis for their environmental concern and subsequent activism.

Generally the findings from all studied indicated that environmental attitudes are typically significant predictors of environmentally responsible behavior and in comparison to men, women tend to be more concerned about environmental issues. Additionally, women perceive environmental problems as more severs than men do.

However, anthropologist like Bamberger believed that the influence of Religious, Belief, Value (or social structure) on people attitude is crucial factor impact to gender behavior (Wongthed 1991: 126). This matter was clearly described in study of Buadaeng (2001: 37). She said that ritual, cult and myth obsess mental model are presented through social role. In Watershed Spirit Ritual (***Lue ta***) held once every three years, for example only Karen men conduct the ritual; where as women were prohibited in the ritual site. Women were allowed to join ceremony, after a cow and couple of chickens for the sacrifice were ready cooked.

As evidenced in the examples above, 51 studies of attitudes and behavior published from 1971 to 1985 revealed that the meta-analysis produced a corrected correlation coefficient of .347 for the relationship between attitudes and behavior. It means that attitude may impact human relevant behavior (Cordano, 1998: 8-9).

However, most of studies, used demographic variables, found that age, education, and farm structure have inconsistent relationship on work activities. This would suggest that demographic variables tend to be weak predictor of women's activities. And most finding reported that they make decision with their spouse.

In environmental management behavior, for example, it found that managers' environmental attitudes influence overall environmental policy of organization and individual management decision. Among three type of environmental leadership organization – value-driven, market-driven and regulation-driven, it concluded that the role of senior managers' environmental attitudes in accordance with values, attitudes and belief is decision making.

In watershed management, Gender Socialization Theory was applied in evaluation the function or act of duties of female in watershed management involvement. Females identify with and relate to their reproductive tasks, since they assume their role in health and safety concerned. The primary applications have been to demonstrate the effects and potential impact of gender socialization on individuals and society in general. The theory seems most applicable to exhibit behavior and attitudes. Performed role had been conducted under culture norm; believe, perception and attitude of society, whereas expectation role was acceptance by society desire. It is based on social relations, shaped by cultural and material conditions and is variable through time. Advocate of this theory claim that poverty, wealth and cultural norms will affect environmental concern. Changes in social and cultural systems result in new norms, values and social roles and relationships. It is observed that all mentions above deals with social culture - Norms, Believe and Network which detailed these crucial variables, namely Trust, Awareness, Cooperation, Institute Culture, Social Relation, Education, Economic and Law and Regulation.

4.) Variable in Gender Socialization Theory Women participation management behavior can be predicted according to the principal of theory. Based on the concept that 1) women tend to define themselves in relation to nurturing roles towards societal surroundings and as their place is in the private sphere according to

rigid stereotype in society, attitude functioning will allow women to imagine the consequences associated with watershed management ethic, which helps individuals determine the suitable approach in management, especially in reproductive tasks. 2) In attitude functioning, information can be processed through individuals by integrating the symbols with knowledge, and then conceptualize the practice associated with watershed management. Dissemination of information regarding watershed conservation practice can serve as a stimulus for the process. Pros and cons in orientation were evaluated in system thinking. Therefore, management practice occurs when they receive more information. However, individuals have extreme difficultly conceptualizing management practice. Women who feel more strongly about environmental risk should have a tendency to advance actions.

The dependent variable in this study examined participation level in watershed management. In addition, Independent variables utilized to explain dependent variable include 1) attitude and 2) communication approaches.

2.3.3 Women Participation in Watershed Management

Among a heap of women literatures there is a little discussing on the role of women in watershed development. Seeley, Batra, and Sarin. (2001) observed all watershed development programs supported by the Indian government and found that women participation through their private sphere more than public spheres. Rani (1999) described that because of the influence of natural free bio-mass, women perform key roles not only in the gathering but also in the processing, storing, utilization and marketing of free biomass goods – natural resource.

Even although women are great technical know-how, they lack opportunity to cooperate in project because of participation process perception problem, not include in number of watershed development team and expert's field, and the caste system which treat status of women lower than men's. In contract, the study of Ellis who studied the role of women in the commercial bushmeat trade in Cameroon and established integrated model for wildlife conservation found that role of women not

only key stakeholders in economic providers - the main household's income but also a constituent of stakeholder which influence the success of biodiversity conservation planning (Ellis, 2000).

However, UNESCO (2003) mentioned that women are willing to involve in watershed management if it is provided four basic needs and their daily activities:

1.) Access to a reliable source of safe drinking water within a reasonable distance, and improvements in health and hygiene. It is found that often the irrigation and activities in watershed that enhance water access for agriculture ignore women's water needs for household purposes, livestock etc.

2.) Access to a steady flow of income to ensure food, fuel and financial security.

3.) A secure future for their children through education.

4.) Participation in household decision-making and community affairs.

In Thai context, women participation always in concerning of individual project such as water resource conservation: river and stream conservation; otherwise soil conservation. There is a little movement in participation the big project like watershed management.

2.4 Women in Thai Society and Watershed Management

The concept of gender has been influenced on Thai society throughout centuries. In Sukhothai period, 1250-1350 the role and status of Thai women in traditional society are the lower priority position. National Council of Women of Thailand (1975: 10) described that after the harvest, women do weaving, and played a greater role in the family in terms of authority, control over property of the family (household money and expense) while men do mental work. Then 417 year later, in Ayudthaya period, 1350-1761 women status were declined and depended on the husband's status and income. Thus, primary role of women was to entertain and give pleasure to men in the household (Boonsue, 1998: 7). This stereotype of women is still rigid in early Rattanakosin period, 1782-1851. Women were taught and trained to be wives and mother (Purisinsit, 2002).

After that the influence of western culture gave rise to a progressive movement in the country. Women were provided more education by entering university; the equal right between male and female is emerged in 1932, the first Constitution of the Kingdom of Thailand. In addition, in 1981 the Long Term Women's Development Plan 1982-2001 was established to focus on development program for women. However, the relation of women issue to the National Economic and Social Development Plan was review in few studies.

In the National Economic and Social Development Plan and women's issue, Pongsapich (1986) informed that neither the First nor the Second Plan (1961-1971) saw an increase in sensitivity to gender issues. The first attention of women issue was in the Third Plan (1972-1976). Women were mentioned because of the population and family planning policy where women were the target group of policy implement. Documented research on women mostly indicated that in the beginning period of the National Economic and Social Development Plan women's participation deal with industrialization issue (Boonsue, 1998). In the Fourth Plan (1977-1981) which is the period of rapidly economic development women was affected in three areas: promoting equal access to education, promoting occupation training and revising and modifying laws discriminating against women in order to expand women's role is in the labor market instead of unpaid family work in agriculture sector. Besides, the Office of the Prime Minister announced the Long Term Women's Development Plan 1982-2001 to promote women activities. After that period woman are involved in every area of development plan. For example in the Sixth plan (1987-1991) which regard to social development, women's development plan was established to promotion of self-reliance. However, women and natural resource issue was not explicitly accounted; in spite of women constitute a dominant component.

Women and environment issue was written in the Seventh Plan in an annex part (1992-1996) (Boonsue, 1998: 24). In addition the Steering Committee for Women's Development Planning under the National Committee for the Promotion and Coordination of Women's Affairs was revised and established the second Long Term

Women's Development Plan 1992-2011, which emphasize women's potentiality, quality of life and women's participation in social, economic and political affairs. The outstanding point is this plan perceive of men as the important factor in supporting the changing role and status of women, especially the gender relations in the family and household. The Eighth Plan (1997-2001) is mostly emphasized about women more than other plans. Women Right was raised especially in terms of human right and the linkage of equality, development and peace, which is the national goal of women development. It has blossomed the women participation in any activities (Women Foundation, 2000: 13).

Tradition was important in rural areas and women's lives retained many elements of tradition. While women were participating in the market economy, they were often also performing traditional domestic roles. Women were involved in cooking over coal, childcare, washing, and caring for domestic livestock their rights are now recognized by law and economic realities are facilitating paid employment opportunities.

In terms of watershed management, there is a little number of studies; however, Sittirak (1996) is the first person who realized that rural women have great indigenous knowledge in natural resource conservation. Yet the modernization is the crucial factor which decreased their sense of awareness.

2.5 Women Empowerment in Watershed Management Participation

As a result of the Earth Summit in Rio de Janeiro (1992) and the Fourth World Conference on Women in Beijing (1995), the need to recognize the role of women in the development and management of natural resources, and to ensure their participation, has been widely accepted. Recent approaches to gender participation aim at considering women in relation to other groups with distinct stakes and roles in the provision and maintenance of natural resource. The time has come to take stock of

experience gained and to achieve a clearer understanding of the contribution gender participation makes to critical aspects of sustainable management.

The pivotal role of women as providers and users of resource drives women play a central part in the provision, management and safeguarding of natural resource. However, women are still lack of power and influence. Women, in all parts of the world receive less formal education. Hence, acceptance of women's status equip participate at all levels in resources management programs, including decision-making. Empowering the status of women also enhances their decision-making capacity at all levels in all spheres of life, especially in the area of sexuality and reproduction.

In case of Thailand, The idea of empower women has explicitly started in 8th plan (1997-2001), which focus on human centric and 9th plan (2002-20006), which focus on the King's Economic sufficiency theory. However, by the year of 1989, National Women Promotion and Cooperation Committee, on behalf of Prime Minister's office were set up by the Thai Royal Government. The only long-term policy on women (1992-2011) was established to promote women's participation and right. Since the time passed, that strategy on women was not fully practiced. So, women empowerment is the only chance to let them show their voice in society.

This study qualitatively investigates women empowerment in watershed management at the Khwai Noi Upper River in Kanchanaburi province. Crucial concerns are on the issues of the roles of women in self-empowering. Attitudes and beliefs on gender norms and their effects on women empowerment are examined, as well.

CHAPTER 3
MATERIALS AND METHODS

Based on objectives of this study, women's empowerment in watershed management of the Upper River Khwai Noi sub watershed is the core topic. Role underneath social structure context were examined in this study, and then measured the women's attitude toward watershed conditions. Finally, factor affected to empowerment in participation is studied. In this chapter, generally every part is divided into two folds, according to objective as following:

- The first one includes the watershed inventory employed by Geographic Information System and Remote Sensing, and then interprets in terms of watershed conditions;
- The second one includes role of women participation within culture which related to forest, water, and soil resources in terms of their perception. Factors related to women empowerment are also added.

Based on the circumstance mentioned above, it indicates that there is a need for a combination of quantitative and qualitative approach that can facilitate in-depth interview. According to Neuman (1994), a case study approach facilitates the researcher to thoroughly examine mental model and behavioral pattern. Therefore, the research design of this study in a part of women empowerment is based on qualitative approach, whereas the situation of watershed quality is based on quantitative approach.

3.1 Materials

Data employed in this study was collected from various sources in the form of digital data, report and field survey. Material used in the study consisted of:

3.1.1 Material Used in Watershed Inventory

1.) Remote sensing data between the year 1990-2000 Bands R5G4B3 (LANDSAT Thematic Mapper);

2.) Existing maps:

Land use map (Scale 1:50,000; Department of Land Development, 2000)

Topographic map (Scale 1:50,000; Royal Thai Survey Department, 1983)

Soil map (Scale 1:50,000; Department of Land Development, 1985)

Forest map (Scale 1:50,000; Royal Forest Department, 1999)

Watershed classification map (Scale 1:50,000; Office of Environmental Policy and Planning, 2000)

3.) Climatic Data Table (monthly rainfall) between the year 1991-2000 by Meteorological Department and Royal Irrigation Department.

4.) Computer with software “ARC View version 3.2” and “ERDAS IMAGINE 8.5”

3.1.2 Materials Used in Finding Women Empowerment

1.) Socio-cultural data gathered from Ministry of Interior (2002), National Economic and Social Development Board (2001), and Office of Watershed Conservation and Management, Royal Forestry Department (1999).

2.) Questionnaire from field survey.

3.) Tape Recorder

4.) Other Published information.

3.2 Methods

All data are manipulated according to objectives. Thus, the method used here are as following:

3.2.1 Methods Used in Watershed Inventory

1.) Remote Sensing Data. One set of Remote Sensing data, namely LANDSAT-5 Satellite Thematic Mapper (TM) sensor in 1990, 1995 and 2000 was acquired from the Geo-Informatics and Space Technology Development Agency (Public Organization) (GISTDA) in form of digital data, which is easy to make a relief map. It can also be combined with image data for a number of purposes. The visual and computer assisted approaches were used to identify the land use/ land cover data.

Actually, RS was classified to monitor forest land changes in three significant time period: 1990, 1995 and 2000. Then it use DEM or Digital Elevation Model techniques (from GIS) to find solution.

2.) Spatial Data. Several thematic layers were prepared for GIS coverage (Table 3.1). In addition, many techniques were used to make an output such as overlay, DEM and interpolate techniques.

Table 3.1: GIS Data Layers of the Study Area.

No.	Thematic layers	Base source/ map	Scale	Year	Publisher
1.	Watershed class	Topographic map	1:50,000	1985	OEPP
2.	Political Boundary, Road	Topographic map	1:50,000	1983	Royal Thai Survey Dept.
3.	Drainage	Topographic map	1:50,000	2000	DEQP
4.	Soil	Soil map	1:50,000	1985	Soil Classification Division
5.	Land use	Land use map	1:50,000	1990, 1995	Dept. of Land Development
6.	Land use (2000)	LANDSAT TM	30 x 30 m (1:50,000)	2000	RS data interpretation
7.	Slope	DEM	-	-	-
8.	Contour Elevation	Topographic map	1:50,000	1985	Royal Thai Survey Dept
9.	Rainfall, No. of rainy day, Temp., Relative humidity, Evaporation	Meteorological data	1:50,000	1990-2000	Generated by interpolation

Then, using overlay technique through ARC View version 3.2 to identify watershed condition by using formula below:

$$\text{Watershed Status} = \int (B,P,H,L)$$

Where as B = Biological Resource

P = Physical Resource

H = Human Resource

L = Human Life Quality Value

That formula is based on the study on environmental status in watershed of highland area in Tak province by Kaipanon (1999: 27-39), the evaluation of watershed situation in Nan province by Navanugraha (2002: 63), the evaluation of watershed situation in Sonkhla Lake by Tanavud (2003) and Mathematical models of soil erosion

and sediment pollution in watershed by Tangtham (2002: 5.6). The reason behind that idea is shown in Table 3.2:

Table 3.2: Spatial Variables Used in the Study

Watershed Status Component	**Parameter**	**Criteria & Source**	**Data Used**	**Method**
1. Biological Resource	Forest area in watershed	In 1A, 1B, 2 watershed classification, 100 % of forest area is appreciated (Tanavud, 2003)	Land use from RS	Overlaid the land use classification map onto the watershed classification
2. Physical Resource	Soil Erosion	Soil Loss rate in watershed is not exceed 5 ton/rai/year (LDD, 2000)	R = rainfall and runoff erosivity index for geographic location K = soil erodibility factor L = slope length factor S = slope steepness factor C = cover management factor P = conservation practices factor	Calculated by Universal Soil Loss Equation (USLE): A = R K L S C P
	Volume of Water	A large volume of rainfall increases runoff (Navanugraha, 2002).	Isohyetal line of rainfall data (1400-2800)	Interpolate average yearly rainfall from 1990-2000

Table 3.2: Spatial Variables Used in the Study (Cont.)

Watershed Status Component	Parameter	Criteria & Source	Data Used	Method
3. Human Resource - Human Use	-Slope	According to geology, 35 % of slope is hilly or moderate steep, which is not suitable for settlement. Thus, both agricultural and urban area is not exceed than 35 % of slope (RFD,2000; Tangtham, 2002)	Land use from RS	Overlaid the land use classification map onto the slope
- Human Life Quality Value	Population Density in watershed area / km².	Number of household in agricultural land, which based on criteria that one household (average 4 people) hold 20 rai (MOI, 2002; Navanugraha, 2002)	- No. of population = Household X 4 -Watershed area = $\frac{\text{Agricultural land}}{20}$	Calculated by: capacity of watershed area/ density people = $\frac{\text{No. of population}}{\text{Watershed area}}$ (head/ km²)

3.2.2 Methods Used in Finding Women Empowerment

1.) Socio-cultural and Participation Data. Socio-cultural data consist of the information on, such as land holdings and tenure, cropping pattern, watershed management knowledge, the natural resource in watershed change affection and women partnership. Data was collected in both document and field survey by questionnaire and focus group discussion.

2.) Sample Size and Population. Owing to the theoretical framework guiding, target groups of this study are women who lived in Upper River Khwai Noi sub watershed. All population is 2,825 households, albeit the sampling size at 95% significant level according to Yamane is 345 households. The proportion of sample in each area (Sangkhla Buri, Thong Pha Phum, Sai York) calculated from Ministry of Interior's statistic, namely 148:169:28 as shown in Table 3.3.

Table 3.3: Number of Subdistrict and Village in the Study

District/ Sub district / Village	Population* (household)	Sample size**
Sangkhla Buri	**1,228**	**148**
*** Nonglu		
1. Ban Mai Pattana	240	29
2. Ban Song Kralia	41	5
3. Ban Huai Kop	79	9
4. Ban Wia Ka Di	76	9
5 .Ban Huai Malai	67	8
6. Ban Phra Chedi Sam Ang	120	15
Total	**623**	**75**
*** Lai Wo		
1. Ban Lanae Pong	69	8

Table 3.3: Number of Subdistrict and Village in the Study (Cont.)

District/ Sub district / Village	Population* (household)	Sample size**
2. Ban Kong Mong Tha	74	8
3. Ban Ko Sa Deng	38	5
4. Ban Lai Wo	26	3
Total	**207**	**24**
*** Plang Pha		
1.Ban Tha Din Dang	104	13
2. Ban Wang Khanai	114	14
3. Ban Huai To	84	10
4. Ban Chong Hua	96	12
Total	**398**	**49**
Thong Pha Phum	**1,373**	**169**
*** Pilok		
1. Ban Rai Pa	115	14
2. Ban Mai Rai Pa	94	12
Total	**209**	**26**
***Sahakhon Nikom		
1. Ban Sa Ha Kon Ni Kom	104	13
2. Ban Sa Pan Loi	129	16
3. Ban Sa Ha Kon	71	8
4. Ban Din So	148	18
5. Ban Huai Som Chit	101	13
6. Ban Song Ngan	111	14
Total	**664**	**82**
*** Hin Dat		
1. Ban Moung Ka La	99	12
2. Ban Hin Dat Ta Wan Tok	59	7
3. Ban Nong Phu	46	6
4. Ban Hin Dat Ta Wan Ok	104	13
5. Ban Kui Muang	83	10
6. Ban Dong Khrong	61	7
7. Ban Wang Pha Tat	48	6
Total	**500**	**61**
***Chalae	-	-
***Tha Kanun	-	-
*** Huai Khayeng	-	-
***Lin Tin	-	-

Table 3.3: Number of Subdistrict and Village in the Study (Cont.)

District/ Sub district / Village	Population* (household)	Sample size**
Sai York		
*** Sai York		
1.Ban Thung Khang Yang	104	13
2 .Ban Tha Tian	120	15
Total	**224**	**28**
*** Tha Sao	-	-
Si Sawat	-	-
***Mae kra Bung	-	-
TOTAL	**2,825**	**345**

*National Economic and Social Development Board (2001)

**Yamane, T (1973)

***Sub district

3.) Sampling Method. Two steps were used to select the target group, namely:

- The First Step or Initial Survey. Stratified sampling is used to find a target group. One woman from every other household is selected to be the household representative and individuals were selected in the sample if they fulfilled two requirements. Those criteria are:

1. one year- living in community is needed;
2. Women in 15 years old according to working age by MOI are added to find a sample.

The respondent's type of work is divided into 2 types- agricultural and non-agriculture. The purpose of this stage is to find a background data from total sample or 345 women by using prepared questionnaire.

- The Second Step or In Depth Survey The questionnaire from the first step contained question inquiring about the respondent's type of work; as a result, the result should be classified participants into a number of groups. In each cluster, women were asked to participate in FGD (Focus Group Discussion), according to the proportion in the first stage. Outline was prepared to be a guideline in discussing (Appendix B.). However, there were 32 women who are willing to be the sample. If target was unavailable or declined to participate, then village leader are included.

4.) Tools and Reliability. The items in questionnaire were designed to assess the factors that influenced women's participation in watershed management. It contained watershed knowledge, attitude items and participation behavior in watershed management, which is derived from feminist environmentalist literature and social capital literature (Putnum, 2001; Agarwal, 1992). The content of participation items are focused on regulation**.** Consequently, the participation practices were firstly designed to assess the pressure participation level according to three levels by FAO (2003). Then, the details of each level were evaluated according to eight items by Amstein (1995) in figure 2.2. Items aimed at measuring the pressure degree of participation level and then interpret in terms of empowerment**.** In this sense, if respondents were principal advocates for any of decision making, the advocacy variable was coded as a "1" or no need to empower.

Attitude was used to assess the level of perceived risk to environment. Respondent could express their beliefs regarding the risks of water quality. A full copy is provided in Appendix A.

The development of the questionnaire and outline question in FGD was interdependent. However, it is important to examine the effects of similar independent variables on women practice in watershed management, since there is such limited quantitative data on women's watershed management attitudes and behavior. The FGD outline question was drawn from the first draft of the questionnaire. All stems in questionnaire were based on concept of people participation, and gender socialization. The questionnaire was divided into four sections – 1) demography data, 2) Attitude

toward Watershed Management, 3) Participation in natural resource management, and 4) Partnership, Women's Identity, and Communication Approach in Watershed Management. A Likert-type scale instrument, ranged from 1-strongly disagrees to 5- strongly agree, was used to measure all variables. The questionnaire was designed so that higher scores reflected stronger levels of watershed management concern.

On the contrary, the outline of question in second step is a pencil sketch for focus group discussion. The full copy of questionnaire outline is provided in Appendix B.

- **Reliability and Validity**. Reliability and validity help determine whether the goals of measurement have been accomplished. Reliability means the extent to which repeated measurement of the same phenomenon will yield the same data each time in repeated observation. Validity refers to the degree to which an indicator measures the concept it is intended to measure rather than reflecting another phenomenon.

Content validity was considered in questionnaire by consulting with Scholar. The details are in Appendix D. Adjustments were made to the measurement instrument until it is rationale. Then, in reliability assessment, the questionnaire was tested by statistic. Internal consistency value of each item in questionnaire is the main focus; therefore, Cronbach's alpha, one type of internal consistency of the item measurement, is used to measure the reliability. If the alpha value or relation value were high above 0.60, it is considered credibility or highly intercorrelated (Table 3.4).

Table 3.4: Reliability Criteria According to Fisher and Corcoran

R = 0.71-1.00 mean High Reliability

R = 0.41-0.70 mean Acceptable Reliability

R = 0.21-0.40 mean Marginal Reliability

R = 0.00-0.20 mean Low Reliability

Source: Patrayuvat (2002: 77)

Finally, pre-test was conducted in Highland Welfare Center, Kanchanaburi province to double check in both reliability and validity. The result is presented below (Table 3.5):

Table 3.5: Questionnaire Content and Reliability Score

Scale	Source	Items #	Reliability
Attitude of Watershed Management	**Ingold (2000)**		**Alpha = .75**
1. Knowledge about Hydrological cycle		1-4	
2. Knowledge about Nutrient Cycle		5-8	
3. Knowledge about Energy Flow		10, 11-13	
4. Knowledge about Green House Effect		9,14-15	
5. Affective about the change of environment		16-27	
6. Affective to manage watershed (measure the willingness)		28-31	
Behavior in watershed management participation	**FAO (2003)**		**Alpha = .93**
1. No participation		1-19	
2. Partial participation (Consultation and Joint Planning)		1-18	
3. Full participation (Decision Making)		1-7	
Partnership			**Alpha = .79**
Go, NGO and Academic agency		1-4	
Women's Identity in Watershed Management			**Alpha = .78**
1. Problem facing		1-3	
2. Ability in problem solving		4-7	
3. Leadership		8-11	
Communication Approach	**Melkote (2001)**	**1-3**	**Alpha = .86**
Influence of media			

3.3 Data Collecting

There are two techniques in collecting data. Figure 3.1 is presented those types:

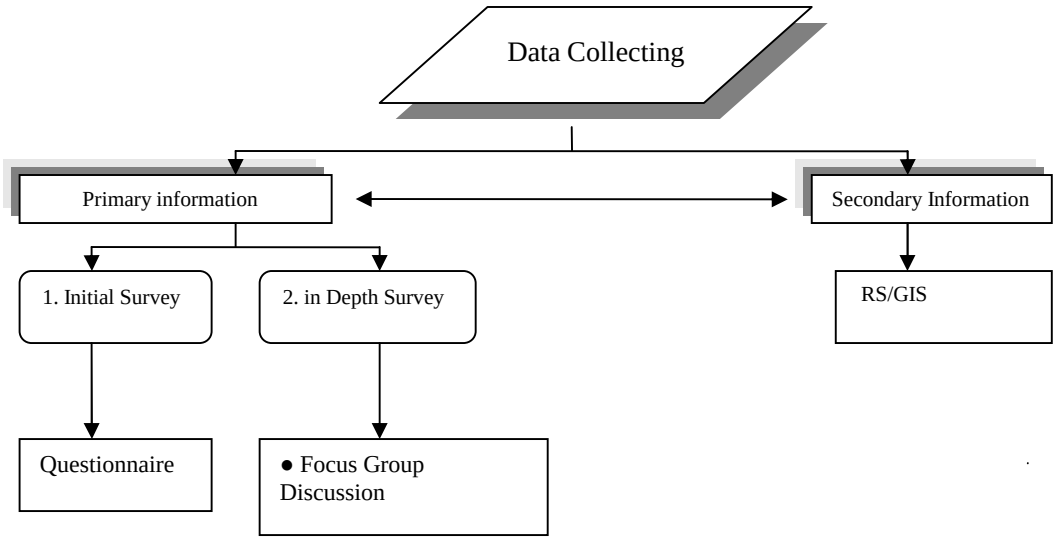


Figure 3.1: Data collecting process

Data were collected through a structured oral questionnaire and Focus Group Discussion (FGD). Fieldwork was administered between December 2003, January 2004, February 2004 and March 2004. Ten trained collectors, students from Kanchanaburi Rajabhat Institute University with 2 Karen-Mon translators were hired to collect data. The questionnaire was distributed to 345 household and 100% response rate were accepted.

Trust was established before FGD in order to overcome limitations of discussion such as anxiety, anger, and personal bias. From the first round of questionnaire, the list of informants was individuals who are willing to participate in FGD. Thirty-two people are gathered in discussion.

GIS and RS data was collected from related agencies as mentioned in Table 3.1 and established in form of thematic map. Then, it was linked with social survey data.

3.4 Data Analysis

In this stage, the context deals with data measurement. Data analysis was basis on measurement of sensitivity, which is divided into two folds: GIS data analysis and socioeconomic data analysis.

3.4.1 Watershed Sensitivity by GIS data analysis. According to research by Navanugraha (2002: 74), the condition of sensitivity was the major predictor of user's responsibility. Hence, Weighting and Rating Score was used to classify output from GIS/ RS in order to group watershed situation. The idea behind thinking is crisis situation have lower score, which computed from many variables related; on the other hand high score of all variables related is in good condition. Then the number was ranked from high to low, according to its score (Table 3.6 and 3.7).

Table 3.6: The Rank of Weighting Value and Score of Parameter for Watershed Situation Analysis

Parameter	Weighted Value*	Indicator and Meaning	Rated Score**	Total Score
1. Forest area in watershed	10	Forest area in watershed area > 80 % of watershed 40-80 % of watershed < 40 % of watershed	 3 = High 2 =Moderate 1 = Low	 30
2. Soil Erosion	8	Soil Loss area > 5 t/r/y < 10 % of watershed 10-20 % of watershed > 30 % of watershed	 3 = High 2 =Moderate 1 = Low	 24
3. Volume of Water	8	Maximum –minimum of rainfall volume/ year > 2, 601 mm 2,001-2,600 mm. < 2,000 mm.	 3 = High 2 =Moderate 1 = Low	 24

Table 3.6: The Rank of Weighting Value and Score of Parameter for Watershed Situation Analysis (Cont.)

Parameter	Weighted Value*	Indicator and Meaning	Rated Score**	Total Score
4. Agricultural and Urban Area within slope > 35 %	6	Agriculture in slope area < 5 % of 35 % slope 6-10 % of 35 % slope >11 % of 35 % slope	 3 = High 2 =Moderate 1 = Low	 18
5. Population Density in watershed area	6	Population Density = 20 people/ km² < 20 people/ km² 20-50 people/ km² > 50 people/ km²	 3 = High 2 =Moderate 1 = Low	 18
			Total	114

Remark**:** weight and score derived from experts and LDD, MOI, RFD

*High score means it affects watershed's structure and function in high level

*and ** Based on Tanavud (2003) and Navanugraha (2002)

** Low score means it makes watershed's structure and function change in high rate

The procedure of watershed situation's total score is calculated by equation:

Total score = W1R1+W2R2+W3R3 + ……. …… WnRn

Where W1 … n = weighted score from resource 1 to n (value of variable)

R1 …. n = rated score from resource 1 to n (suitable value of each variable)

Finally, regrouping score can be conducted for interpretation. The range of interpretation value is calculated by using the total of highest value in each parameter subtract the total of lowest value in each parameter and divided by number of range. The highest score means good situation, in turn the lowest score means crisis situation, according to the previous rating-weighting score. Hence, in this study, the interpretation range is divided into four levels (Table 3.7):

Table3.7: Watershed Situation Score

Watershed Situation	Weighted Score
1. Nature (there is no change in watershed structure and function)	>96
2. Warning (there is some disturbance in watershed structure and function, but it is in acceptance level)	77-95
3. Risky (much disturbance in watershed structure and function, and it needs restoration)	58-76
4. Crisis (most disturbance in watershed structure and function, and no chance to restore)	<57

Source: Adapted from Navanugraha (2002: 74) and Petplai (1998, 33)

3.4.2 Socio-culture data. The data were analyzed with **S**tatistic **P**ackage for **S**ocial **S**cience or SPSS computer software program:

1.) Basic descriptive statistics (frequency, percentage, means, and standard deviation of variable) were utilized to describe general trends within data set.

2.) Multi factors ANOVA was used to analyze the relationship between demographic data and predictor factor both within group and between groups with watershed management practice's level. The statistical analysis was employed to assess difference between women who have watershed management practice in terms of no participation, joint planning and decision making (FAO, 2003) and women who had not. The watershed management practice in the differences work of women was also analysis in terms of geology which differs in up stream, middle stream and down stream – Sangkhla Buri, Thong Pha Phum and Sai York district. Then the interpretation was emerged under these criteria:

However, the outcome from item 3.4.2 is interpreted by criteria in table 3.8.

Table 3.8: Interpretation Score Used in the Study

Criteria (scores)	**Meaning**
1.0 - 1.5	Very Poor
1.6 - 2.5	Poor
2.6 - 3.5	Moderate (neither + nor -)
3.6 - 4.5	Well
4.6 - 5.0	Extremely Well

Source: Patrayuvat (2002: 172).

3.) Multiple Classification Analysis or MCA was used to evaluate correlation between independent variable and dependent variable with control variable (Figure 3.2).

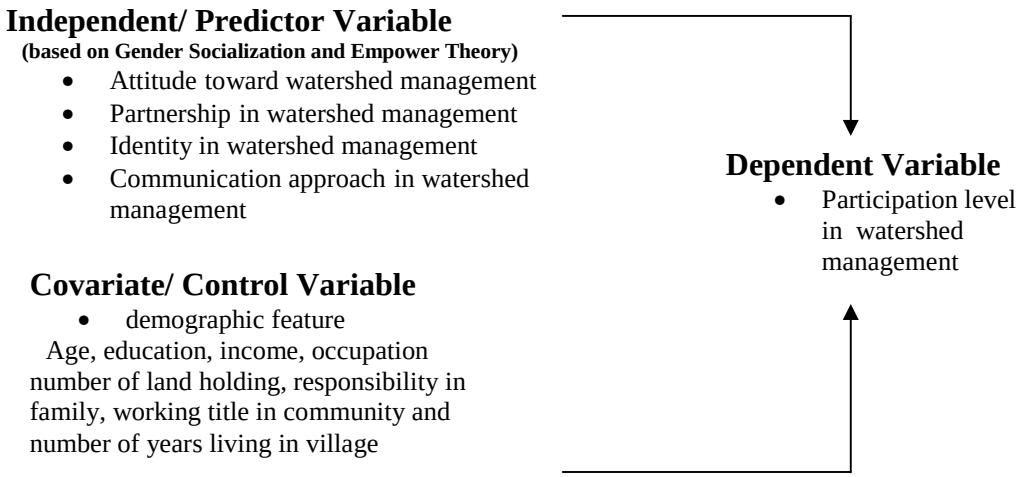


Figure 3.2: Variables used in Multiple Classification Analysis

A good fit is demonstrated by a higher value. Possible values range from 0 to1: 0 indicate no relationship, and 1 indicates a perfect positive relationship between variable. Only those values with statistically significant at the 95% confidence level ($p>.05$) were reported. Then, the diamond diagrams depict the difference in each aggregate variable index.

3.4.3 Acceptance Predictor Variable by Local Women in Study Site. After using MCA to find out the influence of predictor variable and diamond diagram in each stream reach, the result was corroborated in Focus Group Discussion. Indeed, there are two kinds of verification, namely in-situ and ex-situ. In this case in-situ verification was used. The respondents in FGD were asked to repeatedly evaluate the validity of predictor variable and empowerment priority. The results were reported in chapter 5.

CHAPTER 4
THE STUDY AREA

The quality of watershed condition in the study area is influenced by the environmental setting-an interrelated set of natural and cultural factors. Thus, in this chapter, the study contexts are explained in terms of physical or natural and socio-cultural. As a matter of fact that the structure of watershed has inlet and outlet, study area can be roughly divided into three zones: 1) Up stream where there is full of many small perennial stream - Sangkhla Buri district, 2) Middle stream where the waterway joins to form the river - Thong Pha Phum district and 3) Down stream where it is the River Khwai Noi - Sai Yok district. The details are described in following subsection.

4.1. The Khwai Noi Upper River

The Kwai Noi Upper River is a tributary of the Mae Klong River in Kanchanaburi Province and is located west of Kwai Yai River. Its watershed is connected to the Khwai Noi River Basin to the south. To the east is the Khwai Yai River Basin. The Upper Khwai Noi River watershed encompasses 4,126.01 square kilometers or 2,578,760.23 rai and covers some part of Sanghkla Buri, Thong Pha Phum, Sai Yok and Si Sawat districts. Seven sub districts and thirty-one villages lie fully within the watershed. The study area is depicted in figure 4.1- 4.2.

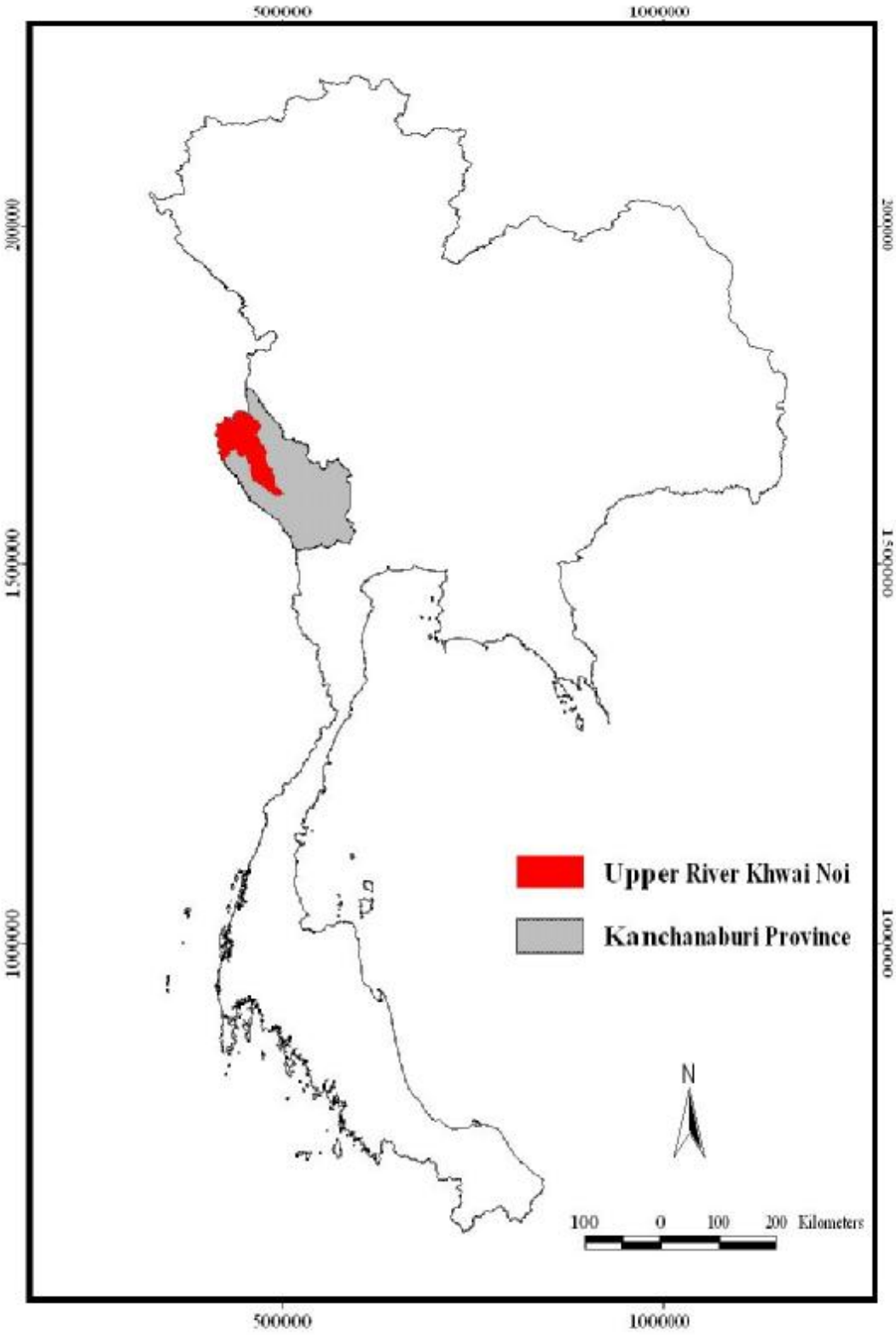


Figure 4.1: Location of Study Area in Kanchanaburi Province
Source: Topographic Map Scale 1:50,000, DEQP (2000).

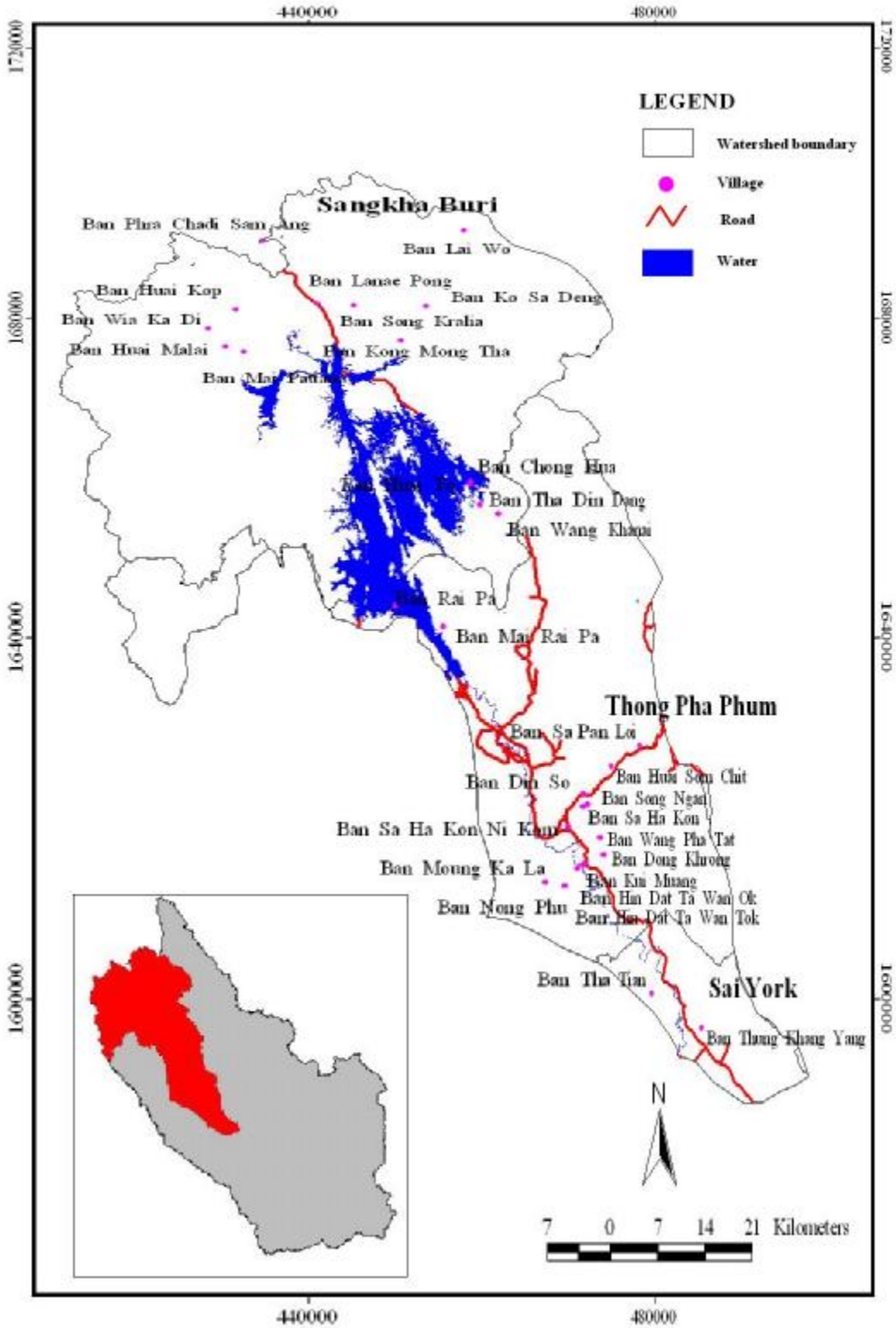


Figure 4.2: District, Subdistrict and Village of the Khwai Noi Upper River
Source: Topographic Map Scale 1:50,000, DEQP (2000).

4.1.1 Topology and Slope

According to their geology, the Khwai Noi Upper River divided into 3 zones:

1) Upstream. Sangkhla Buri district comprises of hilly topography. The mountains are generally composed of limestone, shale and sand stone. The higher elevation ranging is between 100 - 1800 meters. The mountainous area slopes toward the east and the south. Most of this area is still covered by thick evergreen and mixed deciduous forest (Office of Watershed Conservation and Management, 1999). Thus, the government has declared about 70 percent of the total area as forest reserve except in the plain along three rivers.

2) Middle stream. About one-third of the landscape in Thong Pha Phum district is mountainous with a pristine area comprised of evergreen and mixed deciduous forests. Additionally, Thong Pha Phum covers with moderately steep and valley along the river. The height is similar to up stream except the valley along the Kwai Noi River, which is between 100-200 meters.

3) Downstream. Compared to those two stream reach, Sai York has more flat area. However, the study site is only two sub district (Ban Thung Khang Yang and Ban Tha Tian) in one district (Sai York). The elevation varies from less than 100 meters in the lower part of the valley to more than 100 meters in the highest part of the mountainous highlands. See table 4.1 and figure 4.3.

Table 4.1: Land Classification by Elevation in the Khwai Noi Upper River

Elevation (meter)	District Area (rai)			Total (rai) *
	Sangkhla Buri	Thong Pha Phum	Sai York	
> 100	-	66,149.36	24,663.57	90,812.93 (3.78 %)
101-200	123,738.01	120,472.60	30,763.08	274,973.69 (11.45 %)
201-300	301,084.17	116,892.73	24,775.12	442,752.02 (18.44 %)
301-400	238,715.64	154,484.41	23,519.90	416,719.95 (17.35 %)
401-500	158,723.68	114,979.55	13,005.32	286,708.55 (11.94 %)
501-600	141,913.93	97,092.47	37,203.31	239,006.40 (9.95 %)
601-700	115,319.38	117,243.98	15,588.07	248,151.43 (10.33 %)
701-800	65,959.05	92,080.49	6,467.07	164,506.61 (6.85 %)
801-900	36,099.33	34,261.23	2,577.50	72,938.06 (3.03 %)
901-1000	24,839.73	8,304.87	96.76	33,241.36 (1.38 %)
1001-1100	20,624.16	3,657.76	-	24,281.92 (1.01 %)
1101-1200	18,588.68	2,247.48	-	20,836.16 (0.86 %)
1201-1300	16,572.33	1,510.33	-	18,082.66 (0.75 %)
1301-1400	15,604.54	1,517.62	-	17,122.16 (0.71 %)
1401-1500	12,911.28	865.02	-	13,776.30 (0.57 %)
1501-1600	9,254.93	593.07	-	9,848.63 (0.41 %)
1601-1700	2,061.17	236.12	-	2,297.69 (0.09 %)
1701-1800	73.85	41.27	24663.57	24,778.69 (1.03 %)
Total	1,302,083.86	932,630.43	178,658.86	2,413,373.15 (100 %)

* Area is excluded water body area (165,386.31 rai)

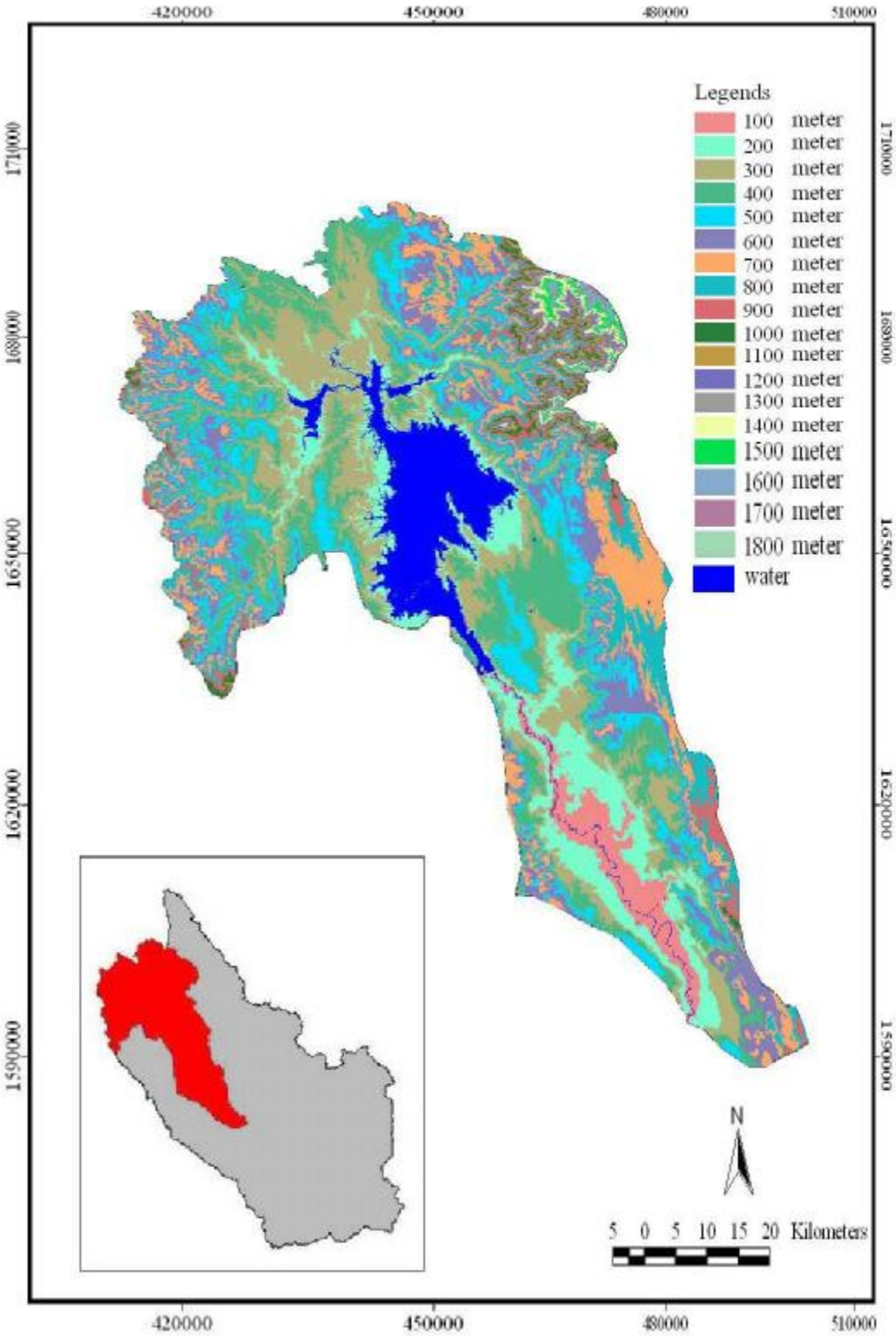


Figure 4.3: Elevation Map of the Khwai Noi Upper River

Source: Topographic Map Scale 1:50,000, RTSD (1985).

According to National Forestry Policy 1985, any land with the slope of 35 percent shall be designated as forest due to the fact that its geography is extremely steep or mountains. Thus, no title certificate was allowed (Bhusal, 1996: 4). In the Khwai Noi Upper River, the slope is classified into five categories, according to land use. It is found that up stream has a large volume of land with slope of 35 percent more than middle and down stream (281,373.63, 126,353.04 and 21,243.09 rai respectively). The detail is shown on table 4.2 and map 4.4.

Table 4.2: Land Classification by Slope in the Khwai Noi Upper River

Slope (%)	**District Area (rai)**			Total (rai) *
	Sangkhla Buri	Thong Pha Phum	Sai York	
< 8	844,947.99	648,704.08	117,527.01	1,590,050.07 (66.47 %)
8-16	44,674.14	60,316.33	19,872.96	124,863.46 (5.22 %)
16-35	131,088.19	97,206.96	20,016.40	248,311.03 (10.38 %)
35-60	198,221.55	87,903.61	14,815.71	300,940.77 (12.58 %)
> 60	83,152.08	38,499.43	6,427.38	128,078.61 (5.35 %)
Total	1,302,083.86	932,630.43	178,658.86	2,413,373.15 (100 %)

* Area is excluded water body area (165,386.31 rai)

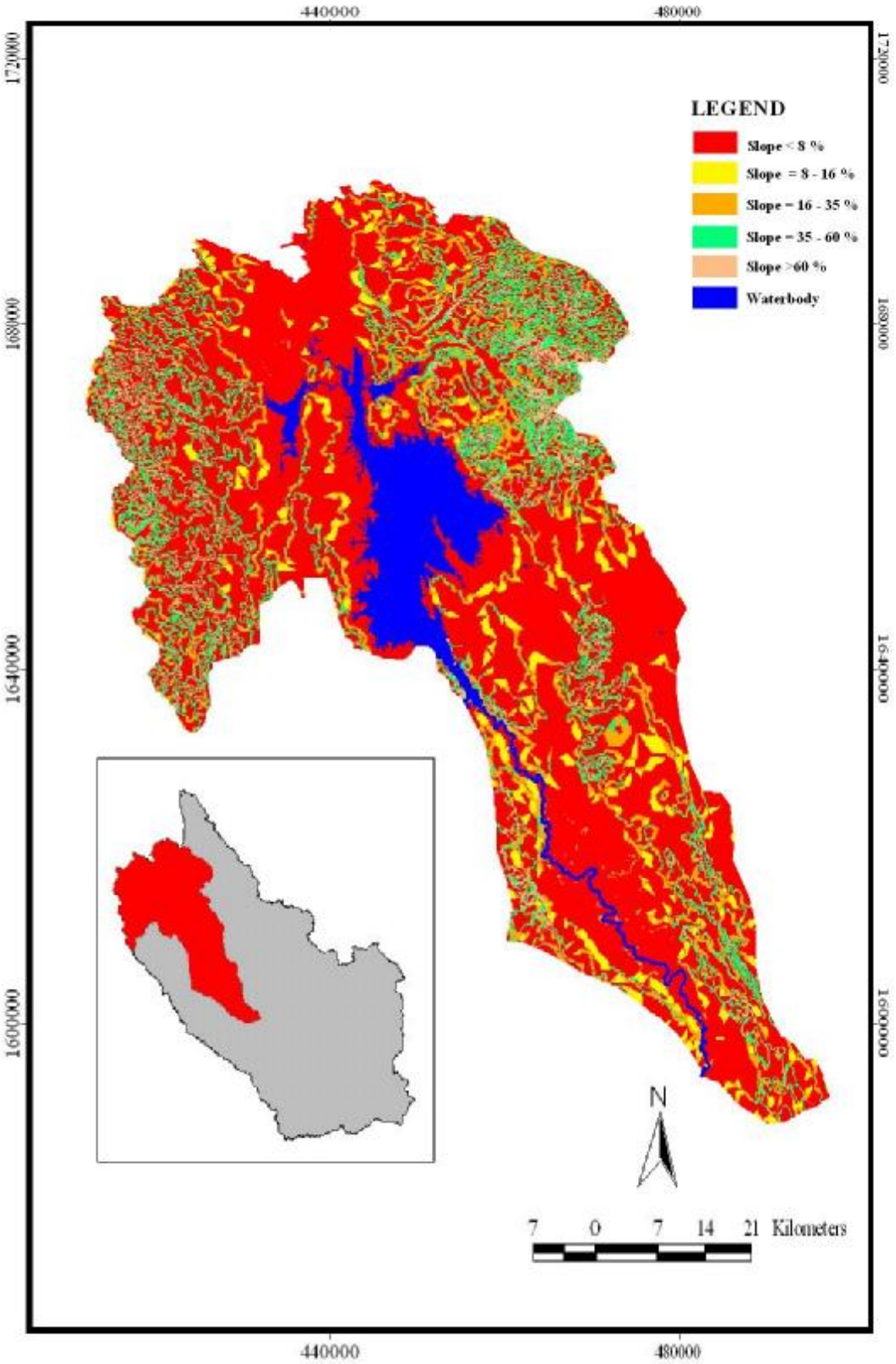


Figure 4.4: Slope Maps of the Khwai Noi Upper River
Source: Digital Elevation Model, Based on Topographic Map, DEQP (2000).

4.1.2 Soil

The original parent rock in the Khwai Noi Upper River is limestone and the geographical structure is Karst topography. According to Department of Land Development (2000), the Kwai Noi Upper River comprises of 14 groups of soil, namely soil group number 4,20,29,31,33,35,36,46,47,48,52,55,56 and 62. However, some of the area is gently sloped with fertile soil, because the area was previously under the forest. In most cases Latosol soil has been noted. Characterized by deep layer, low organic matter, slightly acidic at the top and higher acidity in the sub-soil, these soils have low fertility and high erosive, especially in the rainy season (Deesang, 1998: 13; Boonrueng, 2001: 140). Considered by each stream reach, it was found that:

1.) Upstream are areas positioned topographically in the higher elevations and are usually not suitable for intensive agricultural cropping. However, soil survey by Land Development Department (1994: 165-170) reported that this area composed of unit of soil:

- Slope Complex: Sc. Soil in this area originates from the weathering of the various parent rocks in mountainous with 16-35 percent slope. Most of soil is stoniness' structure and highly eroible. In addition, characteristic of soil is clay, medium drainage system, medium to high soil fertilities, poor physical properties.

- Lat Ya: Ly. Originated from the weathering of the sand rock and relating to shale on the surface from weathering, the founded area is undulating, sloping 4-20 percent, very deep soil, good drainage, the underground water is about two meters deep. This soil series do not suit for any agriculture sector.

2.) Middle stream areas are similarly, the red brown earth, which is the most dominant soil type in this watershed area. The texture is clay. Associated problems with these soil types are low fertility and high erosivity, particularly in the undulating area. However, soil survey by Land Development Department (1994) reported that this area composed of unit of soil:

- Pak Chong series: Pc. Grouping in Raddish Brown Lateritic soil (national) and Oxic Paleustults; Clayey Kaolinitic isohyperthemic (USDA) from the weathering of the igneous rock and relating to limestone on the surface from weathering, the founded area is flat, sloping 1-2 percent, very deep soil, good drainage system, good permeability, slow surface runoff, the underground water is about three meters deep. The mineralogy of this soil series is moderate available potassium, and good physical properties, which suit for fruit tree and orchard.

- Thap Khwang series: Tw. Groping in non calcie brown soils (National) and typic haplustalfs, fine, kaolinitic isohyperthemic (USDA), original soil from the weathering of the igneous rock with light color, some area relating to limestone, physical properties is undulating sloping 2-5 percent, medium soil deep, medium drainage system, medium soil surface runoff. Underground water is more than 3 meters deep. The texture is clay loam and low natural mineral, good physical properties.

- Kamphaeng Phet series: Kp. Groping in non calcie brown soils (National) and ultic haplustalfs; fine silts, mixed isohyperthemic (USDA) from the sedimentation of water of old river, flat area to undulating sloping 1-2 percent, very deep soil, good drainage, medium permeability, low syrface runoff, normally underground water from 1 meter. The texture is loam mix with fine sand and has medium mineral food, easily plouching.

3.) Downstream area. The most widespread soil is red yellow podzolic which is relatively more vulnerable to accelerating erosion. The soil series is similar to middle stream. See figure 4.5.

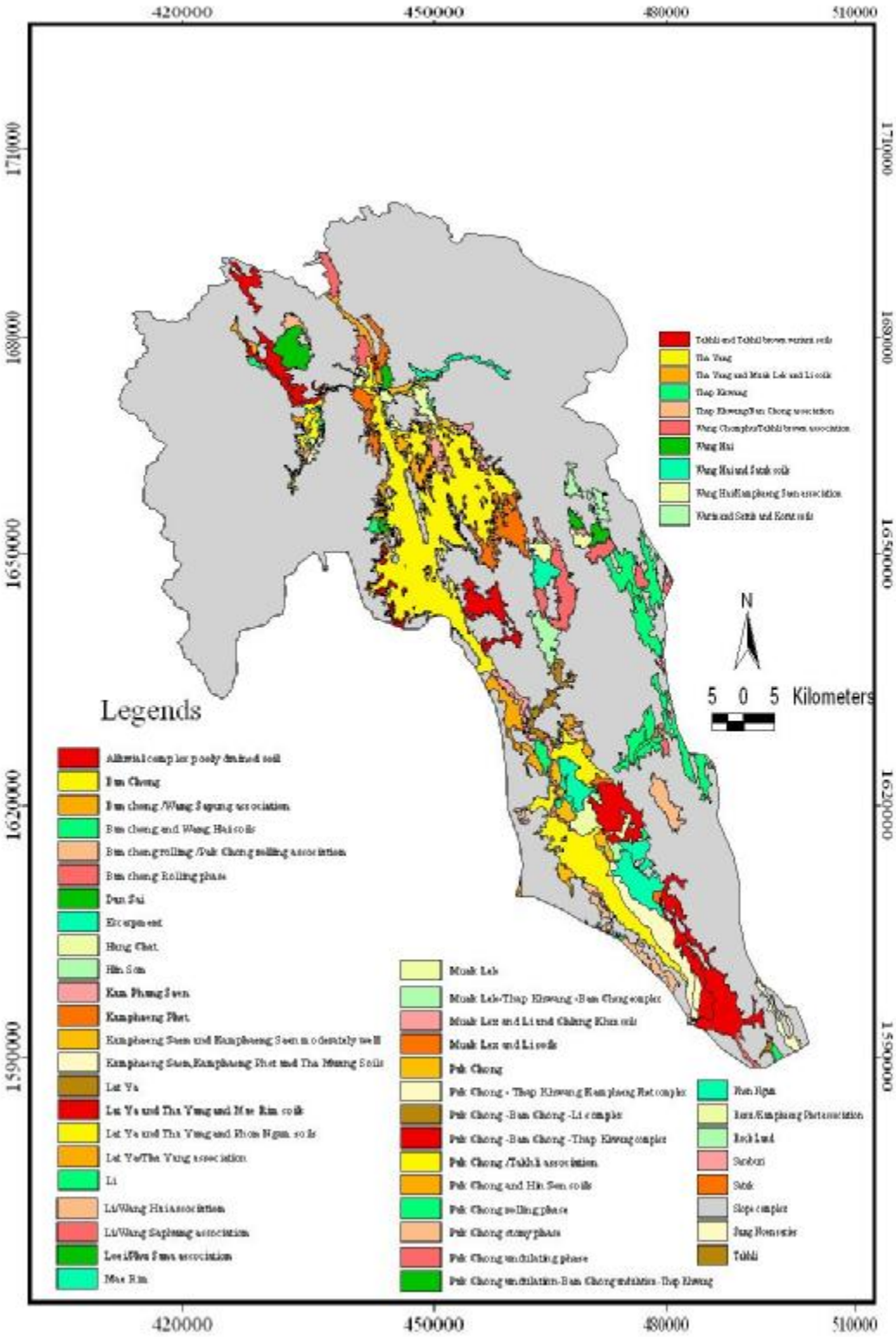


Figure 4.5: Soil series of the Khwai Noi Upper River
Source: Soil Map Scale 1:50,000, DLD (2000)

4.1.3 Water Resource

The geography area of the Khwai Noi Upper River is mountainous, which originate in Ta Now Sri hill, and really slow steep in the south and west. The river flows down to the south and west. The drainage network system is dendritic drainage, but the shape of watershed is Rectangular. The Upper River Khwai Noi has only three major rivers with many perennial. And then go to be Mae Nam Noi. The depth and width of the major riverbeds is average 7 to 10 meter. The maximum flow rate in the river occurs between rainy seasons in May to October. The major use of water in the upper, middle and down stream reach is agricultural activities. (Boonrueng, 2001: 158). The river and tributaries flow in each stream reach as shown below:

1) Upstream. In Sangkhla Buri, Bee Kee river, Run Tee river, and Songgalia river is the major source of water, which nurtures this area. Those three rivers join to form The Mae Nam Khwai Noi at Sam Pra Sob, Nonglu sub district, and then flow down to Thong Pha Phum district. Besides, there are other small perennial stream directly join with Mae Nam Khwai Noi in the south part.

2) Middle stream. The Mae Nam Khwai Noi is the major river flows to Thong Pha Phum district. In addition, there are three major tributaries joining Khwai Noi within this area - Plu Huay, Pilok Huay and Kui Mang Huay. These creeks get dried following the cessation of the monsoon. In summer and winter very small amount of water remains in these creeks. To mitigate the scant supply of water the government has constructed a large dam at the north – Vajiralongkorn dam. Besides, a medium and small size reservoir also serves the ever increasing demand of irrigation water e.g. Ban Prungkasi reservoir, Di So creek check dam at Tha Kanun, Thong Pha Phum district.

3) Downstream. In Sai York district, The Mae Nam Khwai Noi, Mae Nam Noi, Bong Tee creek in north, and to south Mae Kra Bung creek and Lum Sum creek are the major source of water. The Mae Nam Khwai Noi joins the Khwai Yai to form the main river, the Mae Klong. Due to the expansion of agricultural sector in this area,

Government has been constructed small size of irrigation project in Sai York district – Ban Thung Khang Yang reservoir. However, in dry season, the water in these creeks is often dry. It indicates that the intensity of water use is quite high and thus, there is a sarcastic cry for water, especially in area which far from water ways. Data is shown in figure 4.6.

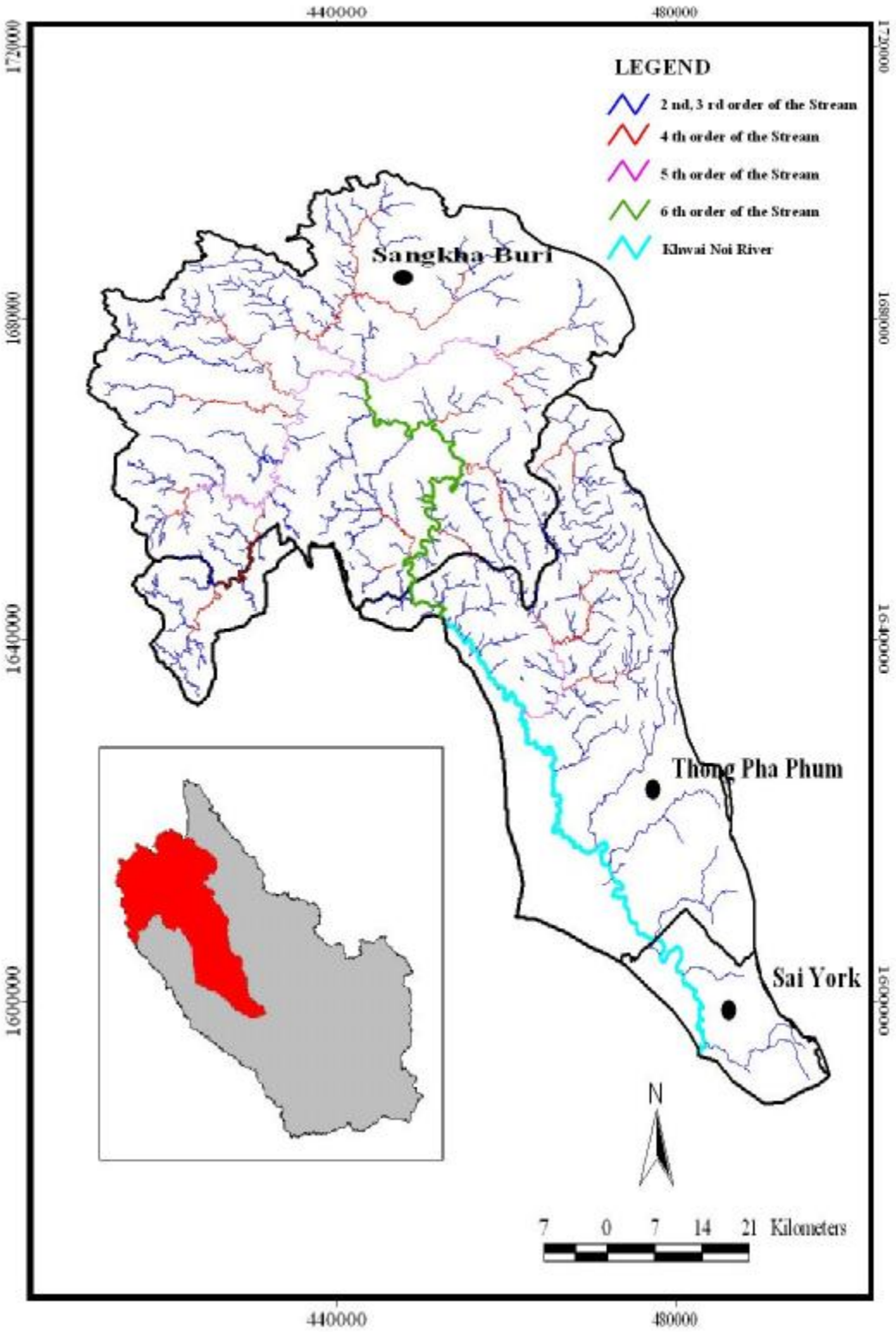


Figure 4.6: Drainage of the Khwai Noi Upper River
Source: River and Stream, Based on Topographic Map 1:50,000, DEQP (2000).

4.1.4 Climate

There is tropical type of climate in this watershed with three seasons, rainy (May-October), summer (February-May) and winter (October-February). According to the information recorded by the Meteorological Department, the mean monthly temperature vary between 22.6 degrees Celsius and 29.4 degrees Celsius. Highest values occur during summer when temperature may exceed 30 degrees Celsius while minimum temperature of about 20 degrees Celsius turns out in December and January. The winter is fairly warm while the summer is very hot. The climate in this area is largely influenced by the tropical monsoon (Boonrueng, 2001: 110). The annual average rainfall is between 2,200 and 2.400 mm.

Relative humidity is generally lowest in March with an average value of about 83 percent. This results from the high temperatures and low precipitation during month. Detail is shown in figure 4.7 – 4.8 and table 4.3 – 4.4.

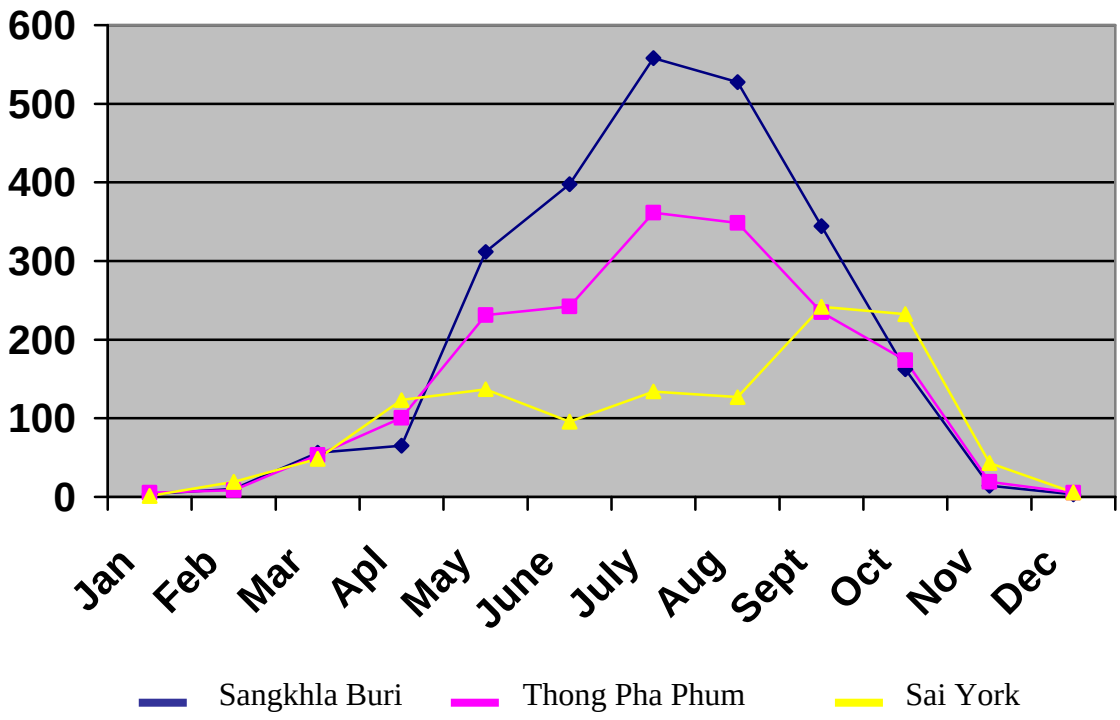


Figure.4.7: Average Rainfall in the Khwai Noi Upper River during 1990-2000

Source**:** The Meteorological Department (2000)**.** Remark: Unit = mm.

Table 4.3: Average Rainfall, Humidity and Temperature during 1990-2000

Month	Avg. Rainfall (mm)			Avg. Humidity (%)	Avg. Temperature (°C)
	Sangkhla Buri	Thong Pha Phum	Sai York		
January	3.5	5.4	1.1	78	25.6
February	10.1	8.5	19.0	73	26.6
March	56.1	53.2	48.2	70	27.8
April	64.8	100.2	123.1	74	29.4
May	311.5	231.3	136.9	84	27.9
June	397.7	242.1	95.6	89	26.4
July	558.3	361.5	134.0	90	26.2
August	527.8	348.5	126.8	91	26.1
September	344.3	234.9	241.7	90	26.5
October	162.5	173.8	232.2	87	26.1
November	14.2	19.1	42.9	84	24.4
December	3.4	5.1	5.6	81	22.6
Average/ Year	2,454.2	1,783.6	1,207.1	83	26.3

Source: The Meteorological Department (2000)

4.1.5 Land Use

Land degradation in watersheds is the result of land use practices that are not compatible with the soils, vegetation and topography. However, there are four broad types of land uses, namely agriculture, forests, residence and water bodies (table 4.5 – 4.7):

1.) Forest Area. Vegetation cover plays significant role in maintaining the condition of watersheds. The degradation of watershed is due to the fact that there is steady encroachment of forest. However, forest type in the Khwai Noi Upper River is divided into:

- Upstream. Most natural forests in this area are looked dense and healthy with significant number of large trees. It was covered with evergreen forest, as dry evergreen forest and non-evergreen forest – deciduous forest. Thus, the government has declared total land area as Thung Yai Naresuan Wildlife Sanctuary. The major proportion of the forest is concentrated in the mid-eastern and far-western parts where the topography is hilly. Mixed Deciduous forests in this area dominate the existing vegetation. Main species of forest trees are *Wrightia tometosa Roem & Schult, Sindora siamensis Teijsm. Ex. Miq., Microcos paniculata, Dalbergia caltrata Grah ex Benth* and *Lag*ersloemia *calyculata.* (Office of Watershed Conservation and Management, 1999: 47).

- Middle stream. Likewise up stream, forest here is evergreen forest and mixed deciduous forest. The reserved forest area in this area is Kao Lam National Park. Forest area is widespread in every part in Thong Pha Phum district except along Khwai Noi River valley. However, after the Electricity Generating Authority of Thailand completed the construction of the Khao Laem Dam on Khwai Noi River in 1984, forest land has been cleared for reservoir with a storage capacity of 8,860 million cubic meters. Some land has been converted to agriculture land. This might be the vital reason of a large in-migration of people from surrounding areas, especially people from outside this area who have pursued opportunities for investment as a new modernization projects were launched (Krajangwonga, 2001).

- Downstream. Mixed deciduous forest and dry evergreen forest are found in area with the elevation of 200 to 800 meter. Teak and rubber plantation is scattered along Khwai Noi River. See figure 4.11.

2.) Agricultural Area. According to the mention above, the degraded forest has been replaced by orchards, which take place on steep slope, even the land of more than 35 percent slope gradients. However, according to geology, the type of agriculture area is divided into:

- Upstream. As already mentioned earlier, most of area in Sangkla Buri district are reserved for forest. Consequently, some part of this area has been substituted by paddy fields and fruit trees. Marginal groups converted forest land into agricultural land, for instance Karen expanded their shifted cultivation area and Mon expanded their community. Singh and Yadana (2003) said that the tradition practice of highlanders is to plant upland rice as the major crop. However, three major rotation crops are plants following the cycle of rice to make soil fertility. They begin with corn and after its yield becomes low, they switch to cassava. Cassava is a crop variety that is able to intake nutrients from less fertile soil. After cassava is harvested, they will plant soybeans to bring back to the soil before renewing the crop cycle again. However, when cash crop provides more net profits, rice cultivation was decreased. See figure 4.8.

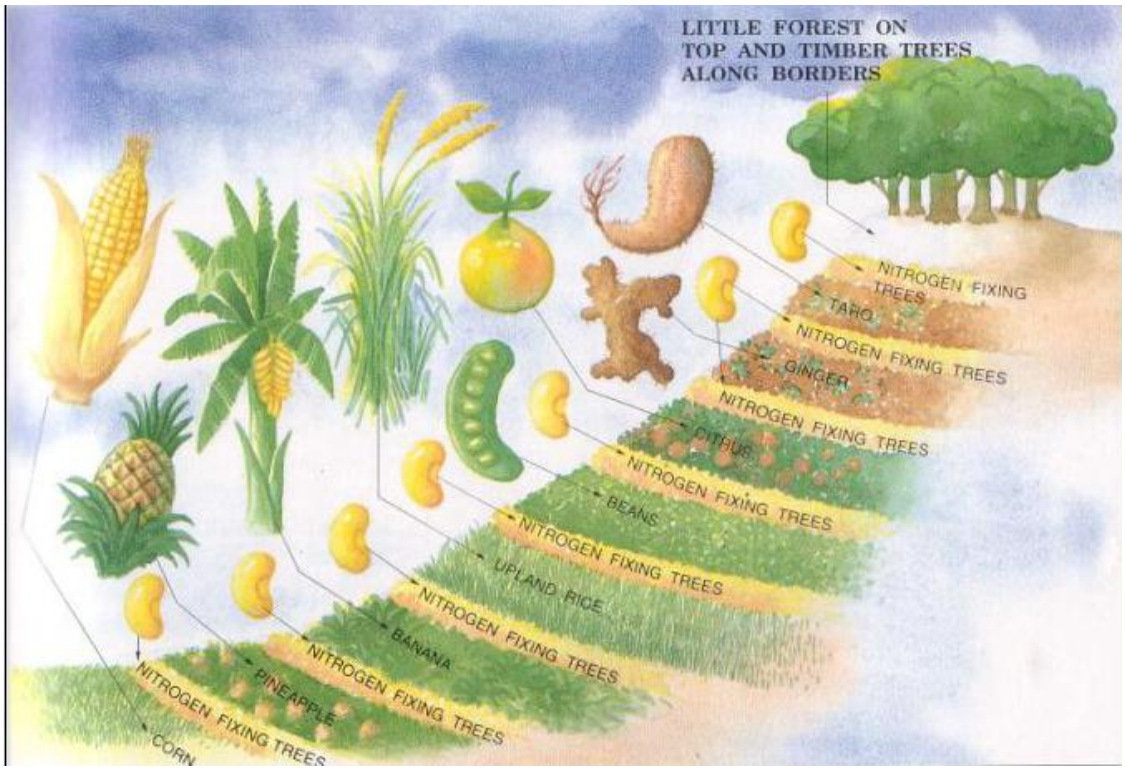


Figure 4.8: Traditional Crop Cycle in Upstream Area

Source**:** Boonrueng (2001).

- Middle stream. Nearly half of this area has been utilized in agriculture. Fruit trees and Teak is the mainstay. Main fruit species are corn, cassava, soy bean, banana, mango, very hot peppers (Karen chili) and citrus varieties such as lime, pamelo, orange, etc. Besides, toxic-free fruits, middle latitude vegetation planting and para-rubber, which was introduced into this area by Ministry of Agriculture and Cooperatives, is cultivated all over the district (Boonrueng, 2001). Rice cultivation is limited to a small area due to the substantially higher profit margin accruing from fruit farming.

- Downstream. In the lowland, lowland rice varieties such as jasmine rice are planted in areas that have local irrigation systems. However, rice yield are rather low in comparison to fruit tree. Many fruit tree species not native to this area, but it was promoted by Department of Agriculture Affairs Promotion in order to improve the economics i.e. pomero, mango, logan, lychee, tamarind and lime. Some area is changed in the form of orchards. See figure 4.9.

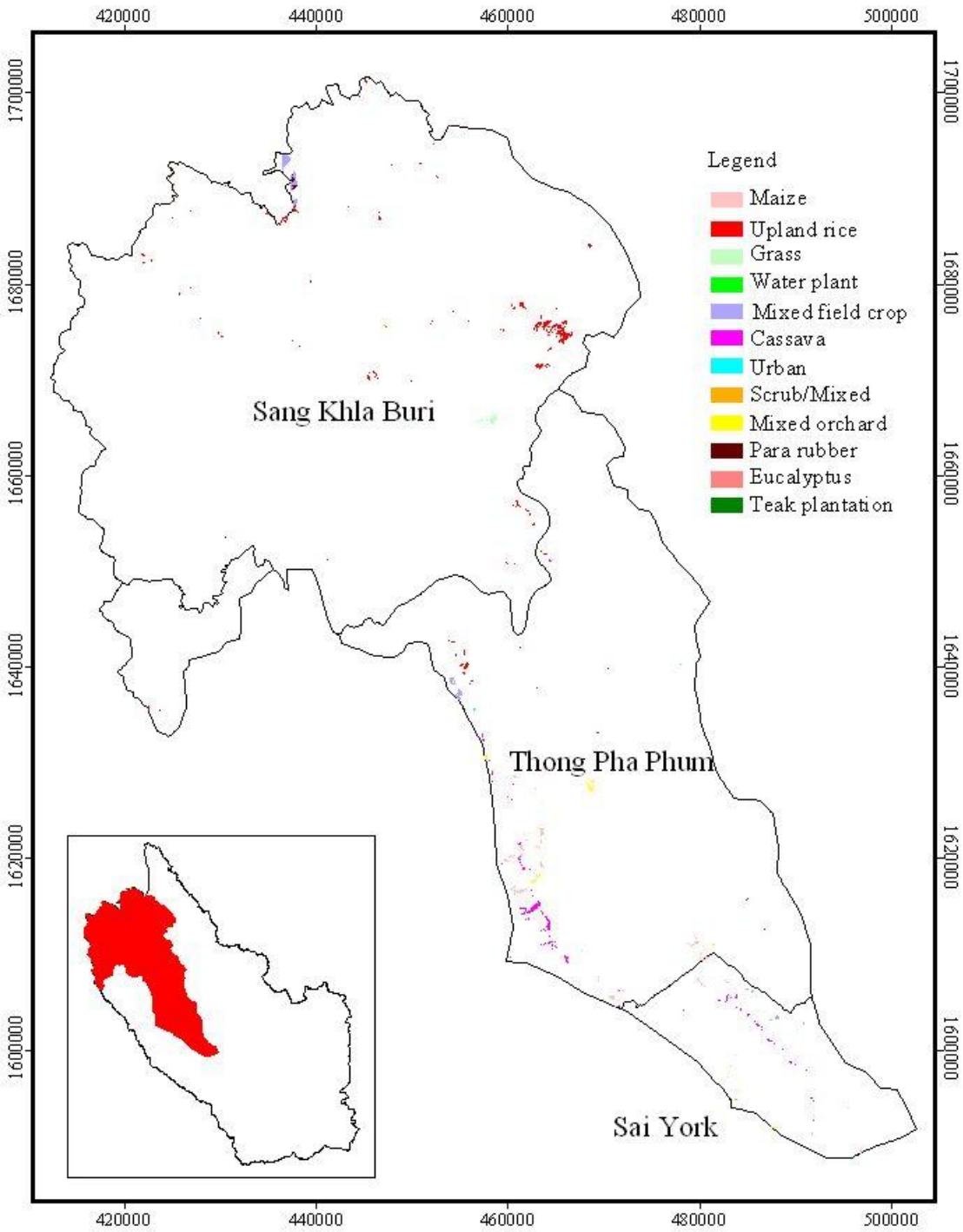


Figure 4.9: Crop Pattern in the Khwai Noi Upper River

Source: Land Use Map Scale 1:50,000, DLD (2000)

3. Residence Area. Developed land included areas with buildings and concrete surfaces. It is reported that about 165, 386.31 rai of land, which is 6.43 % of the total area has been utilized for residential purposes. According to study of Krajangwonga (2001), the increasing settlement area is due to the fact that there were a large amount of in-migrants who come to this area in order to search a better job and increase their economic.

4. Water Bodies. The area includes streams, river and all waterways. In addition, it also includes man made water bodies like the dam's reservoir. Upstream area has a large volume of water, comparing to the others, namely middle stream and down stream.

4.2 People in the Khwai Noi Upper River

In the Khwai Noi Upper River, there are 2,825 households in 31 villages and 13 sub districts. Each household differs from background, occupation, and residency. The broader picture is shown as below:

4.2.1 Population. The population of the Khwai Noi Upper River is about 24,748 of whom 11,494 were female and 13,254 were male. The number of households in 2002 was 2,825 (MOI, 2002). When compared to district area, it is obvious that 3,592.87 km² or 2, 245,543.75 rai in Sangkla Buri district has 9,072 population or one head / 247.52 rai. As, Thong Pha Phum has 406.22 km² or 253,807.5 rai with 10,672 population or one head/ 23.78 rai. Sai York/ down stream only has 127 km² or 79,375 rai or one head/15.86 rai. The detail is shown in table 4.4:

Table 4.4: Population in the Khwai Noi Upper River

District and Sub district	**Area** (km²)	**Female** (head)	**Male** (head)
● Sangkhla Buri			
Nong lu	1,156.89	2,050	2,417
Lai Wo	1,723.98	843	966
Plang Pha	712	1,292	1,504
● Thong Pha Phum			
PIlok	40.22	2,104	2, 518
Sahakhon Nikom	161	1,349	1.533
Hin Dat	205	1,494	1,674
Chalea	-	-	-
● Thong Pha Phum			
Tha Kanun	-	-	-
Huai Khayeng	-	-	-
Lin Tin	-	-	-
● Sai York			
Sai York	127	2,362	2,642
Tha Sao	-	-	-
● Si Sawat	-	-	-
Mae kra Bung	-	-	-
Total	**4,126.09**	**11,494**	**13,254**

Source: MOI (2002)

4.2.2 Community Settlement. Due to easier enter through border line; the international migration still occurs in the Upper River Khwai Noi during times to times. Myanmar, Mon, Nepal and Lao are always found in this area. Popangphum (1998) found that the main pull factor is that they migrate in search of farmland. Nowadays these aliens still have obtained Thai citizenship and have entered the mainstream labor in rural society. However, survey from Office of Watershed Conservation and Management Unit 16 (1999) found that this group of people is low illiterate, which is the big constraint in natural resource management. However, this area is divided into 3 parts:

1) Up stream area. The inhabitants here are of many race and languages. Historically, this area belongs to the Karen people. The Karens live throughout much of Lower Myanmar, from the Arakan Yoma and the Delta region to the edge of the Shan State, as well as along the Thai border region as far south as Tenasserim Division.

When the Myanmar rulers of the Karens, their ancestors came to the area fleeing political and religion suppression to Thai borderline. In the early 19th century, the ethnic Pwo Karen of this western border area received formal settlement rights from the Governor of Kanchanaburi and their leader was conferred the Siamese title *Khun Suwan* and then, *Phra Si Suwannakhiri* in era of King Rama III (Buergin, 2002: 11). Descendants of Karen settled in most of this area. Some settlements were found in the wildlife sanctuary area of Thung Yai Naresuan (West). The detail is shown in figure 4.10.

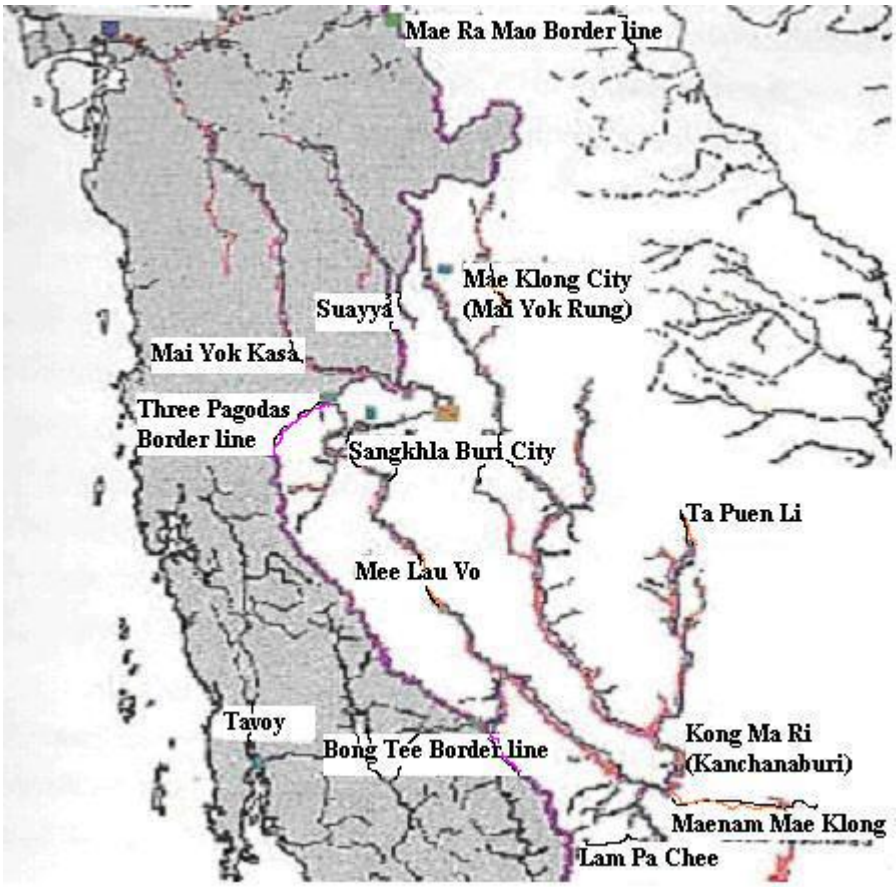


Figure 4.10: In-migration Route of Karen to Thai Kingdom

Source: Keawsuwan, 1999: 29.

The other majority race in this area is Mon minority group, which is widespread in the west of Sangkla Buri – Nonglu sud district. The Mon still keep their own culture, especially their language. Being hired labored in agricultural activities is the main career of the Mon, especially in rubber plantation - one of cash crops was promoted by Agricultural Promotion and Cooperation Department.

From the history, it indicates that most of the natural resources have come into direct contact of this in-migrant people (World Bank, 2000). Survey from Office of Watershed Conservation and Management Unit 16 (1999) confirmed that most of them have encroached reserved-forest and settled their community along stream or they are clustered inside the valley (figure 4.11 – 4.12).

Figure 4.11: Village Distribution in Laiwo Subdisctrict, Sangkhla Buri

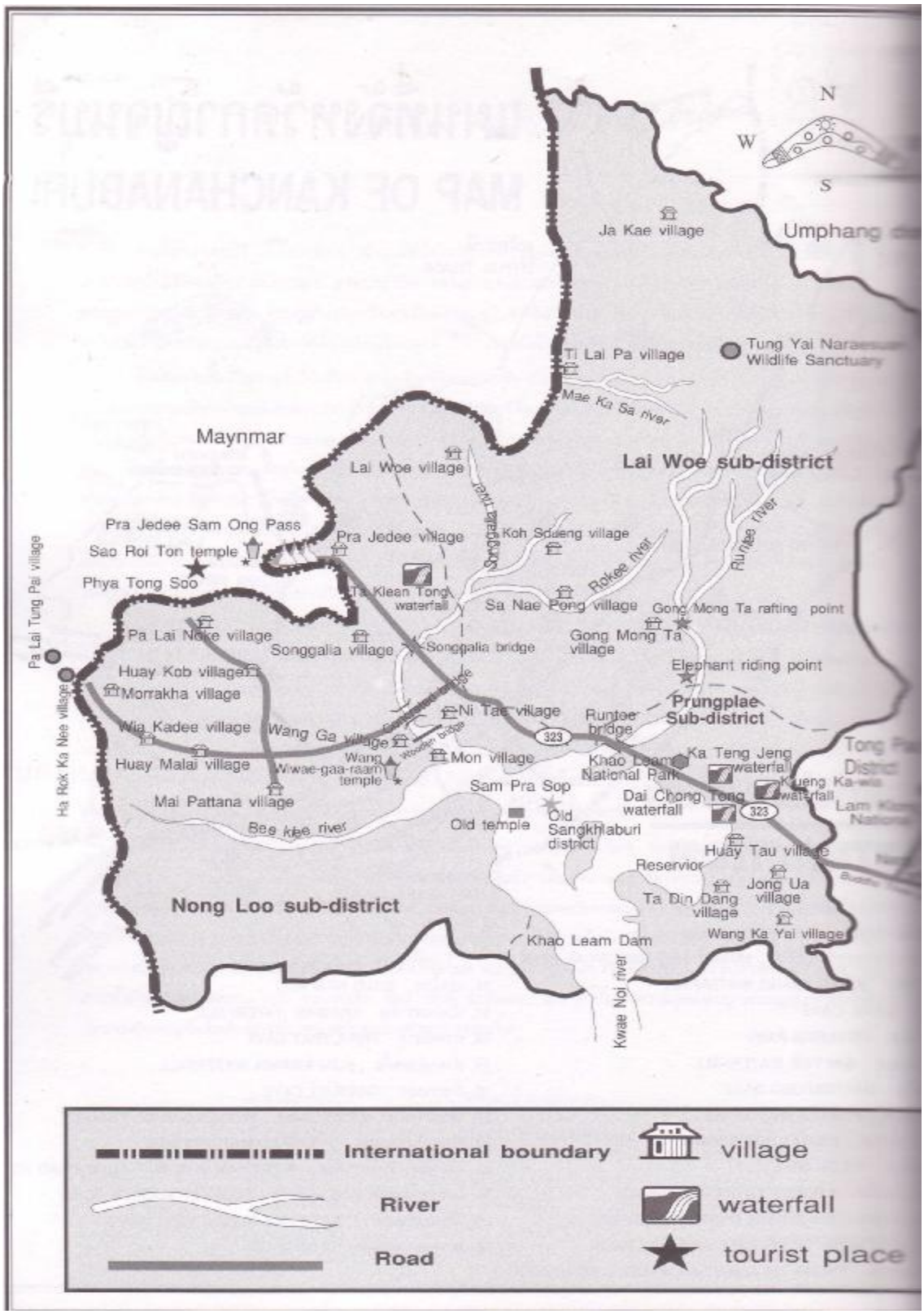


Figure 4.12: Village Widespread in Sangkhla Buri district

Source: Trips Magazine 3 (31), 18.

2) Middle stream area. Thong Pha Phum is also an area comprised of a number of ethnic groups that entered this area in different periods. Likewise the up stream area, this area was occupied by Karen, Mon, Tavoy and Myanmar. However, the native people are Karen, Thaungthu and Kamu, which are all hill tribes. In addition, due to mountainous landscape, the only means of communication to reach this area in the past was using boat transportation via Khwai Noi River; hence this area was formerly considered as one of the most remote areas in the central region with a sparse population. After Khao Laem Dam (now its name is changed to Vajiralongkorn Dam) has been constructed, this area attracts both intra-migration and international migration to the area, especially tourist industry and commercial sector (Krajangwongs, 2001: 48).

3) Downstream. People in this area moved from various provinces to settle their community. See figure 4.13 – 4.14.

Figure 4.13: Village Characteristic in Thong Pha Phum and Sai York disctrict

Source: Field Survey**,** 2004.

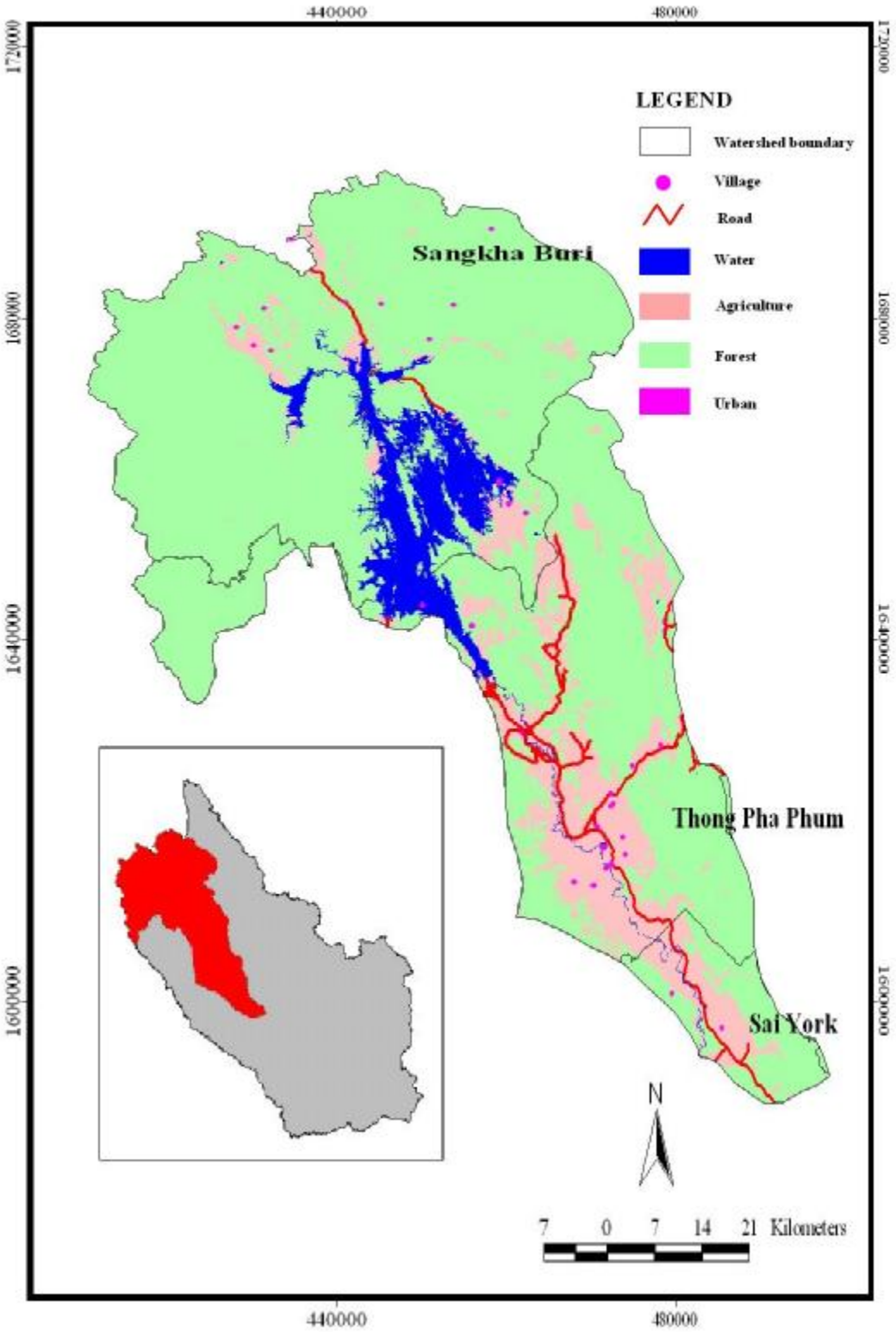


Figure 4.14: Location of Village in the Khwai Noi Upper River
Source**:** Land Use Map, Scale 1:50,000, DLD (2000).

4.2.3 Culture in Watershed Management

In generally, the local people's resource management is based on the belief, which comes from religious, especially Buddhism. The root system was animistic belief. The belief in souls, spirits, gods or goddesses of different kinds and ranks inhabit certain places like forests, mountains, rivers, streams, waterways, etc. In Thai society, it is known as angle or *thewada* (in Thai) and spirit and ghost or *p'ii* (in Thai) (Kabilsingh, 1998: 50).

Rasmussan (2000: 56) reviewed that large and old trees receive particular respect among local people not because of the trees themselves but the spirits believed to be residing therein. Moreover, that reason make local people conserve forest trees and other flora elements at the headwaters of small streams for provision of abundant ground and sub-surface water for absorption and supplying water in their village. Nobody is allowed to cut down forest trees and other plants or to use this kind of land for any activities. In terms of water, to pollute water or destroy a pond is to commit a great sin because all lives depend upon water without, which they would come to an end. Those beliefs have played a significant role in the conservation of nature and to a great extent guard against the destruction of forest, water and even soil.

According to traditional culture, women's natural resource conservation system is based on everyday life incident in domestic spheres and transmitted into myth story-telling (Koleva, 2000: 63-75). Even though economic factor compel the women into the production or public sphere and decreases their role in household, women still do their traditional household work and are close to the environment through food providing for their offspring.

CHAPTER 5
RESULTS AND DISCUSSION

RS/GIS are used to reveal the physical characteristics of the whole watershed. The social survey aims at obtaining the women behavior in watershed management. Both types of data were adjusted to find a best solution at the community level. The following chapter is divided into three main sections, namely watershed situation, study sample and hypotheses examination. Qualitative and quantitative methods were both used to gather and analyze data. The variables used here are part of the Gender Socialization Theory (attitude in watershed management) and Empowerment and Participation Theory (partnership, communication approach and identity). The results are described in the following subsection.

5.1 Empirical Study on Watershed Situation.

The delineation of watershed was done by using satellite data. The interpretation was followed by standard visual interpretation technique as well as digital classification technique. Identification and characterization of study site were done by using GIS technique, as mention in table 3.2. Forest area, soil erosion, volume of water, agricultural area within slope and population density in watershed area was the vital parameters which were used in watershed situation classification.

However, according to the topography, the Khwai Noi Upper River was classified into three zones. When considering in terms of political boundary, those three zones were delineated into three districts:

1.) Upstream where there is full of many small perennial streams. Most of upstream is located in Sangkhla Buri district, which is comprised of three sub districts and fourteen communities;

2.) Middle stream where the waterway joins to form the river. Most of this area is in Thong Pha Phum district. The study site in middle stream area is in seven sub districts and fifteen communities;

3.) Down stream where it is the River Khwai Noi and it is in Sai Yok district. The study site is covered three sub districts and two communities. See detail in table 3.3 and figure 4.1. Thus, the result in this chapter is described according to the classification above.

5.1.1. Land Use Change and Forest Area Change. Satellite images, LANDSAT - 5 resolutions 30 x 30 meters, were used for classifying the land cover. Band 3 is used to identify vegetable types; Band 4 is used for collecting data about the depth or shallowness of water and dispersion of sedimentation in the water and Band 5 is used for geography, water resources, road, communities, land use and land cover change, vegetation identification, forest and agriculture.

From LANDSAT TM scene taken in 1990, 1995 and 2000, the classification results generally showed that there have been tremendous changes in the Khwai Noi Upper River. Among the fours types of land cover, namely agricultural, forest, urban and water body area. The significant change was a decrease in the size of forest areas and an increase in the size of human settlement. The results from table 5.1, 5.5 and figure 5.1, 5.5 have shown that:

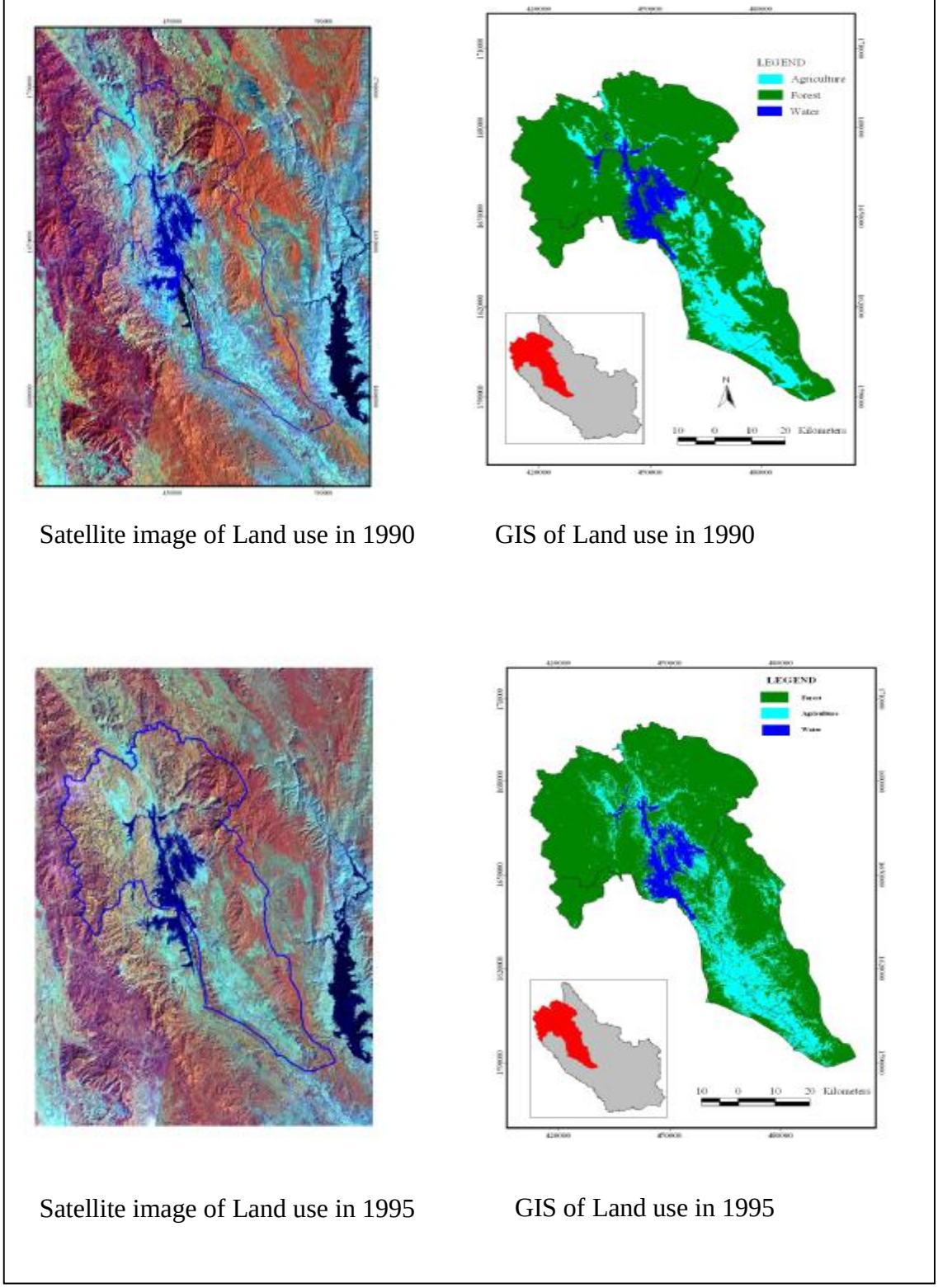
1.) Agricultural area was increased 3.91 percent of total area or 100,880.60 rai in 1995 but decreased 2.36 percent of total area or 60,915.39 rai in 2000.

2.) Forest area was continually decreased in 1995 (1.93 % of total area or 49,622.46 rai) and 2000 (1.08 % of total area or 2,038.17 rai).

3.) Urban area was increased 0.06 percent of total area or 1,503.57 rai in 1995 and 0.05 percent of total area or 4, 967.12 rai in 2000.

4.) Water body area was increased 0.64 percent of total area or 16,507.42 rai, but decreased 1.96 percent of total area or 50,669.78 rai in 2000.

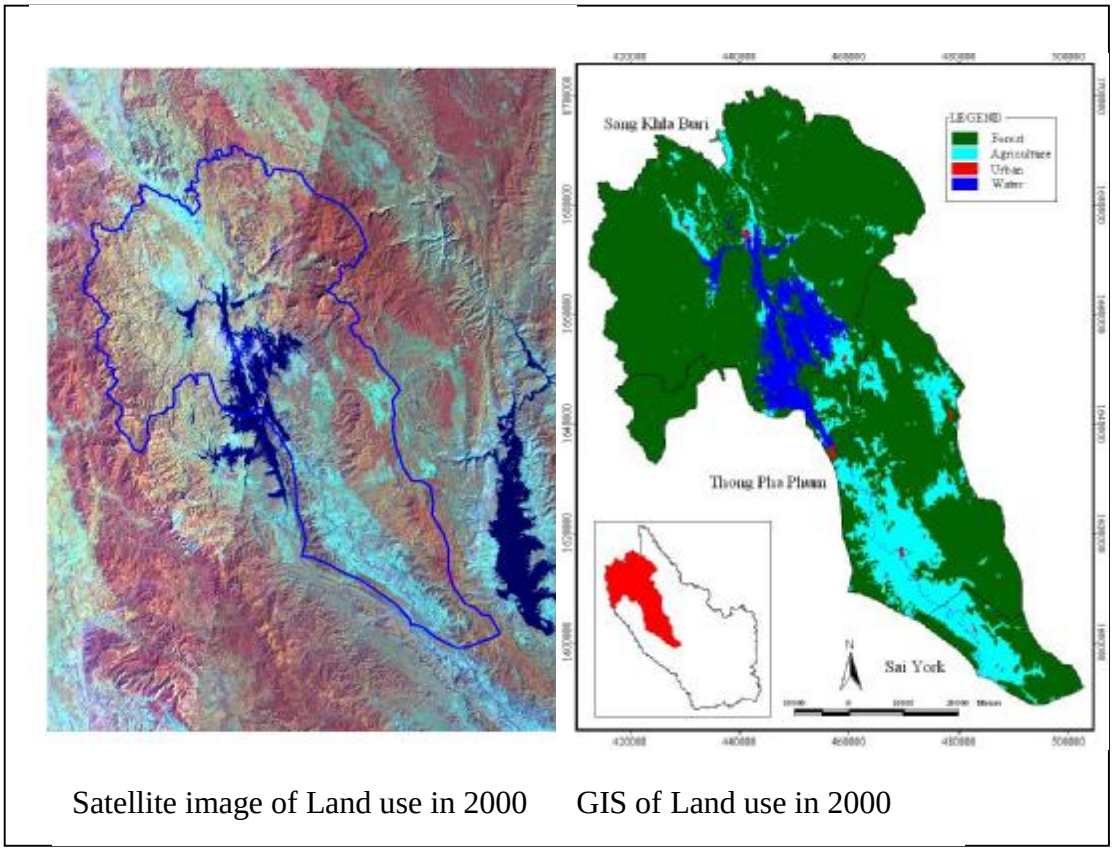
In particular, the pattern of land use change was dived into two parts, namely 1.) In the past ten years, natural forest land was replaced by agricultural area with fruits orchards and forest plantations. For example are teaks, Para rubber and fruit tree plantations. In addition, forest land was changed into human settlement and water body area such as the increasing number of village and medium and small size reservoir; 2.) In the past five year, starting from 1995-2000, forest land, agricultural area and water body area were replaced by human settlement. However, the detail in each stream reach is shown in next section.



Satellite image of Land use in 1990 GIS of Land use in 1990

Satellite image of Land use in 1995 GIS of Land use in 1995

Figure 5.1: The Comparison of Land Use Change in the Khwai Noi Upper River between 1990, 1995 and 2000.



Satellite image of Land use in 2000 GIS of Land use in 2000

Figure 5.1: The Comparison of Land Use Change in the Khwai Noi Upper River between 1990, 1995 and 2000 (Cont.)

Source**:** Land Use Map of Year 1990, 1995 and 2000, Scale1:50,000 (DLD, 2000) were prepared from classification of LANDSAT TM

Table 5.1: Land Use Classification for Three Different Dates of the Khwai Noi Upper River

Type of Land Change/ Date		Area (rai)			Total (%)
		Sangkhla Buri	Thong Pha Phum	Sai York	
Agriculture area	1990	72,369.44	231,984.94	69,269.18	304,354.38 (11.80 %)
	1995	90,073.16	246,137.48	69,024.34	405,234.98 (15.71%)
	2000	81,175.45	195,068.10	68,076.04	344,319.59 (13.35%)
Forest area	1990	1,222,125.99	670,889.78	109,651.25	2,002,667.02 (77.66%)
	1995	1,212,891.18	630,451.70	109,701.68	1,953,044.56 (75.73%)
	2000	1,220,879.29	619,765.21	110,361.89	1,951,006.39 (75.65%)
Urban area	1990	1,335.45	2,769.89	151.21	4,256.55 (0.16%)
	1995	1,852.68	3,671.91	235.53	5,760.12 (0.22%)
	2000	2,753.31	3,991.89	221.92	4,967.12 (0.27%)
Water Bodies	1990	145,662.66	51,565.60	984.85	198,213.11 (7.68%)
	1995	136,676.51	76,949.12	1,094.94	214,720.57 (8.32%)
	2000	136,667.29	26,013.74	1,369.76	164,050.79 (6.36%)
Total		1,441,493.53 (55.90%)	957,210.21 (37.12%)	180,056.49 (6.98%)	2,578,760.23 (100%)

When considering each stream reach, the classification results were reported as below:

1.) Upstream. Forest area covered in 1990 is 1, 222,125.99 rai. After comparing to map date 1995, it showed that forest area decreased 9,234.81 rai (total is 1,212,891.18 rai). This means that forest covered area was disturbed. The cultivated areas scattered in the watershed class 1A- class 5. In contrast, in 2000 the forest area increase 7,980.11 rai (total area is 1,220,879.29 rai). This result can be described that area is increased due to the forest plantation by Royal Forestry Department (Office of Watershed Conservation and Management, Royal Forestry Department, 1999).

In terms of agricultural area, it shows that in 1995, agricultural area was increased about 17, 703.92 rai. When comparing to the 2000, it found that agricultural area was decreased about 8,897.71 rai due to the forest plantation project. However, when considering to 'use-based zones' according to watershed classification, it is obvious that there are agricultural area 21,919.16 rai in watershed class 1A and 536.34 rai in watershed class 1B, which The Cabinet of 'Watershed Classification' reserved for conservation forest and head water source. Moreover, watershed class 1A and 1B is prohibited by any activities.

In addition, it also found that settlement area in 1995 increased 517.23 rai and 900.63 rai in year 2000, especially in watershed class 1A (7.38 rai), while water bodies decreased 8,986.15 rai in 1995 and 9.22 rai in year 2000.

Thus, the pattern of land cover changes are as follows: forest area and water body area were into agricultural area and settlement area, decreased agricultural land and water body area were caused by reforestation and human settlement. The detail is shown in figure 5.1-5.2 and table 5.1-5.2.

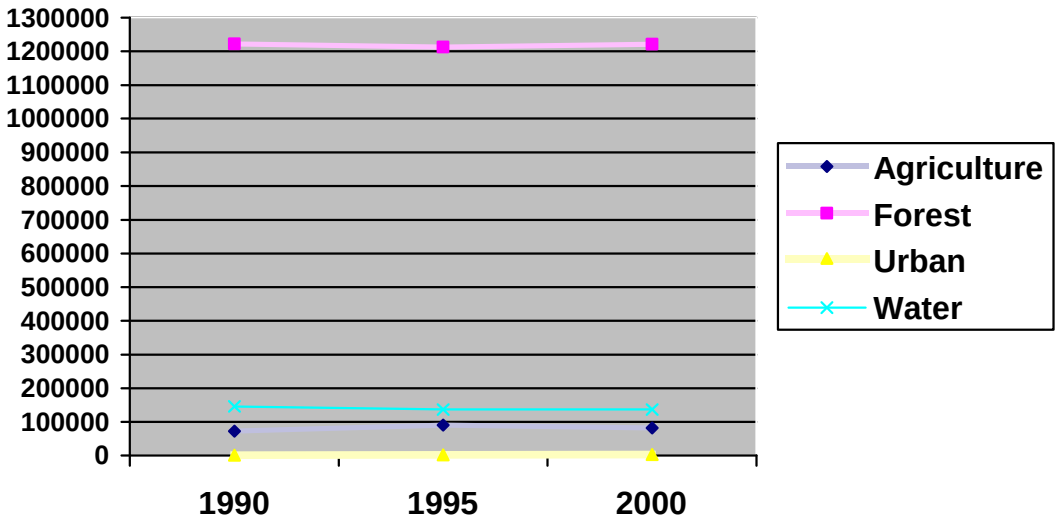


Figure 5.2: Land use Classification for Three Different Dates in Upstream of the Khwai Noi Upper River

2.) Middle stream. The pattern of land use change in this area is different from the upstream. During 1990 – 2000, it was found that forest area was continuously decreased 40,430.08 rai in the 1995 and 10,686.48 rai in 2000. It is also reversed in terms of agricultural area. In 1995 the amount of increasing area was 14,152.54 rai and 51, 069.38 rai decreasing in the year 2000. However, in terms of watershed classification, it showed that there is agricultural area 20, 923.77 rai in watershed class 1A, which is reserved for protected area.

In terms of urban and water body area, it found that in both 1995 and 2000 the urban area were increased 319.98 and 902.02 respectively. Besides, it also found that there is urban area in watershed class 1A 61.33 rai, while water body area was increased 25,383.52 rai in 1995 and decreased 50,935.38 rai in 2000. In case of water body area, Boonrueng (2001: 180-183) added that, there are small scale irrigation project in 1995, namely Di So Creek check-dam (800 rai), Ban U-long check-dam (500 rai) and Ban Pang Ka Sri Reservoir (1, 800 rai), in Tha Kanun district.

Thus, the pattern of land cover changes are as follows: water flooded land were into settlement land, increased agricultural land caused by deforestation, decreased agricultural land caused by flooding and urbanization, increased human settlement area caused by deforestation and conversion of agricultural land. The detail is shown on table 5.1, 5.3 and figure 5.1, 5.3.

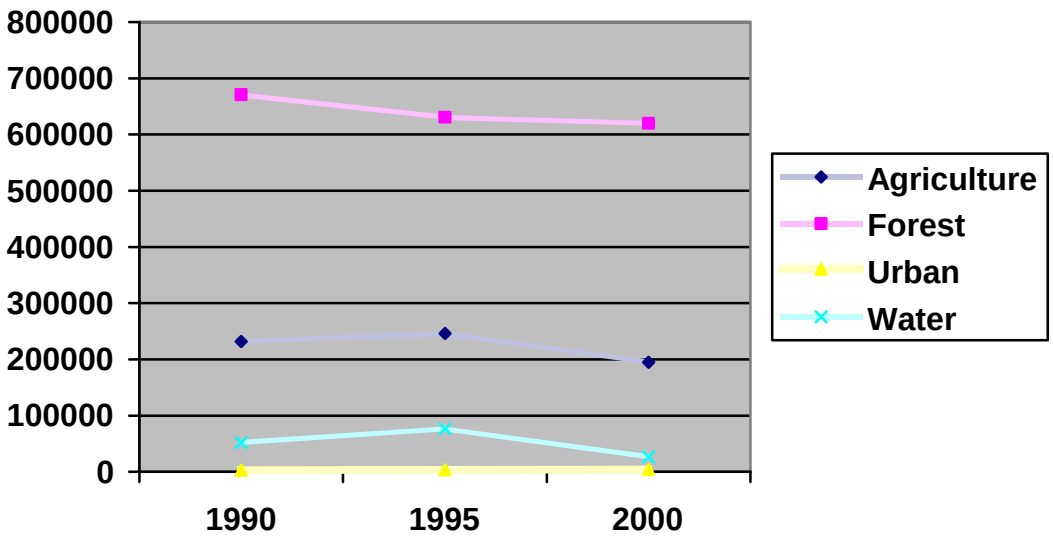


Figure 5.3: Land Use Classification for Three Different Dates in Middle stream of the Khwai Noi Upper River

3.) Downstream. In1990, the forest area covered 109,651.25 rai, then increased 50.43 rai in 1995 and 660.21 rai in year 2000. In terms of agricultural area, it continuously decreased 244.84 rai in 1995 and 948.30 rai in year 2000. When considering to watershed classification, it found that watershed class 1A still has agricultural area 2,797.47 rai.

In terms of urban and water body area, it showed that in 1995 urban area was increased 87.32 rai but decreased 13.61 rai in 2000. However, it found that in 2000, there are urban area 64.93 rai in watershed class 1A. In contrast, water body area was increased both in 1995 and 2000 (110.09 and 274.82 rai respectively).

Thus, the pattern of land cover changes are as follows: decreased agricultural land was caused by flooding and urbanization, reforestation. Urban area was converted by forest land, and water body area. The detail is shown on table 5.1, 5.4 and figure 5.1, 5.4.

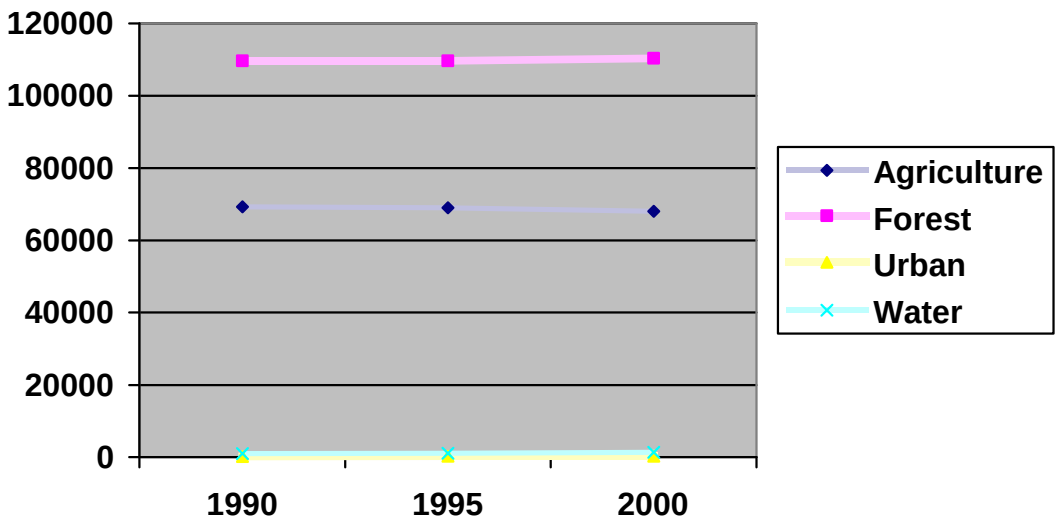


Figure 5.4: Land Use Classification for Three Different Dates in Downstream of the Khwai Noi Upper River

However, the changes on land can be described that human beings need many essentials converted from natural resources such as food and water, shelter and a better quality of life. Therefore, the use and exploitation of natural resources have been occurring in various kinds of human activities. For example, humans use the alluvial flood plain for performing agricultural activities as well as to expand into the urbanization land when the population grows and needs more land. This is the reason explains why the environment has been changing through time.

Table 5.2: Land Use Classification by Watershed Class in Upstream Area, Based on 2000

Land Use Type	Watershed Classification Area (rai)						
	1A	1B	2	3	4	5	Total
Agriculture area	21,919.16	536.34	7,050.58	25,833.41	28,352.42	122.34	83,814.28
Forestry area	936,579.43	11,890.41	163,435.79	96,018.85	8,284.78	800.54	1,217,009.82
Urban area	7.38	-	90.22	633.79	528.43	-	1,259.83
Water bodies	132,589.54	932.54	1,491.92	2,432.28	529.31	-	137,975.62

Table 5.3: Land Use Classification by Watershed Class in Middle Stream Area, Based on 2000

Land Use Type	Watershed Classification Area (rai)						
	1A	1B	2	3	4	5	Total
Agriculture area	20,923.77	-	24,193.87	7,020.56	136,877.35	6,052.53	195,068.10
Forestry area	381,084.24	-	131,635.59	86,870.01	20,175.31	-	619,765.21
Urban area	61.33	-	41.07	531.65	3,338.16	19.67	3,991.89
Water bodies	22,478.07	-	192.03	387.71	2,762.69	193.22	26,013.74

Table 5.4: Land Use Classification by Watershed Class in Downstream Area, Based on 2000

Land Use Type	Watershed Classification Area (rai)						
	1A	1B	2	3	4	5	Total
Agriculture area	2,797.47	64.93	1,487.85	5,023.00	45,972.14	12,730.65	68,076.04
Forestry area	69,315.90	362.20	15,013.26	16,816.04	7,430.40	1,424.07	110,361.89
Urban area	-	-	-	-	163.98	57.94	221.92
Water bodies	-	-	9.29	8.59	640.20	138.68	1,396.90

Table 5.5: Land Use Classification with Crop Pattern in the Khwai Noi Upper River

Crop pattern	Land Use Area (rai)		
	Sangkhla Buri	**Thonh Pha Phum**	**Sai York**
Corn	-	81,067.54	12,730.62
Upland Rice	47,477.53	24,842.09	-
Grassland	622.05	-	-
Wet Rice	1,532.05	5,214.63	-
Mixed Aquatic Plant	976.40	-	-
Mixed Field Crop	3,179.14	14,899.14	1,020.96
Cassava	3,379.22	57,634.63	34,738.88
Mixed Orchard	81.66	8,761.79	9,970.48
Mixed Perennial	12,398.26	44,309.26	9,045.00
Marsh and Swamp	7,507.25	1,150.25	
Scrub	-	-	4,673.38
Para Rubber	3,347.06	559.62	-
Sugarcane	-	-	228.90
Eucalyptus	-	436.51	336.03
Hill Evergreen Forest	332,722.49	179,559.60	11,997.93
Dry Dipterocarp Forest	727.56	5,448.52	610.40
Secondary Growth Forest	1,611.46	2,579.70	92,051.29
Mixed Deciduous Forest	885,565.50	496,856.25	-
Teak Plantation	448.58	4,323.12	780.70
Golf Field	-	387.71	-
Mine	-	152.62	-
Urban	2,753.31	2,847.71	589.21
Water	136,161.99	26,182.81	1,283.11

Source: Land Use Map Level 3 Scale 1:50000 (DLD, 2000)

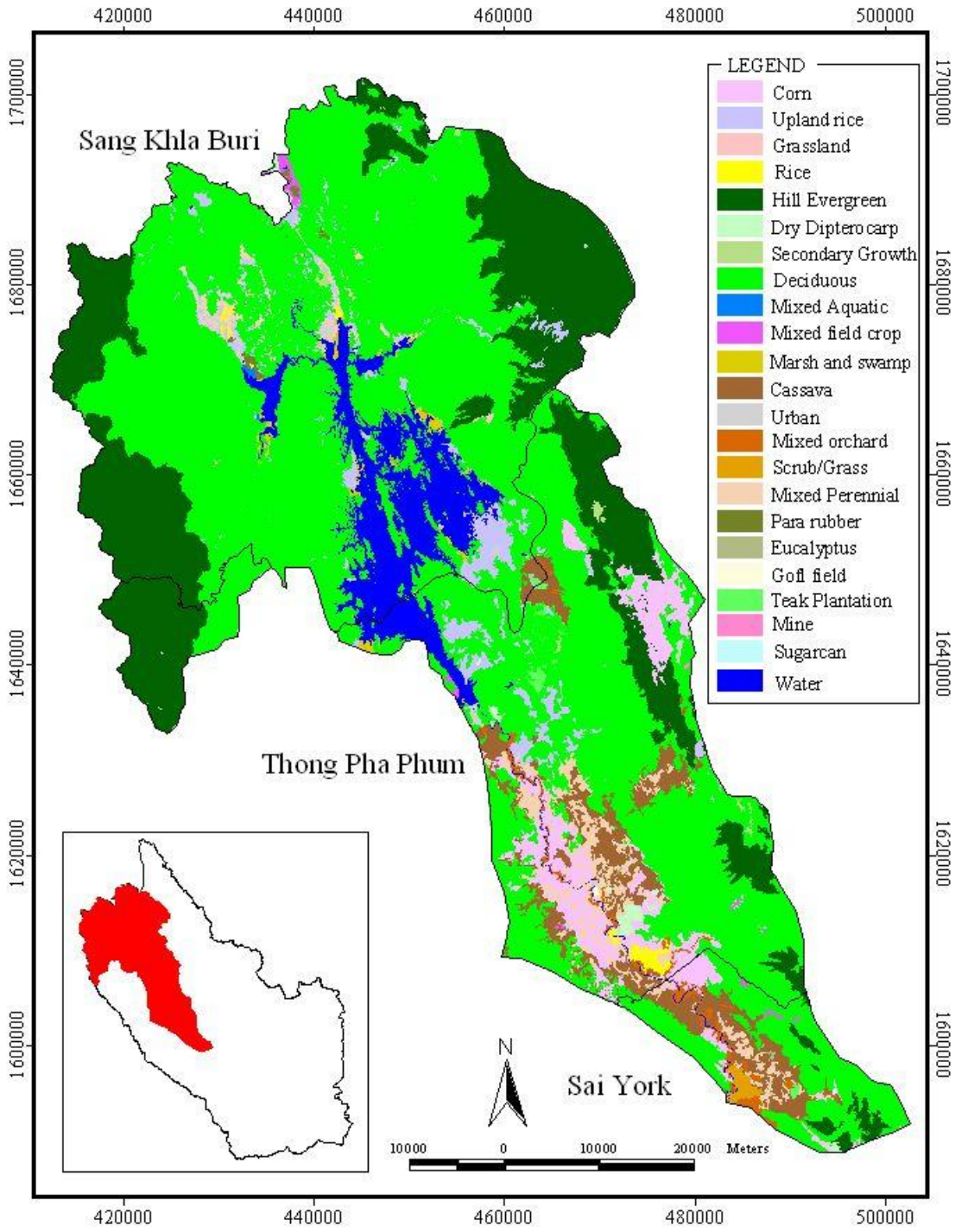


Figure 5.5 Land Use Classification with Crop Pattern in the Khwai Noi Upper River

Source: Land Use Map Level 3 Scale 1:50,000 (DLD, 2000) and LANDSAT TM

When considering forest in each stream reach, the result in table 5.5 showed that most of upstream area is plenty of forest area (1,221,075.59 rai), middle stream comes second (688,767.19 rai) and downstream, (105,440.32 rai) respectively. See figure 5.6.

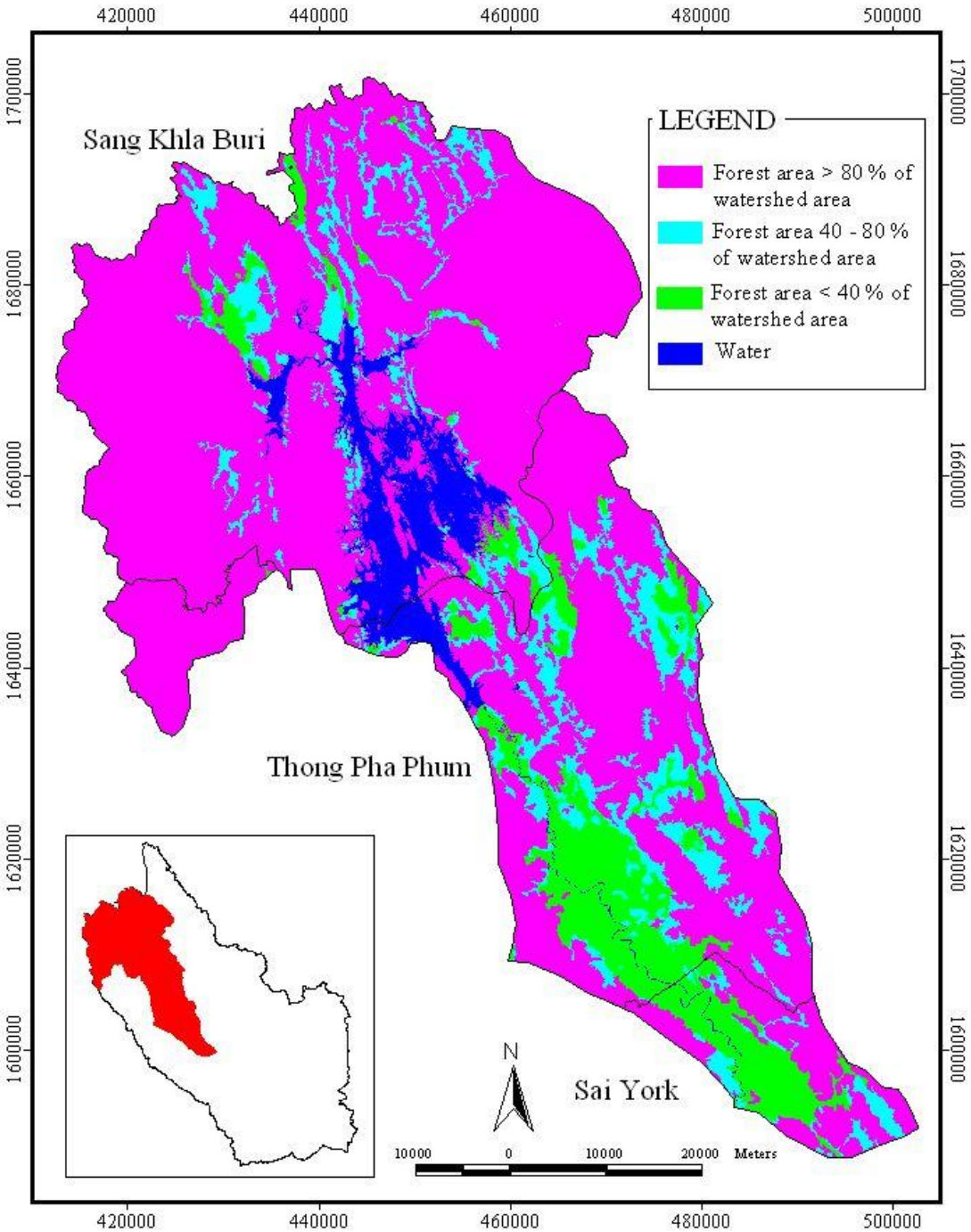


Figure 5.6: Proportion of Forest Area (%) Distribution in the Khwai Noi Upper River

5.1.2 Soil Erosion. One best indicator of watershed verification is soil erosion. However, human can not see soil erosion until the sub-soil has been exposed and rills and gullies have formed. In this study soil erosion is used for evaluating situation of watershed. The result of soil erosion rate is combined with others variables – land use/ forest area, water quantity and watershed capacity for human settlement. Indeed, soil erosion is natural erosion, which may not always be harmful. But, when natural vegetation is cleared for agricultural purposes, the natural protection that the soil had is disturbed and the soil detachment and movement occurs at great speeds.

Most of soil erosion results from incorrect land use practices. It is of two types, one due to water and other due to wind (Tangtham, 2002; 2-18 – 32). Since, erosion due to water is more important in the given context of Thailand, this study is studied soil erosion which was caused by water. In addition, Universal soil Loss Equation (USLE), the most widely used model in the world, was used to assess and predict soil erosion rate. The equation is as follows:

$$A = R * K * L * S * C * P)$$

Where, A is computed soil loss having dimension corresponding to the dimensions used for various parameters in the equation. The unit of average annual soil loss is t/ha/year

R is the rainfall erosivity factor

K is the soil erodibility factor

L is the slope length factor

S is the slope steepness factor

C is the crop management factor

P is the erosion control practices factor

1.) R – factor. R factor (rainfall erosivity index) is the principle function of USLE. The erosivity of a rain storm is function of its intensity and duration, and of the mass, diameter and velocity of raindrops. Previous studies have shown that maximum rainfall intensity for 30 minutes (EI_{30}) expressed as a kinetic energy has the best

correlation with erosivity (Apai, 2003). To compute the R-factor, Tangtham (2002: 5-14) revealed the equation is:

$$E = 0.119 + 0.0873 \log_{10}{}^{i}$$

Where E = kinetic energy in MJ/ha-cm

i = intensity of rainfall in mm/h

2.) K –factor. Soil erodibility is the function of physical characteristics of the soil and management which includes land and crop management (Shrestha, 1999: 72). The erodibility varies with soil texture, aggregate stability, shear strength, infiltration capacity and organic and chemical content. Hence, erodibility was calculated for each soil series using the following equation:

$$100K = 2.1\ M^{1.14}\ (10^{-4})(12-a) + 3.25\ (b-2) + 2.5\ (c-3)$$

Where, M = particle size parameter (% silt + % very fine sand) or (100 - % clay)

a = percent organic matter

b = soil structure class (1 for very fine granular; 2 for fine granular; 3 for medium to coarse granular; and 4 for blocky, platy, or massive)

c = soil permeability class (1 for rapid;2 for moderate to rapid; 3 for moderate; 4 for slow to moderate; 5 for slow; and 6 for very slow)

However, according to soil taxonomy, the same family of soil gives the same k-factor value; although each group of soil has several soil series. This study used K value range 0.04 - 0.56 which was prepared by Department of Land Development (2000). See detail in Appendix.

3.) LS-factor. Slope length (L) is defined as the distance from the point of origin of overland flow to either the point where the slope decreases to the extent that deposition begins or point where run off enter well-defined channel. In Thailand, it is considered slope length of 100 m while computing L-factor. Slope steepness (S) represents the topographical factor. Commonly L and S factor was combined to

express the function of 'slope length' along with the slope steepness. The LS factor was computed by using equation as follows:

$$[(\text{length (m)} / 22.13)^{0.5}] * [0.065 + 0.0456 (\% \text{ slope}) + 0.006541(\text{slope})^2]$$

4.) CP-factor. C is crop management factor and P is the erosion control practices or conservation factor. These two factors are also treated together as CP factor. The value of C – factor and P – factor was derived from LDD (2000). However, most of P value for forest are ranged between 0.000 and 1.000 (Tangtham, 2002: 5-87-90). P value was omitted here because most of study site are dry evergreen forest and mixed deciduous forest, which value is 1.000 and in statistical terms whatever number multiples one is its value. See detail in Appendix.

All the parameters of USLE were computed in the GIS database which was overlaid in terms of the areas with different hazard severity. Based on the five criteria of LDD (< 6.25 t/ha/y, 6.25-31.25 t/ha/y, 31.25-125 t/ha/y, 125-625 t/ha/y and >625 t/ha/y), the annual soil loss area in this study was adapted and categorized into three classes.

The criteria of three classes was based on the study of Tideman (2002: 1) who described that normally soil erosion rate by water or wind in agricultural area in India is between 4 – 10 ton/ha/year. In Thailand soil erosion rate, which based on the Apai's study is 5 t/ r/y (Apai, 2003). Thus, this study was used area of soil loss 5 t/r/y is criteria, then classified the result into three classes, namely area which less than 10 percent of watershed area = 3, 10-20 percent of watershed area = 2 and more than 30 percent of watershed area =1 (See detail in table 3.6). Nevertheless, on-site impact of soil erosion is a reduction in soil fertility. For example in tradition tillage, soil particles from the tilled earth would get transported by wind and water and displaced into rivers and streams. Besides, in terms of off-side impacts, soil erosion resulting from agricultural activities has lead to the siltation of rivers and reservoirs as well as adversely impacted wildlife habitats and water supply.

However, the detail of soil loss area is described in each stream reaches below:

1) Upstream. The total soil loss area in Sangkhla Buri is 1,304,143.33 rai or 54.01 percent of total soil loss area. When considering in terms of watershed classification, it showed that most of watershed class 1A, which is high elevation and very steep slopes has soil loss area in low level (913,571.22 rai). In contrast, most of area in watershed class 4, which is gentle sloping lands, has soil loss area in high level (27,215.75 rai).

This result is confirmed by the study of Office of Environmental Policy Planning, Ministry of Science and Technology (1996). In 1996 it reported that in Khwai Noi, there was sediment yield equals 569.60 ton/square kilometer/ year or 356,000 ton/ rai/ year. Although it is in acceptance rate, it is still a large amount of sediment which is able to harmful fresh water creature in the future if no best management practices.

2) Middle stream. The soil loss area in Thong Pha Phum is 931,026.91 rai or 30.55 percent of total soil loss area. When considering in terms of watershed classification, the result is similar to upstream area, namely watershed class 1A still has soil loss area in low level; on the contrary, most of watershed class 5 and 4 has soil loss area in high level.

3) Downstream. The soil loss area in Sai York is 178,773.66 rai or 7.93 percent of total soil loss area. When considering in terms of watershed classification, it showed that the result is similar to middle stream, namely watershed class 4 and class 5 has soil loss area in high level (Table 5.6 and Figure 5.7).

Table 5.6: Soil Erosion Area in the Khwai Noi Upper River Based on Year 2000

Watershed Class	Sangkhla Buri			Thong Pha Phum			Sai York			Total
	Soil Loss Area Level (rai)			Soil Loss Area Level (rai)			Soil Loss Area Level (rai)			
	High	Moderate	Low	High	Moderate	Low	High	Moderate	Low	
1A	29,553.41	17,286.56	913,571.22	21,110.81	7,088.78	423,047.62	2,459.98	199.03	69,454.41	1,483,771.82 (61.46%)
1B	534.84	92.63	11,841.89	-	-	-	71.59	-	355.55	12,896.50 (0.53%)
2	7,131.42	242.57	163,319.71	20,559.34	17.13	134,945.47	2,572.07	0.49	13,931.63	342,719.83 (14.19%)
3	23,923.76	220.67	98,344.22	64,731.05	19.04	92,698.38	5,637.72	8.21	16,194.91	301,777.96 (12.50%)
4	27,215.75	75.90	9,873.90	133,391.97	26.83	27,336.76	48,788.46	-	4,909.49	251,619.06 (10.42%)
5	122.35	3.15	797.38	6,041.93	-	11.80	14,005.28	-	184.84	21,166.73 (0.90%)
Total	88,481.53 (3.66%)	17,921.48 (0.74%)	1,197,740.32 (49.61 %)	245,835.10 (10.18%)	7,151.78 (0.29%)	678,040.03 (28.08%)	73,535.10 (3.04%)	207.73 (0.00%)	105,030.83 (4.35%)	2,413,951.90 (100%)

Remark: Area is excluded water body area

Source: Prepared by author, 2004.

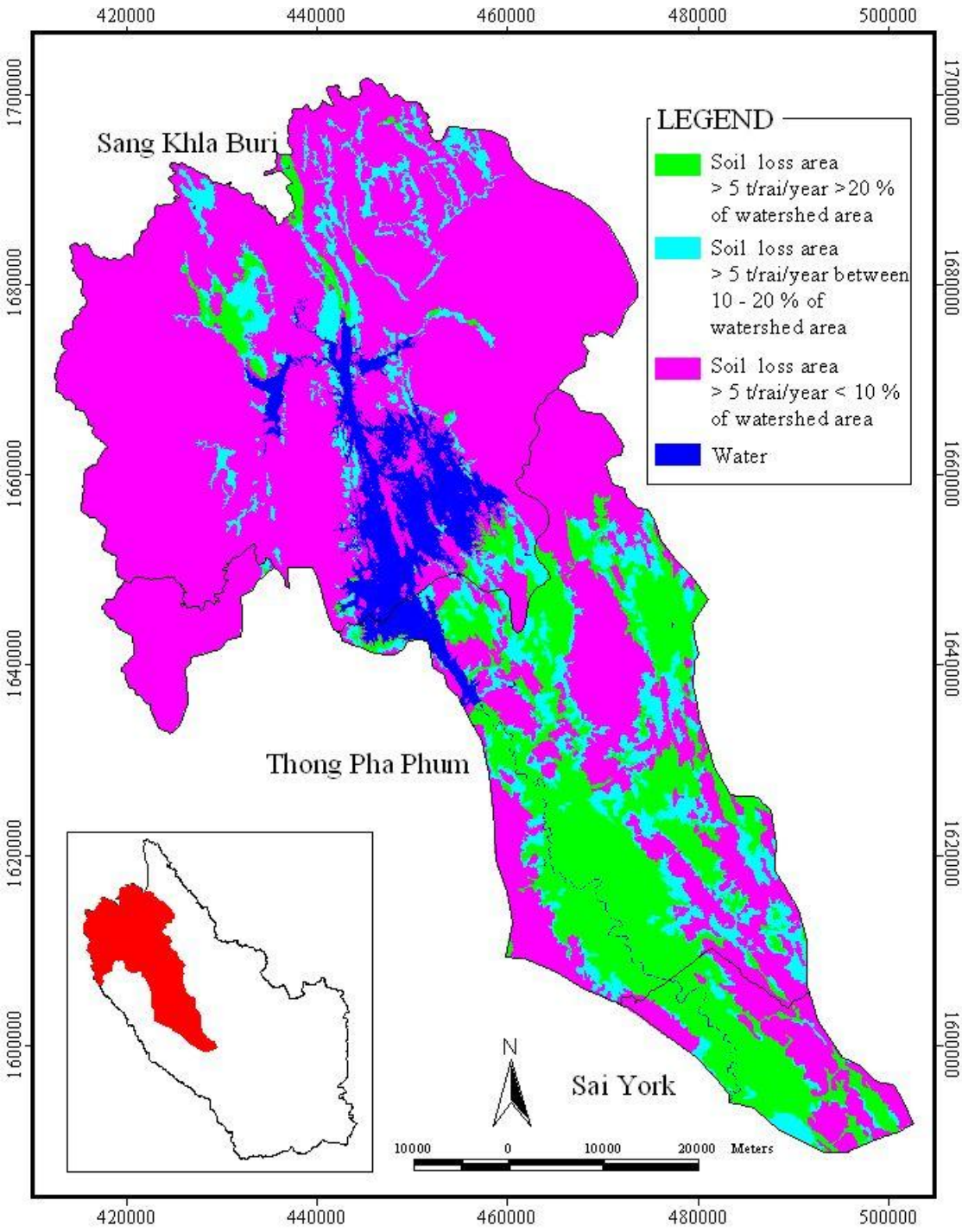


Figure 5.7 Actual Soil Loss Map (ton/rai/year) in the Khwai Noi Upper River

Source: Prepared by author, 2004

Due to the fact that women are closed to nature through their household role, the understanding of gully soil – form drive them avoid the activities related to high erosion rate. Moreover, women have the great responsibility to educate their offspring.

5.1.3 Volume of Water. Rainfall volume is vital variable over geographical area for prediction of natural resources fertility. There are three methods for estimating average precipitation for an area: isohyetal, Thiesses and arithmetic average. To illustrate rainfall volume in a watershed, isohyetal method is a reliable method which considers rain cells that are imaginary line of equal precipitation (isohyets) over an area; in addition, it is good for visual display. Precipitation values between precipitation station 450201 and 450001-450020, 450024, 450032 in Sangkhla Buri, Thong Pha Phum and Sai York district are determined by linear interpolation. However, there is interpolation equation, which Wanielista (1997: 93) was suggested:

$$P = \sum_{i=1}^{n} W_i P_i$$

Where P = isohyetal average precipitation (mm)

P_i = isohyetal cell average precipitation (mm)

$W_i = A_i / A$; A_i – area of cell (km^2)

A= total are (km^2)

n = total number of cells

A_i = area of the cell within the topographical drainage boundaries.

This study used the Inverse Distance Weighted (IDW) interpolator, one of GIS technique, to measure the height, magnitude, or concentration of grid theme and determines the best estimated value which based on the phenomena the value.

The result showed that most of study area has volume of rainfall between 2,001 and 2,600 millimeter (1,611,577.12 rai or 66.76 %). This means that water resource is in moderate to extremely rich. The second is volume of rainfall less than 2,000 millimeter (788,057.31 rai or 32.64 %). There is only 13,738.75 rai or 0.60 percent of total area which has volume of rainfall more than 2,601 millimeter.

When considering to each stream reach, it found that volume of rainfall between 2,001 and 2,600 millimeter is in upstream area, while volume of rainfall between 1,400 and 2,000 millimeter is in downstream area. Middle stream is the only area which has variety of volume of rainfall from 1,400 to 2,800 millimeter. However, LDD (2000) held that the 2,000 millimeter of volume of rainfall is good enough for plantation; hence, it can say that the Khwai Noi Upper River is area is plenty of water resource. See table 5.7and figure 5.8 - 5.9.

Table 5.7 Volume of Rainfall in the Khwai Noi Upper River

Rainfall (mm)	**District Area** (rai)			**Total (rai) ***
	Sangkhla Buri	**Thong Pha Phum**	**Sai York**	
1400-1600	-	19,334.09	126,667.59	146,001.68 (6.04 %)
1601-1800	-	324,055.02	51,991.26	376,046.28 (15.58 %)
1801-2000	-	266,009.35	-	266,009.35 (11.02 %)
2001-2200	32,093.52	171,363.73	-	203,457.25 (8.43 %)
2201-2400	989,048.68	69,899.07	-	1,058,947.75 (43.87 %)
2401-2600	280,941.74	68,230.38	-	349,172.12 (14.46 %)
2601-2800	-	13,738.75	-	13,738.75 (0.60 %)
Total	1,302,083.86	932,630.43	178,658.86	2,413,373.15 (100 %)

* Area is excluded water body area (165,386.31 rai)

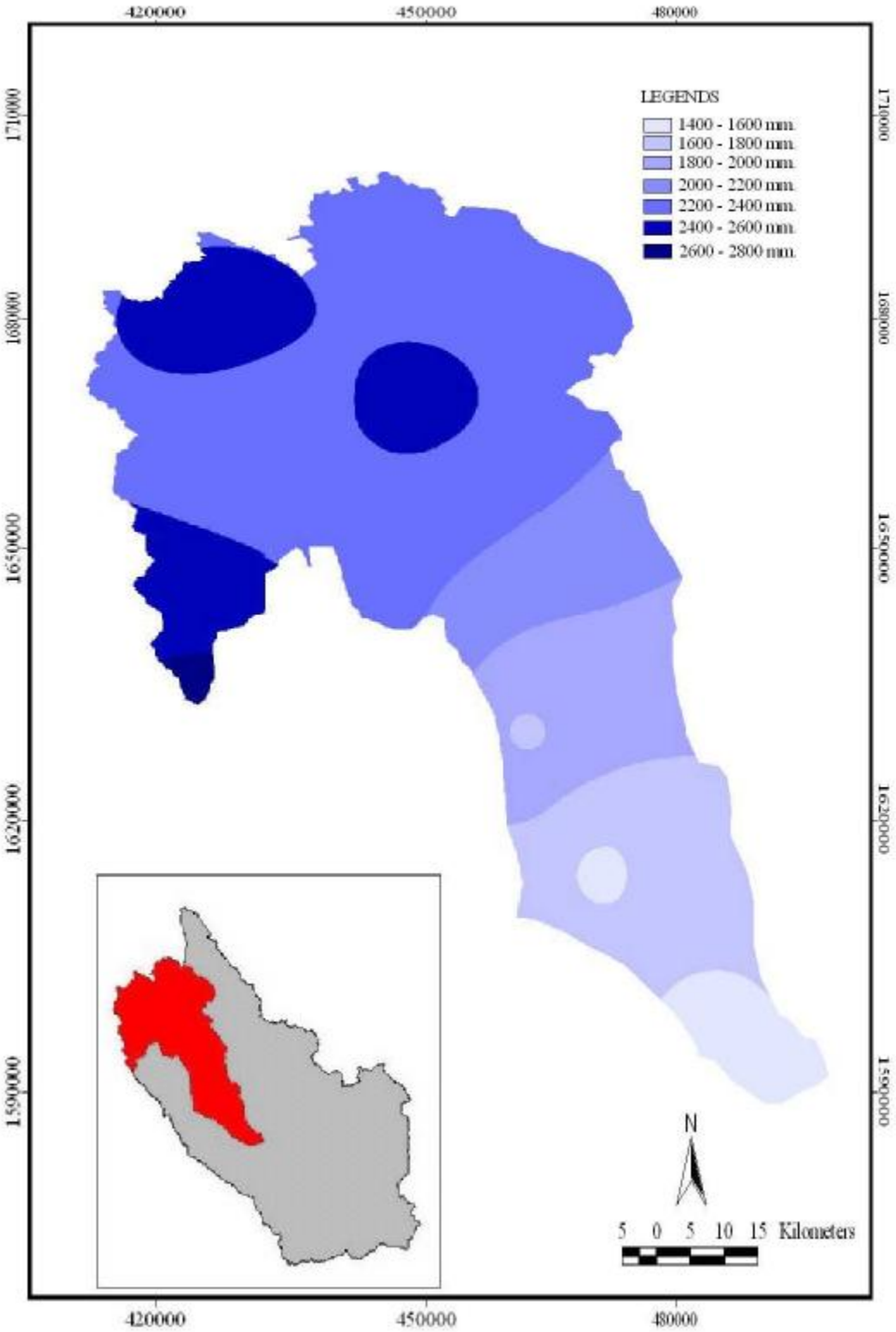


Figure 5.8 Annual Rainfall Map of the Khwai Noi Upper River

Source**:** Generated by Interpolation, Based on the Meteorological Department (2004).

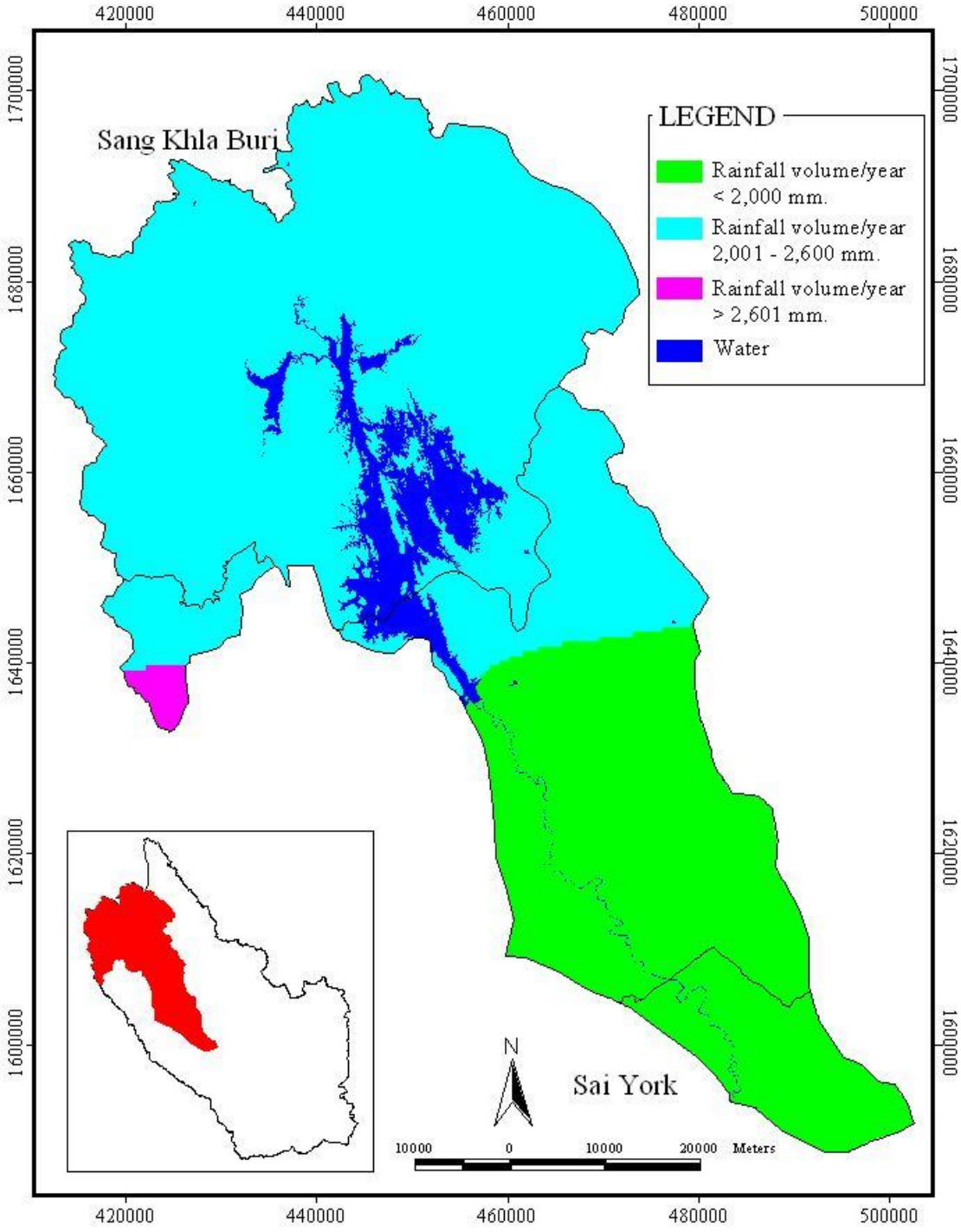


Figure 5.9: Volume of Rainfall in the Khwai Noi Upper River

Source: Prepared by Author, 2004

5.1.4 Agricultural and Urban Area within Slope > 35%. The slope more than 35 percent is not suitable for any activities because of steep slope topography. Moreover, hilly land is preserved for catchment area. This study used slope more than 35 percent in agricultural land and urban area as one of parameter to find watershed situation. The results showed that there are agricultural land and urban in slope area more than 35 percent 12, 569.81 rai. Upstream and downstream area are used only for agriculture purpose, while middle stream for settlement and agriculture purpose. This is supported by MOI (2002) that found that the number of population is increased and driven population find more land for living. See table 5.8 and figure 5.9.

Table 5.8: Land Utilization within Slope more than 35 %

Land Use within Slope area > 35%	**Area (rai)**			**Total**
	Sangkhla Buri	**Thong Pha Phum**	**Sai York**	
Agriculture	5,894.32	5,266.73	1,375.47	12,536.52
Urban	-	33.29	-	33.29
Total	5,894.32	5,300.02	1,375.47	12,569.81

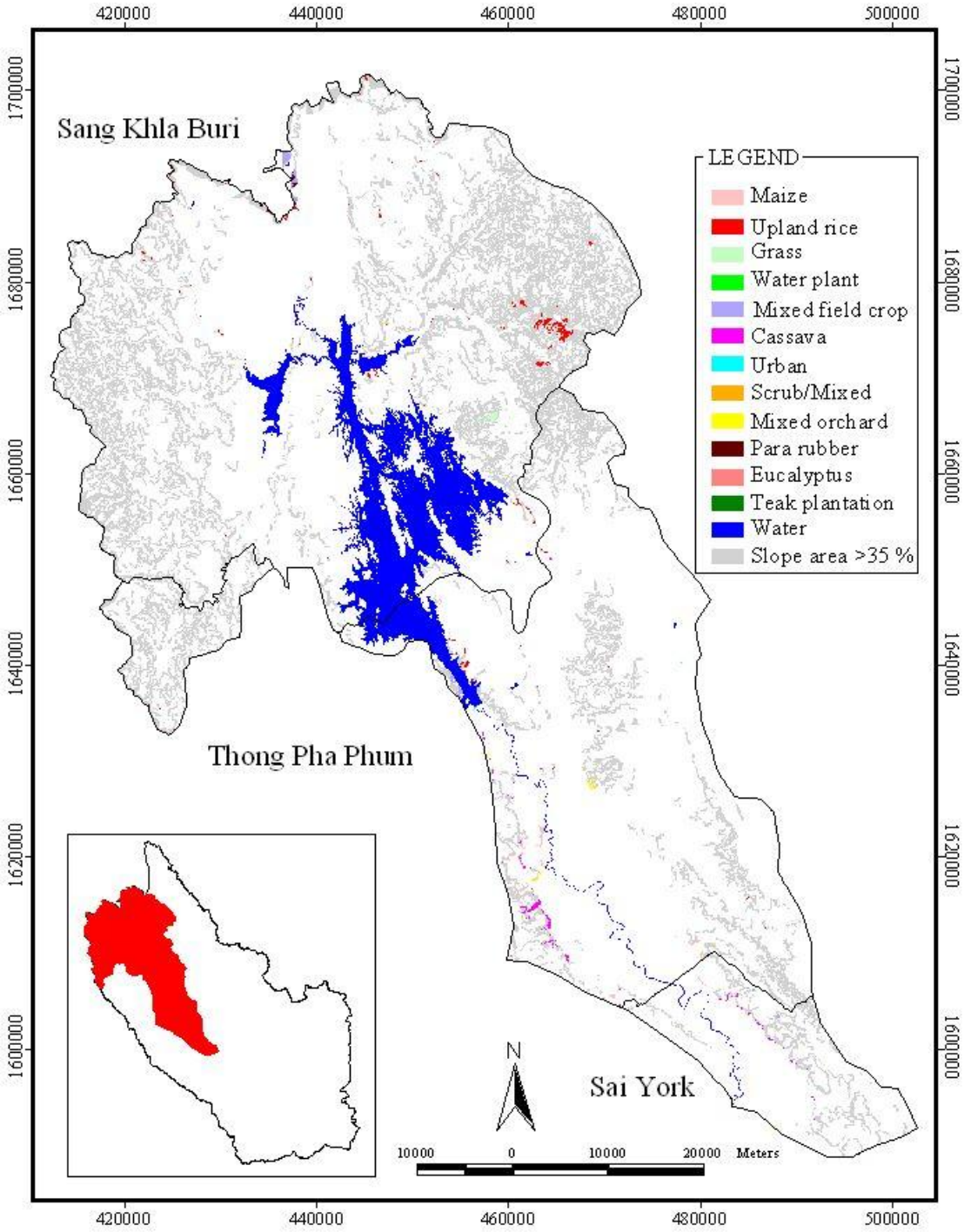


Figure 5.10: Land Utilization within Slope greater than 35 %

Source: Prepared by Author, 2004

5.1.5 Population Density in Watershed Area. Human intervention with the given land use greatly decide the natural resource deterioration, especially the degree of erosion. The human impact has had on the soil, water and forest resources, and then leads to environmental change. However, the complexity, frequency and magnitude of impacts are increasing, partly because of steeply rising population levels and partly because of a general increase on per capita consumption. Thus, some land use such as shifting agriculture, which have been thought to sustain some sort of environmental equilibrium, seem to break down and cause environmental deterioration when population pressures exceed a particular threshold. Population density, human life quality, is one of parameter used in this study. The criteria of MOI were used to find population size in suitable agricultural land of watershed area. See detail in table 3.2.

After using GIS technique, the result showed that 81,175.45 rai agricultural land and 2,753.31 rai urban area in upstream area; the density of population is more than 50 people per square kilometer and most of people live in Ban Phra Chedi Sam Ang – Thai-Myanmar border line and western part of Bee Kee River, where Mon minority live. In 195,068.10 rai agricultural land and 3,991.89 rai urban area in middle stream and 68,076.04 rai agricultural land and 221.92 rai urban area in downstream area, it found that the density of population is 20-50 people per square kilometer.

This means the density of population in upstream area is more than the middle and down stream area. Due to the fact that there is international immigration over times, the density is still high. See figure 5.11.

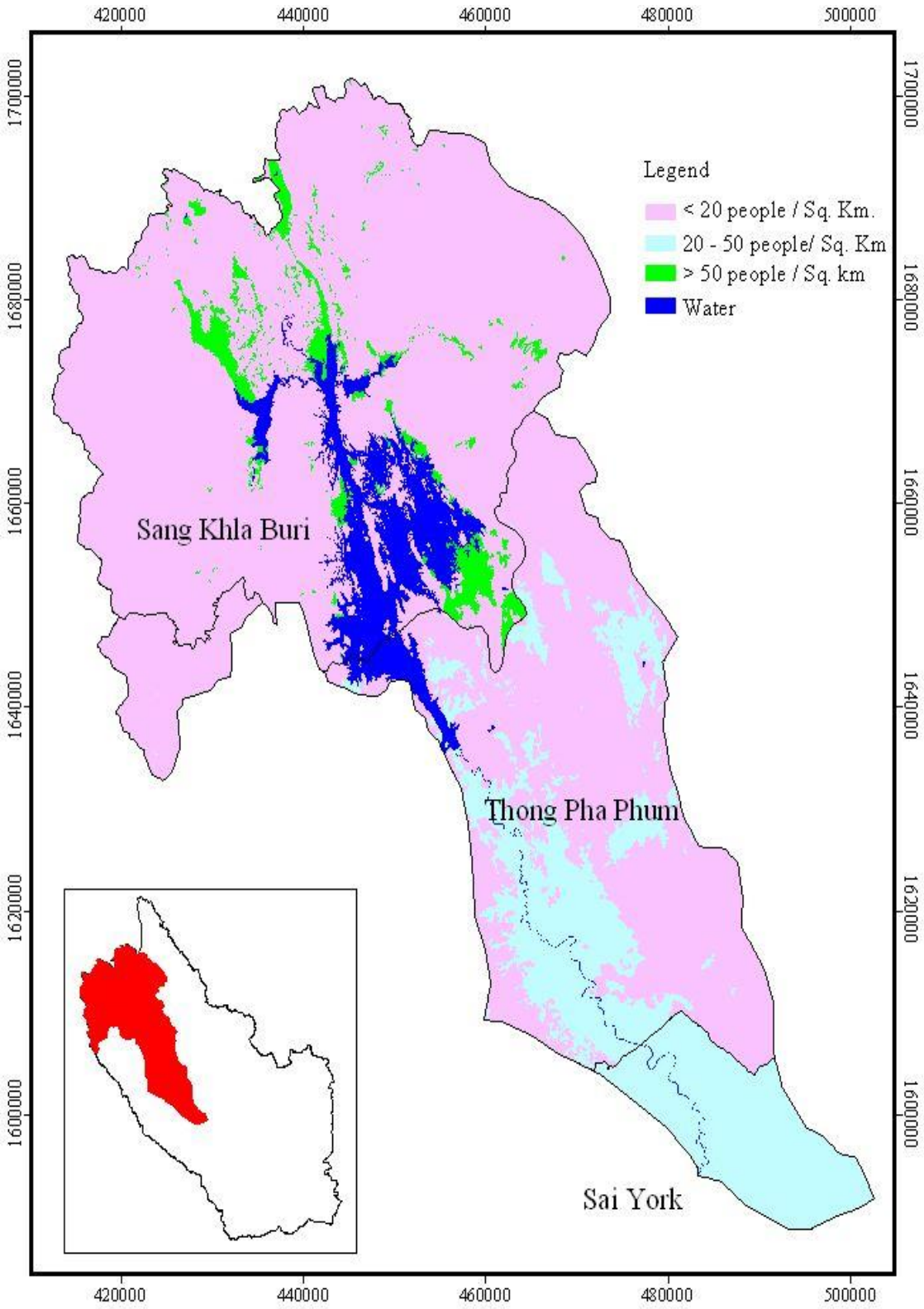


Figure 5.11: Population Density in the Khwai Noi Upper River

Source: Prepared by author, 2004

5.1.6 Watershed Situation. After using GIS overlay technique with five parameters in table 3.6 and 3.7, it reported that situation of the Khwai Noi Upper River divided into3 zones. The circumstance is shown below:

1) Upstream. Most of upstream is in nature situation, which means that thee is no change in watershed structure and function (1,114,006.41 or 77.28 %). It is obvious that there is only 26,898.89 rai or 1.86 percent in crisis. In addition, it is in watershed class 4, which are gentle sloping lands suitable for upland farming, row crops, grazing and fruit trees. Although there are fewer disturbances in upstream area, soil conservation program should monitor in agricultural practice.

2.) Middle stream. Nearly half of middle stream area is in nature situation (438, 001.73 or 45.75 %). The second comes crisis status. The results showed that nearly a quarter of middle area is in crisis, especially in watershed class 3 - 5 (203,344.83 rai or 21.24 percent). When comparing to the upstream, it showed that percent of crisis in middle stream is more than those in upstream, which means that most disturbances is in watershed structure and function; if there is no conservation program, it is no chance to restore the natural resources.

3.) Downstream. Unlike the others two areas, most of downstream is in crisis situation (89,728.92 or 83.03%). It means that most disturbances are in watershed structure and function. In addition, 88,617.61 rai or 49.21 percent is in warning situation, which showed that there is some disturbance in watershed structure and function but it is in acceptance level. It is interested that there is no land in nature situation. See table 5.9 and figure 5.12.

Table 5.9: Watershed Situation in the Khwai Noi Upper River

Watershed Classification	Upstream Area (rai)				Total
	Crisis	Risky	Warning	Nature	
Class 1A	-	-	22,200.20	938,390.97	1,092,410.32
Class 1B	-	-	530.06	11,939.30	13,359.35
Class 2	-	-	7,015.68	163,676.14	172,187.39
Class 3	-	24,932.68	97,555.98	-	124,918.54
Class 4	26,898.59	10,267.00	-	-	37,694.86
Class 5	-	122.35	800.53	-	922.88
Total	26,898.59 (1.86%)	35,322.03 (2.45%)	128,102.45 (8.88%)	1,114,006.41 (77.28%)	1,441,493.32 (100%)
Middle stream Area					
Class 1A	-	-	13,245.49	438,001.73	473,857.13
Class 1B	-	-	-	-	-
Class 2	-	16,596.31	138,925.64	-	155,943.74
Class 3	45,784.13	111,664.35	-	-	157,990.19
Class 4	151,506.97	9,248.59	-	-	163,153.31
Class 5	6,053.73	-	-	-	6,265.35
Total	203,344.83 (21.24%)	137,509.25 (14.36%)	152,171.13 (15.89%)	438,001.73 (45.75%)	957,210.21 (100%)
Downstream Area					
Class 1A	-	-	72,113.42	-	72,113.42
Class 1B	-	427.14	-	-	427.14
Class 2	-	-	16,504.19	-	16,510.58
Class 3	21,840.85	-	-	-	21,847.62
Class 4	53,697.95	-	-	-	54,206.53
Class 5	14,190.12	-	-	-	14,951.46
Total	89,728.92 (83.03%)	427.14 (0.39%)	88,617.61 (49.21%)	-	180,056.49 (100%)

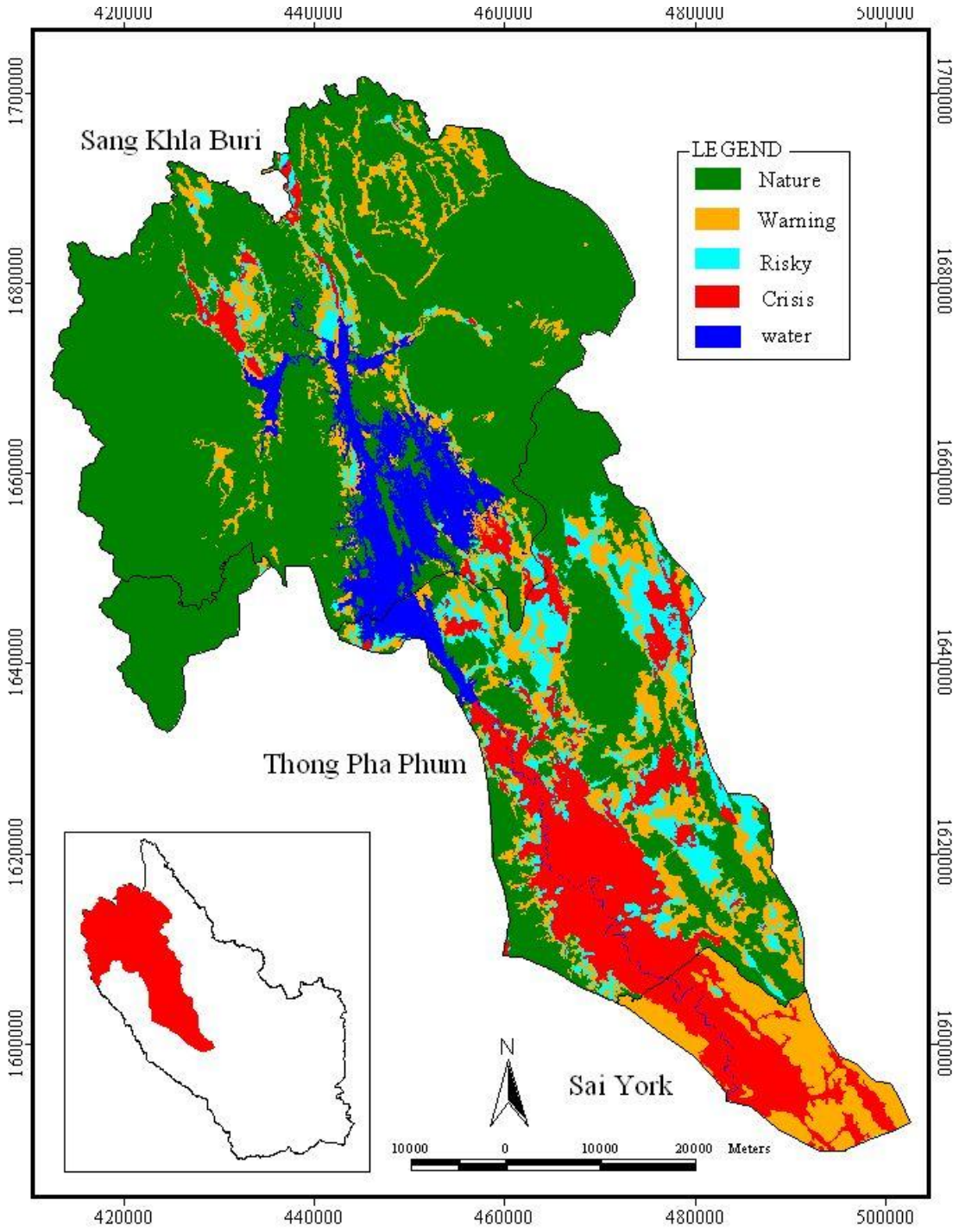


Figure 5.12: Watershed Situation in the Upper River Khwai Noi Based on Year 2000

Source: Prepared by Author, 2004

5.2 Women in the Khwai Noi Upper River

5.2.1 Women Inventory Regarding Social Data. This section describes the characteristics of sample in studied area, 345 respondents. The general picture of women in the Upper River Khwai Noi was presented below:

1.) **Age:** A large number of women (35.4 %) in up stream or Sang Buri, middle stream or Thong Pha Phum, and down stream or Sai York districts were between the age group of 31 and 40 years. 27.8 percent of women were in the age group of 21 and 30 years. 2.6 percent of women was reported among women over 60 years of age. The mean age of women was 35.17 years with a standard deviation of 11.74 years, which indicates that women are average age in middle age.

When grouping the living year in two general groups – new comer who lived in community between 1 and 15 years and natively born who lived in community more than 15 years, it found that most of women (with age 31- 40) have lived in the community more than 25 years or natively born. New comer is women in age 21-30. Figure 5.13 present all details.

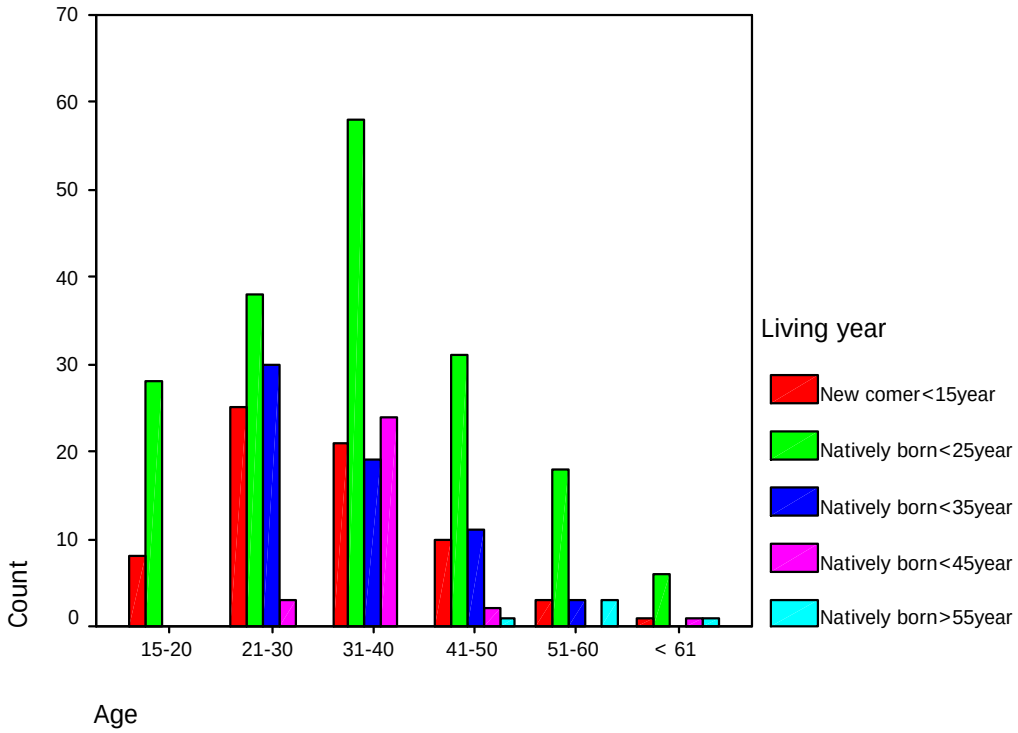


Figure 5.13: A Graph Presents Age of Women by Living Year in the Khwai Noi Upper River

Source: Field Survey, 2004

2.) Caste: Majority of women (84.3 %) in up stream, middle stream, down stream is Thai or long term residents (87.8 %). 15.7 percent of women were Non-Thai. Karen is found the most races (7.4 %). See figure 5.14 – 5.15.

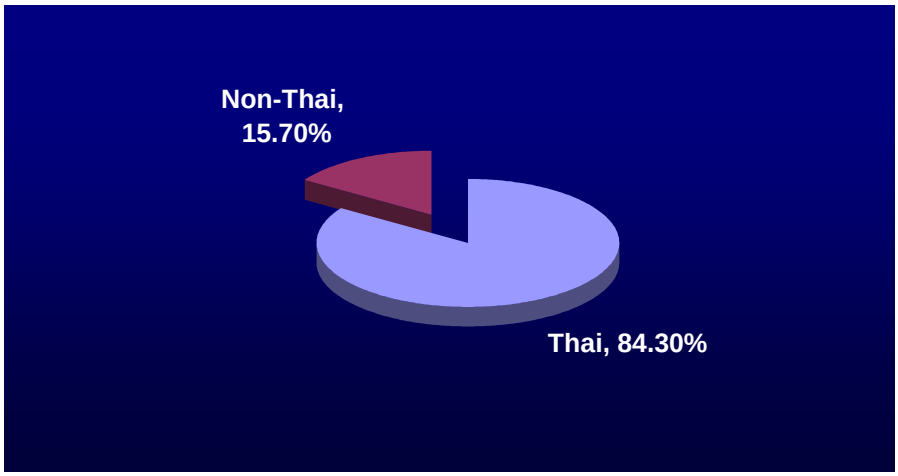


Figure 5.14: Race of Women in the Khwai Noi Upper River

Source: Field Survey, 2004.

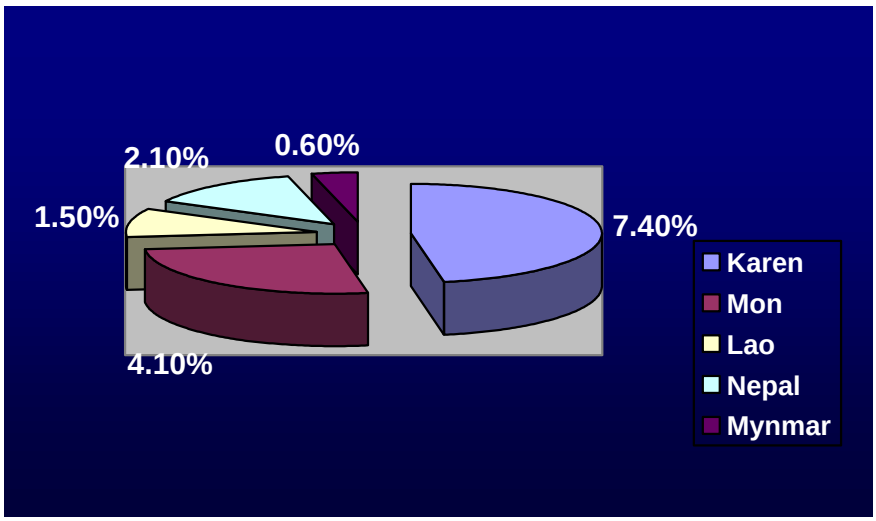


Figure 5.15: Distribution of Non -Thai Women in the Khwai Noi Upper River

Source: Field Survey, 2004.

3. Religion: Majority of women in up stream, middle stream and down stream are Buddhists. In reality, Buddhism is the dominant religion in this watershed because this area is the past holly route of India priest to circulate Buddha's teaching or *Dhamma* (Luangaramsri, 2002). See table 5.610

Table 5.10: Percentage of Age, Race and Religion of Women in the Khwai Noi Upper River

Variables	Sangkhla Buri (N=148)		Thong Pra Phum (N=169)		Sai York (N=28)		Total (N=345)	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1. AGE								
15-20	15	4.3	16	4.48	5	1.59	36	10.4
21-30	45	13.0	51	14.76	-	-	96	27.8
31-40	56	16.2	54	15.66	12	3.50	122	35.4
41-50	19	5.5	28	8.1	8	2.3	55	15.9
51-60	9	2.6	15	4.3	3	0.9	27	7.8
< 60	4	1.2	5	1.4	-	-	9	2.6
2. RACE								
Thai	**104**	**30.1**	**159**	**46.1**	**28**	**8.1**	**211**	**84.3**
Natively born	141	40.9	141	40.9	21	6.0	303	87.8
New comer	7	2.0	28	8.2	7	2.0	42	12.2
Other	**44**	**12.8**	**10**	**2.9**	**-**	**-**	**54**	**15.7**
Karen	22	6.3	3	0.8	1	0.3	26	7.4
Mon	12	3.5	2	0.6	-	-	14	4.1
Burma	-	-	2	0.6	-	-	2	0.6
Nepal	5	1.5	2	0.6	-	-	7	2.1
Lao	5	1.5	-	-	-	-	5	1.5
3. RELIGION								
Buddhism	140	40.6	165	47.8	28	8.1	333	96.5
Christianity	7	2.0	1	0.3	-	-	8	2.3
Islam	1	0.3	3	0.9	-	-	4	1.2

Source**:** Field Survey, 2004.

4. Occupational structure and Education. Half of women in this watershed occupied farmer in agricultural sector, especially farm like corn, cassava, teak and rubber (52.2 %). For non agricultural career, it found that 20.5 percent of women are in commerce and 18.8 percent run their lives as agricultural hired labors. When considering each stream reach, it found that majority of women in up stream and

down stream is commerce. In addition, women in middle stream are more in hired labors than commerce. In terms of increasing household income, majority women do not have a secondary job (67.5 %). See table 5.11

Table 5.11: Percentage of Occupation of Women in the Khwai Noi Upper River

Occupation	**Sangkhla Buri** (N=148)		**Thong Pra Phum** (N=169		**Sai York** (N=28)		**Total** (N=345)	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
• Elementary jobs **Agriculture**	**63**	**18.2**	**103**	**29.9**	**14**	**4.1**	**180**	**52.2**
Paddy field	30	8.7	11	3.1	-	-	41	11.8
Farm	30	8.7	73	21.2	12	3.4	115	33.3
Fruit Orchard	3	0.9	19	5.6	2	0.6	24	7.1
Non agriculture	**85**	**24.6**	**66**	**19.1**	**14**	**4.1**	**165**	**47.8**
Commerce	45	13.0	21	6.1	5	1.4	71	20.5
Hired labors	26	7.5	35	10.1	4	1.2	65	18.8
Live stock	1	0.3	1	0.4	-	-	2	0.7
Student	3	0.9	4	1.2	5	1.3	12	3.4
Housewife	9	2.5	4	1.2	-	-	13	3.7
Government Officer	1	0.3	1	0.4	-	-	2	0.7
• Secondary jobs **Have not**	**113**	**32.8**	**109**	**31.5**	**11**	**3.2**	**233**	**67.5**
Have	**35**	**10.1**	**60**	**17.5**	**17**	**4.9**	**112**	**32.5**
Agricultural sector	-	-	-	-	2	0.7	2	0.7
Non agricultural sector	6	1.7	12	3.4	4	1.2	22	6.3
Both of them	29	8.4	48	13.9	11	3.2	88	25.5

Source: Field Survey, 2004.

In terms of education, most of women in the Upper River Khwai Noi have attained compulsory primary education (80 %). Junior and senior primary level are cited most (22.6, 22.7 % respectively). However, in up stream quarter of women educated from junior secondary level (8.4 %) and junior primary level (7.8 %). One – third of women in middle stream educated in senior and junior primary level (12.5 %,

14.7 % respectively); in contrast, women in down stream educated in junior primary and senior primary level (2.0 %, 2.3 %, respectively). See table 5.12

Table 5.12: Percentage of Education of Women in the Khwai Noi Upper River

Education	Sangkhla Buri (N=148)		Thong Pra Phum (N=169)		Sai York (N=28)		Total (N=345)	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1. Non educated	**40**	**11.6**	**26**	**7.5**	**3**	**0.9**	**69**	**20**
2. Educated	**108**	**31.4**	**143**	**41.4**	**25**	**7.2**	**276**	**80**
Not finished primary school level	4	1.2	1	0.3	1	0.3	6	1.8
Junior primary level (P.4)	27	7.8	43	12.5	8	2.3	78	22.6
Senior primary level (P.5-6)	21	6.0	51	14.7	7	2.0	79	22.7
Junior secondary level (M. 1-3)	29	8.4	25	7.3	6	1.7	60	17.4
Senior secondary level (M. 4-6)	24	7.0	16	4.5	1	0.3	41	11.8
Diploma	-	-	4	1.4	1	0.3	5	1.7
Bachelor degree	3	0.9	3	0.9	1	0.3	7	2.0

Source: Field Survey, 2004.

5. Land Ownership. Ownership security is defined as the possession of the legal right, certified by an appropriate official document. There is no uniform size of land holding, since different farmers got different type of land certificate in different years with varying size. According to the government resettlement programs, there are many certificate types and different right to do with their land:

1.) *PBT (Por Bor To or Phasi Bumrung Thongthi)* is a receipt of tax paid to the village Headman for local development. It indicates that farmer only occupied land for agriculture activities.

2.) *KN 3 (Kor Nor Sor 3)* is the 2nd Class of land title, which requires performing any activities on land to secure the ownership. However, land can be sold to others.

3.) *KN5 (Kor Nor Sor5)* is the 4th Class of land title, which is issued by Department of Cooperative Promotion and Department of Public Welfare for land allocation under settlement programs. After 5 years, it turns to be *KN 3*.

4.) *SK1 (Sor Kor 1 or Baichong)* is the land claim certificates to be issued by Department of Land for temporary occupation for who has been settled before 1993.

5.) *SPK (Sor Por Kor)* is land certificates, which allocate land to farmers according to the Agricultural Land Reform Act 1975.

Due to the government policy, Thais land was kept for Thai families, especially those in the agricultural sector and this area is border line between Thai and Myanmar. One –third of the Upper River Khwai Noi area has been declared as reserve area; thus, the first class land title (*Chanode*) is not given to people to prevent land speculation. When questioned about land ownership, most of women in the Upper River Khwai Noi have no land ownership. There is only 35.4 percent have land ownership. See table 5.13

Table 5.13: Percentage of Land Ownership of Women in the Khwai Noi Upper River

Land ownership	Sangkhla Buri (N=148)	Thong Pra Phum (N=169)	Sai York (N=28)	Total (N=345)	
	Frequency	Frequency	Frequency	Frequency	%
1. No ownership	**113**	**94**	**16**	**223**	**64.6**
2. Ownership	**35**	**75**	**12**	**122**	**35.4**
PBT	24	26	10	60	17.4
KN3	4	25	2	31	8.9
KN5	2	8	-	10	2.9
SK1	2	2	-	4	1.3
SPK	3	14	-	17	4.9

Source: Field Survey, 2004.

5.2.2 Women Attitude. According to Gender Socialization and Empowerment Theory**,** data set was collected to assess how women have managed the watershed. According to theory, attitude, which is included knowledge, understanding and willingness, are determined to analyze in behavior science to understand characteristics of people that limit or promote their resources management in watershed. In addition, attitude can easily be observed form opinion. To measure attitudes toward watershed management, respondents were asked to express their feeling regarding belief and knowledge about conservation practices in their daily life.

1.) Watershed Knowledge: The vital component of watershed management is people awareness and environmental perception, which based on individual's ecosystem knowledge. It could be clarified as follow:

- Hydrologic Cycle. The questions cope with the interrelation among soil, forest and water; evaporation, infiltration and precipitation.

- Green House Effect. The global warming questions cope with the four main source of green house effect - carbon dioxide (CO_2), methane (CH_4), nitrous

oxide (N_2O) and chlorofluorocarbons (CFCs), foe example forest fire. It is also included the effect of greenhouse gas like the rise in temperature of the earth, drought and soil erosion.

- Nutrient Cycle. The macro nutrients as C, H, and O which have cycles with an atmosphere store. Nutrient elements contributed by the surrounding environment i.e. atmosphere. Lithosphere and biosphere are lost to the sediments. The questions cope with essential nutrients from green plants through the process of photosynthesis such as plants growth.

- Energy Flow. According to the mention above, the growth of plants is also the basic source of energy for all living things. The locked energy in plant produces productivity to both itself and other secondary consumer. Hence, the question relates with increasing productivity in their farmland.

In this chapter, women in the Khwai Noi Upper River were asked about their knowledge and the results were interpreted according to criteria in table 3.8, the finding reported that in the whole picture, except for knowledge pertaining to the green house effect, women have good knowledge in every part of ecosystem such as hydrological cycle, energy flow, and nutrient cycle. However, when considered each stream reach by using Analysis of variance and Fisher's Least significant difference, there is no statistically significant difference. Women in up, middle and down stream reaches have similar knowledge, except on the matter of knowledge pertaining nutrient cycle (Table 5.11 – 5.12). It is apparent that women in middle stream/ Thong Pha Phum district and down stream/ Sai York districts expressed that they have more well knowledge pertaining nutrient cycle ($\overline{X}$ = 3.73, $\overline{X}$ = 4.00) than women in upstream/ Sangkhla Buri districts ($\overline{X}$ = 3.44). See table 5.14.

The reason why women in the Upper River Khwai Noi have less knowledge about green house effect is that among of green house gases, CO_2 is the most common gas, which comes from agriculture operations, for instance, deforestation for growing paddy and burning of fire woods or forest fire. Women in the study site believe that growing rice is the common tradition or social norms. Their ancestors did rice farming for ages and every household grows rice for its families. They do not believe that such practices contribute to the damaging of atmosphere, especially the rise in temperature of the earth. Moreover, they believe that growing rice is not the disruption of the plants and animals in the watershed. In focus group discussion, volunteer stated that "*We learn by watching our parents.*" In terms of forest fire, they revealed that forest fires are normal thing that occur and there is no impacts to global warming.

Nevertheless, the statistic also showed that women in middle stream/ Thong Pha Phum and down stream/ Sai York districts knew a lot in nutrient cycle, while Women in up stream/ Sangkla buri have less knowledge. Indeed, they did not know about scientific terms, but they knew that the essential nutrients for plant growth are soil fertility. In addition, best fertilizer comes from nature and unwanted grass never ruins farmland. However, volunteer in focus group discussion added that "*We did not do any activities in up welling area. Every year all of villager clean water way and fix community check dam. Doing so make soil black and our plants grow well."* Knowledge pertaining nutrient cycle is shown in figure 5.16.

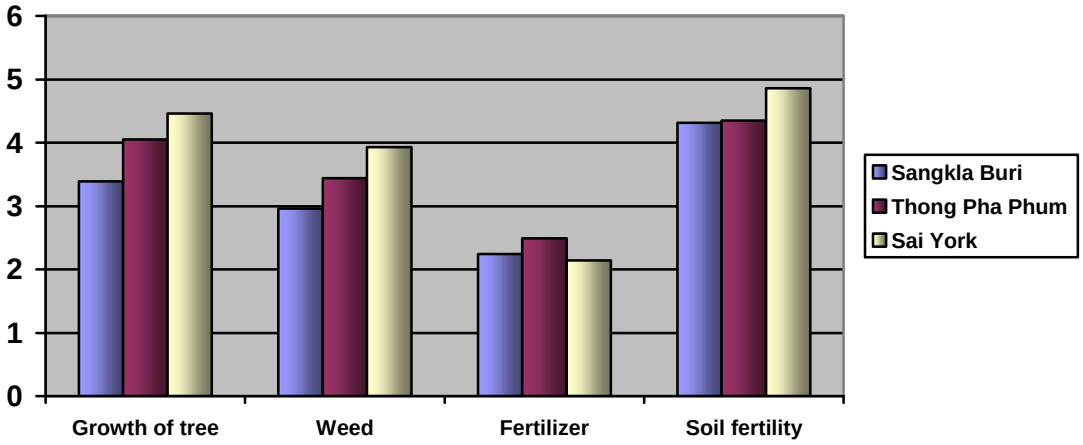


Figure 5.16: Mean Value Presents Nutrient Cycle Knowledge in the Khwai Noi Upper River

Source**:** Field Survey, 2004.

It is described that upstream is a reserve area, which is plenty of fertile forest and low density of village. Women in this area could find things for a meal in the forest nearby. Thus, they do not feel much about the shortage of soil fertility or the problem of tree's growth. Moreover, land holding for agriculture is small amount when comparing to the numbers of forest area. All pollutants were purified by environmental chemistry process. According to Gender Socialization theory, norms or social rule in up stream shaped women's opinion, which they derive from their blood ancestors. Thus, they have low worry in rapid growth of their plant. In contrast, the fertility of natural resource in middle and down stream is less than up stream, women were circulated the opinion about the tree growth. This detail will be discussed next in the race context.

The other reason is number of samples used in this study. 28 cases in down stream were compared to 169 cases in middle stream and 148 cases in up stream. This make the mean value is higher than ordinary case.

Table 5.14: Mean Value of Watershed Knowledge by Race in the Khwai Noi Upper River

Knowledge	**Sangkhla Buri** (N=148)			**Thong Pha Phum** (N=169)			**Sai York** (N=28)			**Total** (N=345)		
	Thai (N=104)	Non-Thai (N=44)	**Total**	Thai (N=159)	Non-Thai (N=10)	**Total**	Thai (N=28)	Non-Thai	**Total**	Thai (N=291)	Non-Thai (N=54)	**Total**
Hydrologic cycle	3.59	3.64	**3.60**	3.70	3.00	**3.60**	3.64	-	**3.64**	3.65	3.52	**3.65**
Greenhouse effect	2.06	2.27	**2.12**	2.24	2.10	**2.23**	2.18	-	**2.18**	2.17	2.24	**2.18**
Nutrient cycle	3.34	3.68	**3.44**	3.74	3.50	**3.73**	4.00	-	**4.00**	3.62	3.65	**3.63**
Energy flow	4.03	3.98	**4.01**	4.03	3.93	**4.01**	4.36	-	**4.36**	4.06	3.92	**4.04**

Remark: Non-Thai women = Karen, Mon, Myanmar, Lao and Paganyao

Paganyao = One caste of Karen. Paganyao has herself culture, which different from Pwo Karen in western part of Thailand.

Table 5.15: Analysis of Variance for Watershed Ecosystem Management Knowledge

Variables		S.S.	*df*	M.S.	F.	Sig.
1. Hydrologic cycle	Between Groups	.085	2	.042	.009	.991
	Within Groups	1611.869	342	4.713		
	Total	1611.954	344			
2. Nutrient cycle	Between Groups	126.294	2	63.147	10.028	.000*
	Within Groups	2153.602	342	6.297		
	Total	2779.896	344			
3.Greenhouse effect	Between Groups	13.183	2	6.591	1.503	.224
	Within Groups	1500.278	342	4.387		
	Total	1513.461	344			
4. Energy flow	Between Groups	24.164	2	12.082	1.549	.214
	Within Groups	2467.546	342	7.800		
	Total	2691.710	344			

*statistically significant = .05

Table 5.16: Fisher's Least Significant Difference for Knowledge Pertaining to Nutrient Cycle

	Sangkhla Buri	Thong Pha phum	Sai York
Sangkhla Buri	-	.93*	1.99*
Thong Pha phum	-.93*	-	1.06*
Sai York	-1.99*	-1.06*	-

*statistically significant = .05

When considered the social factor - the race - in each stream reach, it notices that most of women in the Upper River Khwai Noi got Thai identification card (84.3 %). Only 15.7 percent is non-Thai (Table 5.14). The detail of non-Thai women is shown in figure 5.17.

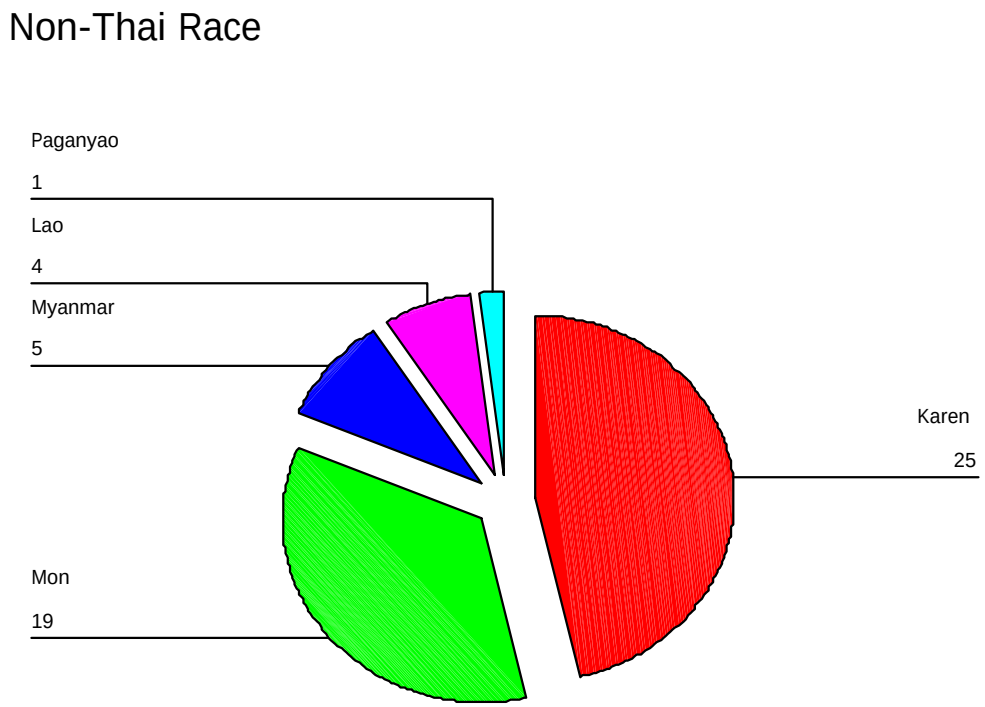


Figure 5.17: Frequency of Non-Thai Women Pertaining to Ecosystem Knowledge in the Khwai Noi Upper River

Source: Field Survey, 2004

The different between Thai and non-Thai ecosystem knowledge, which based on mean value, did not found much:

1) Upstream. The knowledge pertaining hydrological cycle, greenhouse effect and nutrient cycle between Thai and non-Thai women in Sangkla Buri is not much different. Non-Thai women have a little bit more knowledge than Thai women

except knowledge pertaining energy flow ($\overline{X}$ = 3.98, $\overline{X}$ = 4.03, respectively). Though, most of women here got Thai identification card, they are descendants of Karen and Mon. The traditional belief is still in their blood, especially Karen root.

Traditionally, Karen highly respects rice. They held the 'New Rice' ceremony every year and all the villages join the event. Everyone learn through the long continuous process of socialization that the rice grows well in good soil fertility; thus they shift their farm for 3-5 years before restoration. This is the focal base of environmental attitude. Besides, they also believe in supernatural beings, which had been reproduced by elder. They believe that lord or guardian spirits own natural environment. As mention in Boonpinon's study, Karen does not cut the big tree, and build their settlement near the catchment area, which cut off the ecosystem cycle (Boonpinon, 1997).

The way of practice of Mon is different from Karen. Indeed, the Mon and Thai's custom is not different, since they pay a high respect to the Buddhist institution. Traditional Mon society is patriarchy. It only portrays women in household work. Women had their duties like collecting fuel wood; carrying water from stream for using at the house and have no right to do their agriculture without their family's head guiding.

However, Karen, Mon and Thai women have the same characteristic in respond with public sphere. They are too much silence and silence is too often understood to indicate acceptance.

In terms of energy flow, Thai women know a little bit more than non-Thai women. This related to family livelihood. Unlike Karen, which settles their community in the forest, Thai women in rural area firstly seek their meal from stream and their household garden. In case of not enough, they go to nearby forest. They found that long distance in finding their food means low biodiversity in their forest. It can be described in scientific terms that carbon assimilation process, which contain chemical energy, in each food web is low. However, it can say that mostly Thai and non-Thai

women have the same way of living in private sphere. There have nothing different especialy a nature loving way of live. The other reason is the difference of proportion of sample make mean value high than common.

2) Middle stream. The statistic showed that Thai women have more knowledge than non-Thai women in every part.

3) Downstream. There is no comparison between both two races due to the fact that only Thai women live in Sai York district. Moreover, among 28 cases, it showed that 21 cases are natively born and 7 cases are new comer.

2.) Understanding about Resource Change in Watershed: Environmental change perceptions play a key role in forming responses to environmental behavior. In addition, Eco-Feminist indicated that there are important connections between gender roles and perceptions of environmental change. One way to measure and describe environmental change is to explore people's perceptions of change in the environment.

Respondents were also asked to make observations and evaluate three basic natural resources - forest, water and soil or land resources around themselves. According to their comparing to five years ago, women perceived that there were the pessimistic change in soil, forest and water resource ($\overline{X}$ = 3.53, $\overline{X}$ = 3.46, $\overline{X}$ = 3.36) (Table 5.17).

Table 5.17: Mean and Standard Deviation for Understanding about the Change in Watershed

The change in watershed compared to 5 years ago	**Sangkhla Buri** (N=148)		**Thong Pha Phum**(N= 169)		**Sai York** (N=28)		**Total** (N=345)	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
1. Soil	3.39	.846	3.64	.869	3.57	.690	**3.53**	.852
2. Forest	3.39	1.034	3.50	.887	3.64	.989	3.46	.961
3. Water	3.34	.886	3.31	.733	3.68	.476	3.36	.791
Total	3.06	.935	3.02	.873	3.21	.568	3.06	.879

Considering each stream reach by using Analysis of variance and Fisher's Least significant difference, women in up stream, middle stream and down stream reaches have similar watershed knowledge, except the soil change (Table 5.18-5.19). It is apparent that women in Thong Pha Phum districts perceived that the quality soil is slightly worse, the area of forest is decrease when compared with the last five years ago. In focus group discussion, volunteer stated that "*The quality of soil is much worse than five years ago. The women with agriculture career address that fertilizers and pesticides contribute to soil erosion as well as water pollution. The soil is reddish brown and we can not grow vegetables. Moreover the ground water is ironic color and clogs our pot. Only concerned people are concerned about the negative impacts pesticides on the environment, particularly the contamination of drinking water sources. However, people always concern economic over than environment.*"

Table 5.18: Analysis of Variance for Understanding about the Change in Watershed

Variables		S.S.	*df*	M.S.	F.	Sig.
1. Soil	Between Groups	4.879	2	2.439	3.404	.034*
	Within Groups	245.110	342	.717		
	Total	249.988	344			
2. Forest	Between Groups	1.997	2	.999	1.082	.340
	Within Groups	315.724	342	.923		
	Total	317.722	344			
3. Water	Between Groups	3.236	2	1.618	2.612	.075
	Within Groups	211.912	342	.620		
	Total	215.148	344			

*statistically significant = .05

Table 5.19: Fisher's Least Significant Difference for Understanding about the Change in Watershed

	Sangkhla Buri	Thong Pha phum	Sai York
Sangkhla Buri	-	.25*	.18
Thong Pha phum	-.25*	-	-.07
Sai York	-.18	.07	-

*statistically significant = .05

The results showed that women perceived environmental change. They indicated that the quality of soil is slightly worse; there is a lot of deforestation when compared with the last five years. According to Gender socialization theory, household roles make women close to the environment; as a result, they are the first person affected by the negative environmental impact. In Buadaeng's study, for example, she found that Karen women knew that upland fields are exploited every year because a

little number of rice their family bring to join the 'New Rice' ceremony (Buadaeng, 2001:84).

This connection between women and environment is formed by social process. Social positions women in private sphere. To make their household's member healthy, rural women need to find enough food in forest area or household. This drives they know the environment's situation (Agarwal, 1992). However, it can be summarized that distinct patterns of resource requirement and use through public sphere results women concern about their surrounding situation and environment

3.) Willingness to Manage Watershed: Based on the values of the mean in table 5.20, the finding reported that women in up stream, middle stream and down stream are mostly willing to cooperate with agency that has a good record of environmental performance i.e. Green Peace in watershed management ($\overline{X}$ =3.68). Beside, they said that they are willing to sacrifice their budget and time and reduce harmful activities in their household in moderate level ($\overline{X}$ =3.20, $\overline{X}$ =3.22 respectively). On the other hand, they are willing to follow the community in low level ($\overline{X}$ =2.21).

Table 5.20: Mean and Standard Deviation for the Willingness to Manage Watershed

Willingness	**Sangkhla Buri** (N=148)		**Thong Pha Phum**(N= 169)		**Sai York** (N=28)		**Total** (N=345)	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
1. Join reputation environmental organization	3.64	1.272	3.64	1.121	4.07	1.184	3.68	1.200
2. Sacrificed budget and time	3.09	1.155	3.18	1.138	3.96	1.138	3.20	1.165
3. Reduce harmful activities	3.09	1.269	3.22	1.147	3.86	1.079	3.22	1.209
4. Follow community rule	1.99	1.438	2.32	1.215	3.00	1.700	2.21	1.383
Total	3.39	.822	3.31	.900	4.00	.861	3.40	.881

Considering for each stream reach of watershed by using Analysis of variance and Fisher's Least significant difference, there is statistically significant difference in willingness to sacrifice budget and time, reduce harmful activities in household and follow community rule for watershed management. Women in down stream/ Sai York district have the most willingness to follow community rule, reduce harmful activities and sacrifice budget and time ($\overline{X}$ = 3.00, $\overline{X}$ =3.86, $\overline{X}$ =3.96 respectively).

When comparing between middle stream/ Thong Pha Phum and upstream/ Sangkla Buri, it found that women in middle stream are more willing to reduce harmful activities in household, sacrifice budget and time and follow community rule than women in up stream ($\overline{X}$ = 2.32, $\overline{X}$ =3.18, $\overline{X}$ = 3.22, respectively). See Table 5.21 - 5.22 and Figure 5.18.

Table 5.21: **Analysis of Variance for the Willingness to Manage Watershed**

Willingness		**S.S.**	***df***	**M.S.**	**F.**	**Sig.**
1. Join reputation Environmental Organization	Between Groups	4.781	2	2.390	1.666	.191
	Within Groups	490.820	342	1.435		
	Total	495.641	344			
2. Sacrificed budget and time	Between Groups	18.433	2	9.246	7.047	.001*
	Within Groups	448.707	342	1.312		
	Total	467.200	344			
3. Reduce harmful activities	Between Groups	13.692	2	6.846	4.788	.009*
	Within Groups	489.004	342	1.430		
	Total	502.696	344			
4. Follow community rule	Between Groups	27.503	2	13.751	7.464	.001*
	Within Groups	630.051	342	1.842		
	Total	657.554	344			

*statistically significant = .05

Table 5.22: Fisher's Least Significant Difference for the Willingness to Manage Watershed

●Sacrificed budget and time	Sangkhla Buri	Thong Pha phum	Sai York
Sangkhla Buri	-	.90	.88*
Thong Pha phum	-.09	-	.78*
Sai York	-.87*	-.78*	-
●Reduce harmful activities			
Sangkhla Buri	-	.12	.76*
Thong Pha phum	-.12	-	.64*
Sai York	-.76*	-.64*	-
●Follow community rule			
Sangkhla Buri	-	.33*	1.01*
Thong Pha phum	-.33*	-	..68*
Sai York	-1.01*	-.68*	-

*statistically significant = .05

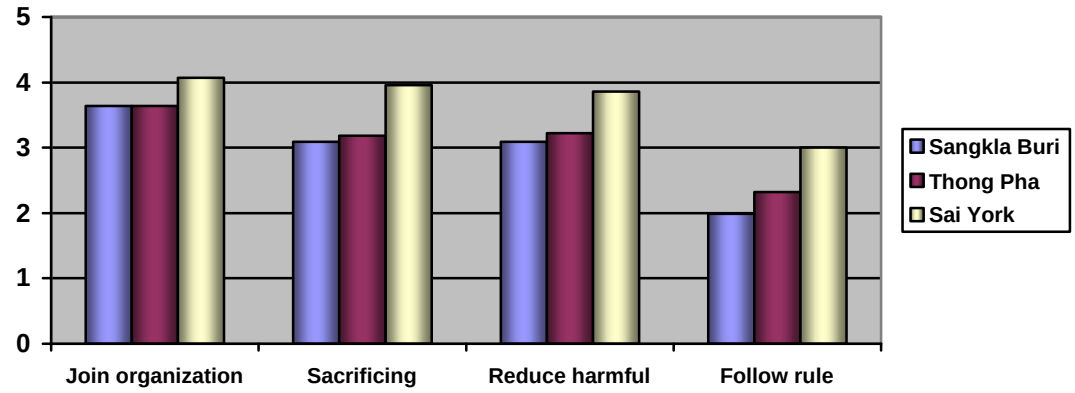


Figure 5.18: Mean Value Presents Women's Willingness to Manage in the Khwai Noi Upper River

Source: Field Survey, 2004.

In terms of willingness, the findings from this study revealed that although the total means score of willingness is in moderate level, women are willing to join and cooperate with reputation environmental organizations to manage their watershed. This is because the activities of reputation environmental organizations were trusted by social that they can better manage watershed situation than those without name. In turn, social process, which is social norm, control perception of people in society and transmit back in form of knowledge to individual including women as Gender Socialization theory has said. Besides, it found that they are still willing to sacrifice budget and time, reduce harmful activities in household to maintain their watershed situation. Ecofeminist like Agarwal (2001) and finding from Bridges study (2001) described that doing so is because women play role as mothers and care-givers which desire for better life of their household. Hence, they are ready to join watershed conservation activities.

5.3 Hypotheses Testing:

This study has three research questions and hypotheses:

5.3.1 Hypothesis: Women perceive the situation of their watershed through women groups meeting within watershed site.

This testing answers question number 1: Through the lens of gender, whether women know watershed condition near their habitat is, by which information flow – paths.

- Results

1.) Watershed situation perception. The previous finding from questionnaire and focus group discussion showed that women in upstream, middle stream and downstream know the watershed situation. They felt that there was the

change in their water quality and quantity, forest area and soil fertility. Five parameters from table 3.6 and watershed situation score in table 3.7 are used to evaluate the watershed situation, the result from GIS provides evidence that the existing watershed situation is in crisis, risky and warning level, respectively.

- Up stream. From the table 5.19; women in Sangkhla Buri district understand that there are the change in soil, forest and water resource in their watershed. Based on frequency, compared to five years ago, most of women feel that soil quality is bad; there is moderate volume of sediment in stream, and they use more fertilizer in their farm. In terms of water quantity and quality, women in up stream feel that the volume of water and flow of water in year round is at moderate level; but the transparency of water in first half year is good. This is accorded to result in figure 4.7, which showed that volume of is much in 2nd half year. In addition, they feel that the water is not safe to drink. Finally, in terms of forest, most of them feel that the volume of deforestation is in most level; moreover, they found that the number of tree species in the forest is decreased. The detail is shown in table 5.23.

Table 5.23: Understanding in the Change of Soil, Water and Forest of Women in Upstream Area

The Changes of resource in Sangkhla Buri	**Number of agreement (N=148)**				
	Worst/ Least	**Bad/ Less**	**Moderate**	**Good/ Much**	**Very well / Most**
● Soil resource					
1. soil quality	39	**41**	37	14	17
2. volume of sediment	16	20	**47**	21	44
3. fertilizer utilization	21	17	33	**35**	42
●Water quantity and quality					
1. volume in 1st half year	21	30	**51**	23	23
2. volume in 2nd half year	22	22	**53**	33	18
3. transparency in 1st half year	16	18	44	**50**	20
4. transparency in 2nd half year	26	23	**47**	35	17
5. flow in 1st half year	15	23	**56**	28	26
6. flow in 2nd half year	26	21	**48**	40	13
7. clean enough to drink	**54**	33	26	18	17
●Forest resource					
1. deforestation	23	28	29	19	**49**
2. tree species decreasing	20	32	29	**42**	25

Due to the fact that most of up stream area is in class 1A, which is head water resource in conservation forest, It is rich of water resource and forest area. Women in this area do not feel much about the natural resource change. However, the original root of majority women here is Karen. Karen community treats women in only private sphere. Women have traditional direct role in take care their family member in food provider and teaching their offspring. Even though the development project and modernization have come to their land, the way of life change little bit, namely women have more roles in production, especially for their family farm. However, there are clearly border line between Karen women and man in production role. Karen women concentrate on upland farming, while Karen man concentrates on constructing terraced field (Vichitporn, 2001: 1).

The perception of women is also proved in terms of spatial data. The finding from table 5.19 and figure 5.4 showed that soil loss area in up stream is 29.4 percent of the total area; moreover, 63.6 percent of majority area is in risk. In addition forest area continuing decreased from 1990 to 2000. Besides, Office of Environmental Policy and Planning (1996) also found that the dissolved oxygen (DO) value is 5.6 milligram/ litre, which is higher than 5 indicates water of doubtful purity (the standard is 5 milligram/ litre).

- Middle stream. Majority of women in Thong Pha Phum district feel that soil quality is low and sediment is in moderate level. In addition, they feel that they put a lot of fertilizer in their farm. In terms of water, they feel that volume of water, transparency of water and flow of water is in moderate level, but the water is not clean enough to drink. However, they understand that the deforestation is in moderate level and the large volume of tree species is decreased. The data is shown in table 5.24.

Table 5.24: Understanding in the Change of Soil, Water and Forest of Women in Middle Stream Area

The Changes of resource in Thong Pha Phum	Number of agree ment				
	Worst/ Least	**Bad/ Less**	**Moderate**	**Good/ Much**	**Very well / Most**
● Soil resource					
1. soil quality	28	**58**	38	22	23
2. volume of sediment	17	20	**68**	33	31
3. fertilizer utilization	11	11	31	**49**	67
●Water quantity and quality					
1. volume in 1st half year	30	40	**52**	39	8
2. volume in 2nd half year	19	31	**62**	48	9
3. transparency in 1st half year	19	33	**70**	36	11
4. transparency in 2nd half year	17	37	**55**	40	20
5. flow in 1st half year	17	32	**60**	46	14
6. flow in 2nd half year	12	36	**60**	47	14
7. clean enough to drink	**54**	33	52	23	7
●Forest resource					
1. deforestation	19	32	**49**	33	36
2. tree species decreasing	14	33	41	**58**	23

Thong Pha Phum district or middle stream is dulating area. In this area the perennial stream comes to join the river at Tha Kanun sub district and flow through the south. Majority of women original live here; some of them migrate from other district in Kanchanaburi province like Muang district. Likewise the eastern culture, the rural tradition here limits women in household sector. Women's voice is not loud in community activity. The spatial data proof shows that soil loss area is 42.0 percent of the total area and majority area is in risk and crisis. In terms of forest area, it shows that there is deforestation from 1990 to 2000. However, the data of water quantity and quality of this area is according to up stream area. It meant that the water does not a little bit purify.

- Downstream. According to the proportion of population, the sample of down stream is 28 cases. As a result, the output might not be the best; when it is compared to the middle and up stream area. However, majority of women in down stream feel that soil quality is in moderate level, but volume of sediment in their stream is much. Nevertheless, they feel that in this time they use a lot of fertilizer in

their farm. In terms of water quantity and quality, women in down stream feel that in the first half year, which is in dry season, the volume of water is less than the second half year. Similar to the transparency of water, they feel that the second half year is better than the first half year. While flow of water on year round is the same – moderate. Like the up and middle stream, they feel that the quality of water is low and can not drink. Moreover, they still feel that the deforestation is in moderate level and there is a lot of tree species in the forest. The data is shown on table 5.25.

Table 5.25: Understanding in the Change of Soil, Water and Forest of Women in Downstream Area

The Changes of resource in Sai York	**Number of agree ment**				
	Worst/ Least	**Bad/ Less**	**Moderate**	**Good/ Much**	**Very well / Most**
● Soil resource					
1. soil quality	4	7	**10**	3	4
2. volume of sediment	6	5	3	**9**	7
3. fertilizer utilization	2	-	7	6	**13**
●Water quantity and quality					
1. volume in 1st half year	-	**10**	8	5	5
2. volume in 2nd half year	3	4	**12**	6	3
3. transparency in 1st half year	1	6	**10**	8	3
4. transparency in 2nd half year	-	4	7	**10**	7
5. flow in 1st half year	1	7	**11**	4	5
6. flow in 2nd half year	1	6	**8**	**8**	5
7. clean enough to drink	**10**	6	5	5	2
●Forest resource					
1. deforestation	2	5	**9**	7	5
2. tree species decreasing	5	3	4	6	**10**

Down stream is gentle sloping flat area, which suit for up land farming to low land farming. The characteristic of women here is similar to the middle stream. Most of them original settle here and they belief in rural norm in rural tradition. Women are muted person in rural society. However, the spatial data proved that there is soil loss area 42.3 percent and the situation in this area is mostly crisis and risk.

In focus group discussion, volunteer from up, and middle and down stream together revealed that" *We would say a local impact first, because that's basically our responsibility. We know there are the changes in our habitat. We would hope that there are others who have the charge and responsibility to look at the watershed overall. We're one of the pieces in the pie. In addition, we can do not much because no titles support us. "*

Those practices are described by the theoretical model of ecofeminism, which related to ideas of women's household function and nature system. Ecofeminists claims that connection of women and the environment is formed by social process. That so-called Gender Socialization Theory places men over women and the environment. Women were expected to be good home maker. Their responsibility is fixed in private sphere, which concerned about food security of family. Thus, the driving force variable affected to women's behavior is attitude, which comprises of knowledge, understanding and willingness.

The study result showed that women perceive the change of natural situation. This finding is consistent with Bridges (2001) who study role of farm women with the environment. She explained that it is because women's work within the realms of nature, subsistence production and reproduction allows them having environmental perspectives or outlooks. Although, the transformation from economy to an urbanized industrial economy altered women work pattern, for example it drive women earn money for the family enterprise by working outside such as factories, stores and school, they are much more involved with household's tasks. Moreover, women attitude toward natural resource management issues is not different. In practice, women still invest a significant amount of energy in household work or perform traditional roles of the past. It is obvious that they often raise gardens and animals for household to insure adequate supplies of high quality foods. Domestic work and maternity role is the stimuli, which push women concern about family member's health, they, therefore, produced various vegetable gardens, which has minimized impact on the environment; as a result that they believed no chemical usage could ensure family health because it decreases the risk of such concerns as groundwater contamination.

As the matter of fact that they closed to the nature, women have strong sense about natural impact, for example, women in agriculture career have strong sense of land stewardship and more concerned about the participation than those in around agriculture career. Manure preparation, soil treatment, seedling transplantation, sowing, irrigating, harvesting, weeding, processing, guarding, etc is the task of farm women do according to Bridges' finding (Bridges, 2001).

As mention in Gender socialization theory, women generally were shaped by society. Their action takes place within the frameworks of cultural norms, status position and role relationships. Female are occupied as maternity, nurturer and care giver due to the gender division of labor. This strong of stewardship sense is social taboo, especial patriarchy society in South East Asia.

The role of women is social discourse, which has seen in the post-World war II period which has seen in the post-World war II period (Melkote and Steeves, 2001: 186). Women were expected to be good housewife in both family agriculture and family domestic work (cleaning, food preparation and childcare etc). Although the study finding of Krajangwonga found that women are more prone to work outside for wages and salaries, they are much more involved with household's tasks (Krajangwonga, 2001). Women attitude toward watershed management issues is not different. The results of this study are consistent with the findings of previous researchers who examine the relationship between gender and environmental concern such as Wongthed, 1991; Sharma 1994; Burger, 1998; Buadaeng 2001; Shirk-Luckett, 2000.

It is believed that if women are more concerned about the environment, they may be inclined to encourage the management behaviors. Some feminist literature maintains that material realities of women, such as their daily activities, are the underlying basis for a special relationship between women and the environment. Moreover, it is said that women can also offer a unique vantage point for creating a new kind of culture and politics where intuitive, spiritual and rational forms of women

knowledge can be integrated in order to eliminate the dichotomy between nature and culture that exists in many societies.

In summary, the finding shows that women understand the situation in their watershed; although they do not how to prove by scientific methods. Thus, this finding, which described in the previous chapter, supported the theoretical model used to guide this study.

2.) **Information flow path**: The information is this part comes from 32 volunteers in focus group discussion. They were asked to sketch their activities for finding information path. Then, complete figure was drawn to confirm their comment and together discuss information flow - path through women in the Upper River Khwai Noi. Twenty – four hour cycle of women's activities was evaluated (Table 5.22). Finally, data flow diagram was presented within this group, which divided onto two sections: inside and outside community (Figure 5.11 -5.12 and table 5.23).

- Inside Community. It indicated that environmental information flows to women via many entities. Volunteer cited head of family is the major determinants of family matter, including environmental condition data. But because of their limited experience with water, soil and forest quality issues, all volunteers reported that they rely on head of village. The other source is head of village "*Puyai Baan* (in Thai) *who is a person telling what to do and do not in community. In our view, head of the village has two important functions. First, he is the elder who have more indigenous knowledge and govern us by using law.*"

Their peer is another source of information. This kind of resource is the most influence on women's opinion in watershed management, especially unofficial group. Volunteer added that"*There are many women groups, which government established i.e. women's weaving group. But every woman in village does not join this group because its activity does not fit their every day life. Moreover, those official group ends when official go back. In our community women gather in group when we finished our home burden, but not everyday. Generally, the group started at the elder women's*

house and women nearby come to join. Our group critiques every matter in our community from funny issue to serious issue. We sometimes gather to help temple activity and consult with Abbot. " See figure 5.20.

From discussion above, it can say that women in unofficial group meeting is focal information path way which transmit all data regarding their daily community's activity. This is because most of rural women devoted day time for domestic function, which started in the morning and nearly finished in the afternoon. They have a few moments before preparing their dinner for household's member. Thus, to join conservation with other women is the popular way. According to Toopgrajank (2001) and Padunchewit (2002), communication is human behavior which occurs to transmit knowledge, attitude and regulation for making better understanding through receiver. Unofficial women's meeting group is oral communication, which is an effective tool for making decision in watershed management. This channel should be empowered women in participation activity.

Table 5.26: Twenty – four Hour Cycle of Women's Conventional Activities

A.M.	
5.30	Wake up
7.00	Food preparation, simply cooked is generally made.
9.00 – 16.00	- In case of farmer, go to the fields with lunch - In case of hired labor and government official, go to work - In other occupations, take care of small kid, visit neighbors, who also stay home
A.M-P.M.	
16.30	Collecting food materials from field, forest nearby, and other places for dinner and next morning's breakfast
18.00	Bath, food preparation and cooking, having dinner
19.00	Chatting with household member, consulting
20.00	Go to bed

Source: Field Survey, 2004.

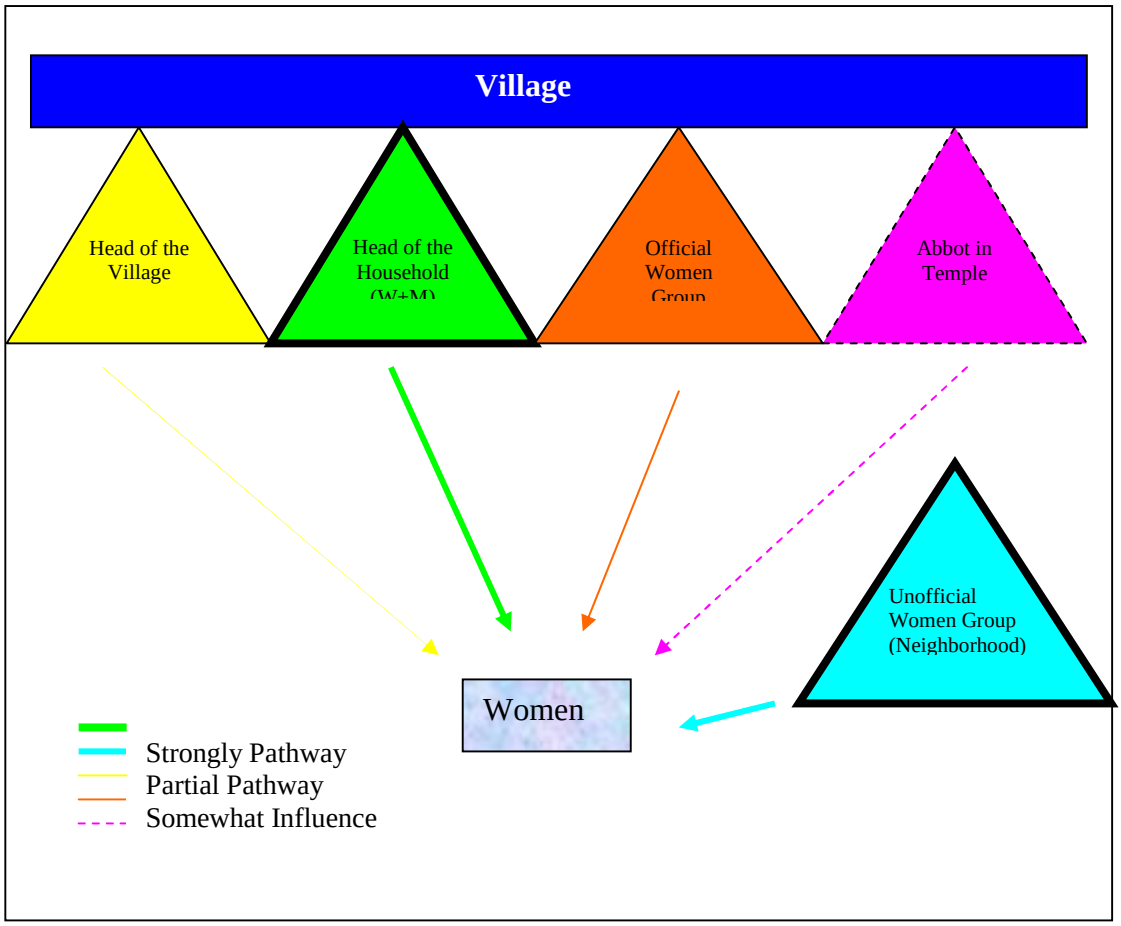


Figure 5.19: Inside Community's Information Path

Source: Field Survey, 2004.

Top: After finished their daily household work, women gather in group meeting

Middle: Some neighborhood joins the group meeting with deserts

Bottom: Senior men occasional join women meeting and discussion

Figure 5.20: Women Unofficial Group Meeting

Source: Field Survey, 2004.

- Outside community Government officials are not mainly found much in this area; as a result its geography is mountainous area and makes it hard to transport. However, head of the village is the significant government official. In addition, the most frequently cited entities are some government agency - Tambon Administrative Council staff, forestry officers, representatives from the Ministry of agriculture and Cooperatives and the Ministry of Interior.

Volunteers revealed that "*Sometimes we have to listen outside. You know we are laypeople; we do not know everything happen outside our house. Then, we need a person who knows our situation and outside world. It is beneficial if there is someone interprets and bridges the gap. However, the outside help is not continuing. They come with budget or technical assistance and disappear when finish their job*." Nevertheless, volunteer together identify group or agency that they relied upon for information. Frequency cited was reported in table 5.27.

Table 5.27: Outside Community's Information Path

Agency	**Agency Group's name**	**Frequency of visited***
1. Non government organization	1. Pattranarak (Kanchanaburi) 2. Rajabhat Kanchanaburi 3. Cooperation group	19 20 16
2. Government organization	1. Soil Doctor program (MOA.) 2. Public Health volunteer program (MOPH.) 3. One tambon one product (MOI) 4. Watershed conservation dept.	32 28 22 26

Remark: * the frequency comes from 32 volunteers in focus group discussion

MOA = Minister of Agriculture

MOPH = Minister of Public Health

MOI = Minister of Interior

5.3.2 Hypothesis: Women manage natural resource through their household role.

This testing answers question number 2: How women manage natural resources in watershed through their role?

- Result

Due to the fact that social placed women on household role in the so-called Gender Socialization theory and the concept of ecofeminist said that women depend on natural resources in terms of food provider and household function, this study was classified women participation in watershed management within household function, according to FAO (2003) and Amstein (1995). Multi-factor ANOVA was used to find the relationship between household role and off household role within watershed management participation.

1.) Natural Resource Management. Women in the whole watershed participate in different levels. However, the proportion of the sample in this study is accorded to the population of whole watershed. That impact down stream has 28 cases, while up and middle stream has 148 and 169 cases and impacts the mean value. To give the explicit scenario, the result is presented in number of case.

- No participation level. It revealed that one - fourth of the women in up stream participate at extreme high level (48 cases). A little bit more than a quarter of women in middle stream participate in moderate level (55 cases), while half of women in down stream participate in high level (14 cases).

- Join planning level. 49 cases in up stream reported that they participate in slightly low level; as the same number of cases in middle stream reported that they participate in moderate level. 13 cases of down stream women participate in moderate and high level.

- Decision making. 59 cases of women in up stream reported that they participate at moderate level, while 79 cases in middle stream and more than half of women in down stream reported that they participate at extreme high level. Detail is shown in table 5.28 and figure 5.21 – 5.23.

Table 5.28: Frequency and Percentage for Participation Level of Women in the Khwai Noi Upper River

Variables	**Sangkhla Buri** (N=148)	**Thong Pra Phum** (N=169)	**Sai York** (N=28)	**Total** (N=345)	
	Frequency	Frequency	Frequency	Frequency	%
1. No participation*					
Low	5	6	-	11	3.2
Slightly low	30	27	1	58	16.8
Moderate	40	55	8	103	29.9
High	25	47	14	86	24.9
Extreme High	48	34	5	87	25.2
2. Join Planning					
Low	15	15	1	31	9.0
Slightly low	49	45	-	94	27.2
Moderate	37	49	13	99	28.7
High	20	36	13	69	20.0
Extreme High	27	24	1	52	15.1
3. Decision Making					
Low	6	7	1	14	4.1
Slightly low	7	10	-	17	4.9
Moderate	59	39	3	101	29.3
High	18	34	8	60	17.4
Extreme High	58	79	16	153	44.3
Total	148	169	28	345	100

Remark * women act underneath Government controlling e.g. they come to join activity but not make decision and join planning

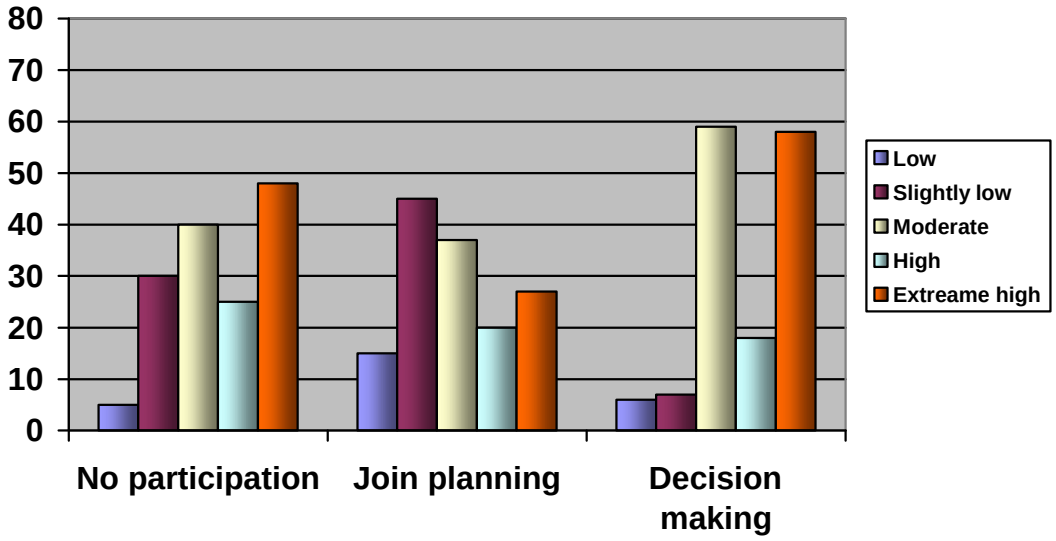


Figure 5.21: Degree of Women Participation in Different Level of Upstream Area

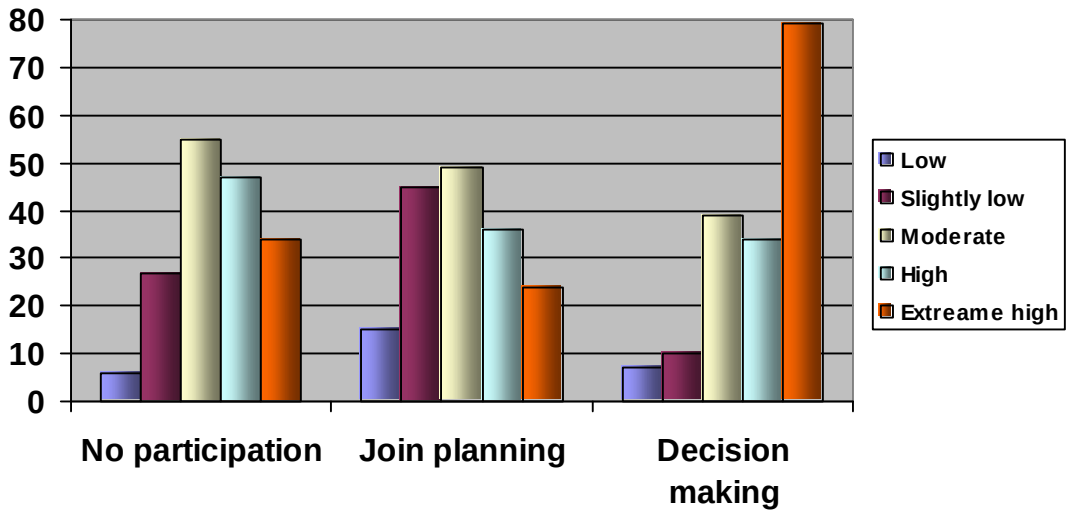


Figure 5.22: Degree of Women Participation in Different Level of Middle Stream Area

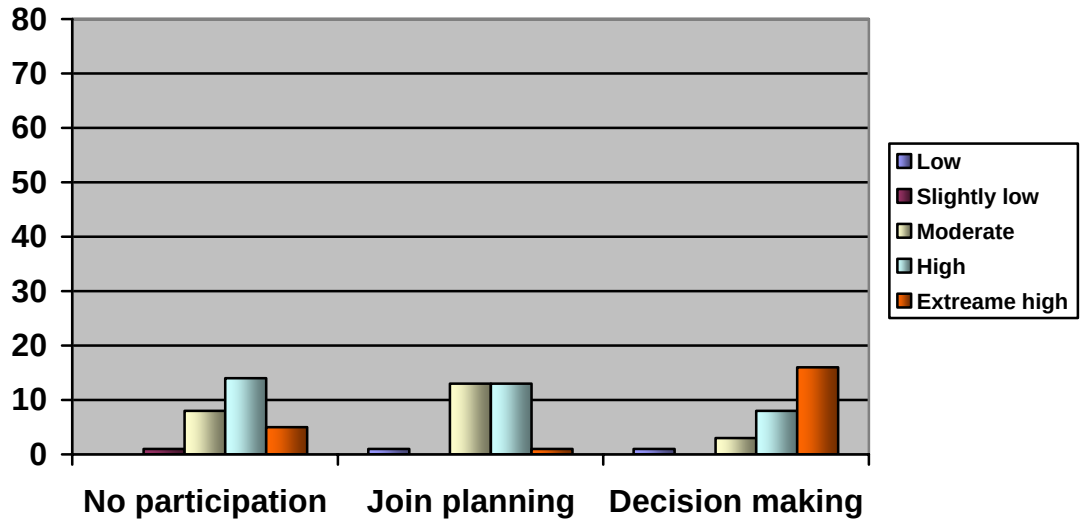


Figure 5.23: Degree of Women Participation in Different Level of Downstream Area

2.) Household Role. It showed that women in upstream, middle stream and downstream involved with domestic responsibilities (53.9 %), childcare (25.5 %) and family farm (20.6 %). When asked about off-household work, most of women in upstream, middle stream and downstream said that they work in commerce and had been hired labors (79.1 %). Only 20.9 % of women in the whole watershed work in community. See table 5.29.

Table 5.29: **Frequency and Percentage for Women Role in the Khwai Noi Upper River**

Role	**Sangkhla Buri** (N=148)		**Thong Pra Phum** (N=169)		**Sai York** (N=28)		**Total** (N=345)	
	No.	%	No.	%	No.	%	No.	%
1. Household work								
Family agriculture	30	8.7	39	11.3	2	0.6	71	20.6
Family domestic work	84	**24.3**	84	**24.3**	18	**24.3**	186	**53.9**
Childcare	34	9.9	46	13.3	8	13.3	88	25.5
2. Off household work								
Community work	27	7.8	35	10.2	10	**2.9**	72	20.9
Other	121	**35.0**	134	**43.8**	18	0.3	273	**79.1**

It is obvious that women catered the role as home extension such as wives, mothers and family income earning support. This finding is similar to Shirk-Luckett's study that women still respond in household, although they earn money from off – household sector (Shirk-Luckett, 2001).

3.) Household Role and Watershed Management Participation. After used Multi-factor ANOVA to test the influence of household work and off-household work on watershed management participation (Table 5.30), it showed that in the Upper River Khwai Noi, neither women work in household nor off-household participate in watershed at the same level. Lines in Figure 5.24 are parallel, which interpreted that there is no relation between them.

Table 5.30: Multi-factor Analysis of Variance of Women Role and Participation

Variables		**S.S.**	***df***	**M.S.**	**F.**	**Sig.**
1. Household work	Between Groups	18.808	104	.181	1.137	.211
	Within Groups	38.165	240	.159		
	Total	56.974	344			
2. Off household work	Between Groups	55.906	104	.538	1.262	.075
	Within Groups	102.256	240	.426		
	Total	158.162	344			

*Statistically Significant = .05

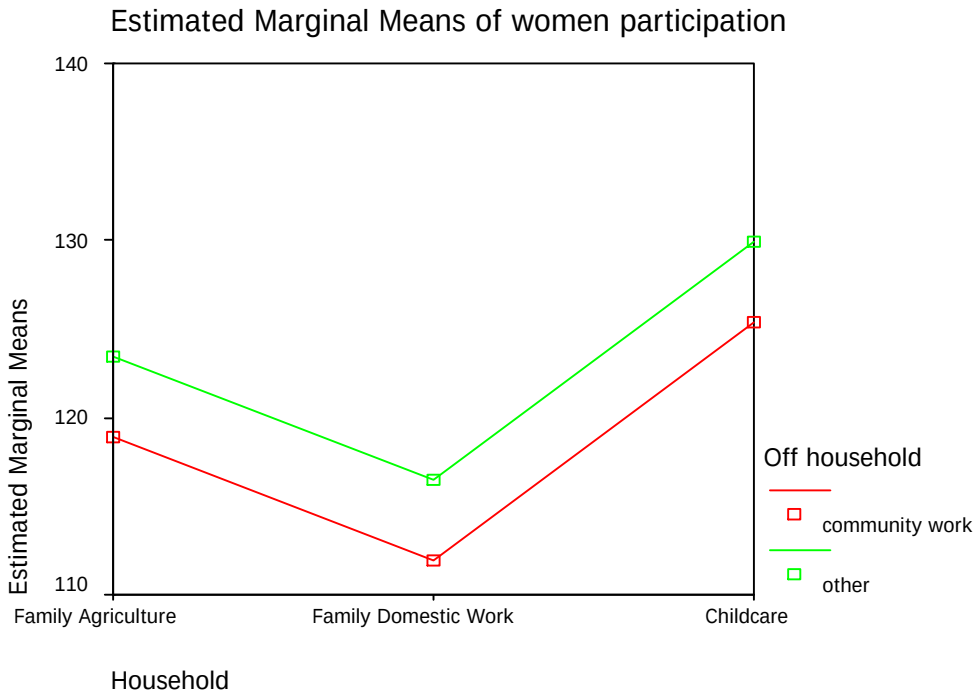


Figure 5.24: Tests of Between-Household and Off Household Effects on Women Participation

5.3.3 Hypothesis 3: Attitude, Partnership, Identity and Communication approach is related to women empowerment in support of watershed management

This hypothesis answer question number 3" What factors empower women participation in watershed management?"

- Result

Firstly, Multi – factor ANOVA was used to determine the correlation between independent variables - attitude, partnership, identity and communication approach and women's participation in watershed management activities. Then, MCA was repeatedly used to calculated coefficients of predictor variable - attitude, partnership, identity and communication approach and covariance - demographic data with women's participation in watershed management activities.

1.) Partnership. Women in the whole watershed work together with Non government organization, Government organization and Academic Institute at high level ($\overline{X}$ = 4.02). Volunteer added the opposite idea that *"We feel it is very much a one-sided affair because this is just like me coming into your house and telling you how to live there. Most of our stakeholders always do so. It is wrong."* However, officials in some agencies are also responsible for providing support to women, in particular, housewife who request money for their expense in household.

2.) Identity. Women in the whole watershed have identity in moderate level ($\overline{X}$ = 3.11). Volunteer expressed their idea that "*Not every women think about conservation. We do nothing if we face survival problem. No food for our children and no money for our family. If we success in that problem, the environmental problem come into our head. Moreover, if we always lean on other people, we can not have our own way. "*

3.) Communication approach. The result found that women in the whole watershed used communication's media at moderate level ($\overline{X}$ = 2.64). Radio and television are media, which they used most. In this case, volunteer in focus group discussion added that *"In the past, our community did not have the electricity; we listen to the radio. Now we watch television instead. Every evening after our children arrived from school; we watch the play. Community tower broadcasting did not work nowadays. However, it is one way communication, staring from the top to down; so, we can not respond our concerns. The place that we can exchange our view is inter personal communication, especially in our group"*

4.) Attitude. All details have been present in section 5.1.However, the result was summarized that women in the whole watershed have good ecosystem knowledge, especially hydrological cycle and energy flow, but less in greenhouse effect issue. They also understand the watershed situation. The worse situation of water, deforestation especially soil infertility. Moreover, they are willing to join reputation environmental organization to manage their watershed. This finding is accorded to Cordano's study that behavior is influenced by attitude. He concluded that environmental knowledge can initiate and sustain a person's orientation to protect and participate in environmental issue (Cordano, 1998). In 1999 Bowler, Kaiser and Hartig also found out that positive environment attitudes contribute towards environmental conservation and they established Attention Restoration Theory (Bowler, Kaiser and Hartig 1999: 19-26). See table 5.31.

Table 5.31: Mean and Standard Deviation for Predictor Variables of Women in the Khwai Noi Upper River

Partnership	**Sangkhla Buri** (N=148)		**Thong Pha Phum**(N= 169)		**Sai York** (N=28)		**Total** (N=345)	
	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**
1. Knowledge and supervise by NGO	4.42	1.658	4.08	1.769	4.50	1.552	4.26	1.710
2. Knowledge and supervise by GO	4.01	2.207	4.27	2.095	4.53	.920	4.26	2.105
3. Knowledge and supervise by Academic	3.98	2.098	4.10	1.942	4.64	1.890	4.09	2.008
Total	3.99	1.904	3.94	1.765	4.64	1.193	4.02	1.794
Identity								
1. Problem facing	3.86	.908	3.85	.859	3.57	1.069	3.83	.891
2. Self reliance	3.82	.871	3.94	.800	4.21	.917	3.91	.845
3. leadership	4.20	.816	4.41	.631	4.75	.441	4.35	.720
Total	2.96	.947	3.20	.854	3.39	.956	3.11	.912

Table 5.31: Mean and Standard Deviation for Predictor Variables of Women in the Upper River Khwai Noi (Cont.)

Communication Approach	**Sangkhla Buri** (N=148)		**Thong Pha Phum**(N= 169)		**Sai York** (N=28)		**Total** (N=345)	
	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**	$\overline{X}$	**S.D.**
1. Radio and television	2.80	1.271	2.67	1.323	3.18	1.541	2.77	1.311
2. Newspaper	1.74	.978	1.96	1.170	2.14	1.580	1.88	1.121
Total	2.60	.647	2.61	.757	3.04	.999	2.64	.742
Attitude								
1. Knowledge	3.16	.603	3.23	.617	3.30	.577	3.22	.613
2. Understanding	3.06	.935	3.02	.873	3.21	.568	3.06	.879
3. Willingness	3.39	.822	3.31	.900	4.00	.861	3.40	.881
Total	3.16	.710	3.29	.848	3.64	.559	3.26	.779

5.) The Analysis of the Relationship among Control Variable and Predictor Variable with Women Participation Level in the Upper River Khwai Noi by Analysis of Variance and Multiple Classification Analysis.

Analysis model comprises of control variable, predictor variable and dependent variable, which detail is shown in figure 5.25.

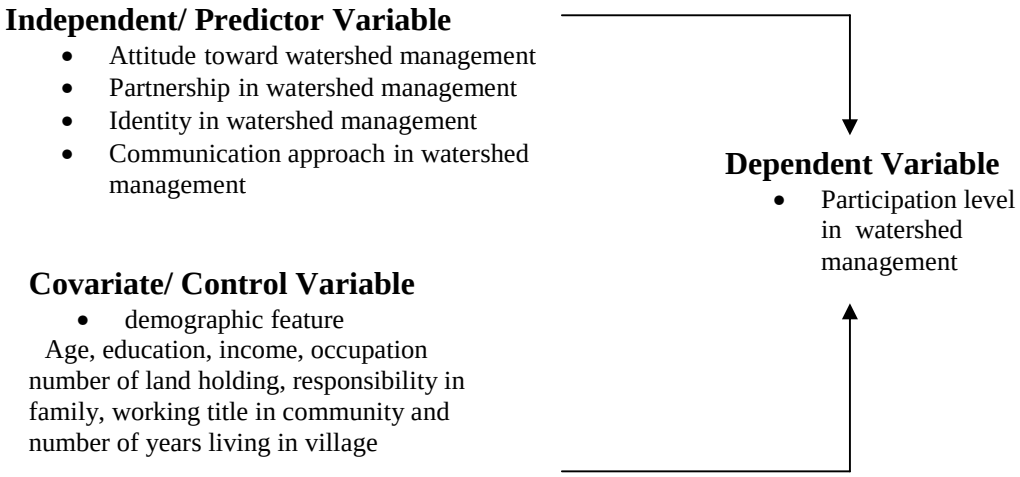


Figure 5.25: Variables Used in Multiple Classification Analysis

From analysis of variance in table 5.24, it found that predictor variable influence on women participation at the 95 percent confidence level (F. Value of main effect is 14.161 and P. value is .000). When considering each predictor variable, it showed that attitude, partnership and communication approach influence on women participation (P. value = .025, .000 and .047, respectively). There is one exception in this prediction, namely identity is not influence to women participation.

In case of identity, women were asked about three main issues, namely problem they face in joining watershed management, self reliance or ability in solving problem and leadership. The cause of no influence is because 1) in practice, there is a variety of occupational women group, so the value of their opinion distributed is widespread, and then causes total mean value is slightly low, when sum of square value was calculated. As a result, the interaction value between participation (dependent variable) and each variable of predictor variable is not enough to present the statistically significant. In this case, it can not say that this variable is not effective; 2) in theory, most of women are underneath patriarchy system or male-center system. Women fettered to a man for life. Moreover, they were confined to their home, under rule, and no right to make decision. This is the way of social culture. Like in any society in Asian country, women play an important role in family – the most base's

social unit – for example, preparing food for household's member. Household's authority in making decision is only passed on from father to son. Definitely, this relationship limits women from public sphere. Laungaramsri (2001) pointed out that family structure system is traced women to the line of housewife and placed men in line of decision making. It is the relationship between women and men that define by social structure.

Moreover, when considering the controlled variable - Age, Education, Occupation, Number of living year, Area holdings and Income, it showed that only area holdings and occupation also influence to women participation (P. value = .011). It is because land holding means right to manage. Women with land right have sense of belonging and willing to participate more than those without. In table 4.12, most of women in this watershed have no land ownership. Some of which has a small scale land holding (less than 5 rai) with PBT or *Phasi Bumrung Thongthi*, which occupied for agriculture purpose and can not give this right to others. In addition, most of women are hired labor in agricultural sector; as a result, they did not participate much. The detail is shown in table 5.32.

Table 5.32: Analysis of Variance of Variable Influencing Watershed Management Participation

Source of variable (N=345)	**SS**	***df***	**MS**	**F**	**Sig.**
Main Effects	**122023.3**	**17**	**7177.840**	**14.161**	**.000***
Attitude	5714.446	4	1428.611	2.819	.025*
Partnership	108830.9	5	21766.173	42.943	.000*
Identity	4941.475	4	634.121	1.251	.289
Communication	2536.484	4	1235.369	2.437	.047*
Covariates	**8518.469**	**6**	**1419.745**	**2.801**	**.011***
Age	1395.174	1	1395.174	2.753	.098
Education	117.100	1	117.100	.231	.631
Occupation	3251.747	1	3256.747	6.415	.012*
Living year	47.747	1	47.747	.094	.759
Area holdings	2181.901	1	2181.901	4.309	.039*
Income	1524.800	1	1524.800	3.008	.084
Model	130541.7	23	5675.728		
Residual	162701.8	321	506.850		**.000***
Total	293243.6	344	852.452		

*statistically significant = .05

When considering the significant of each variable, Multiple Classification analysis is used for comparing the difference of each mean value and average total mean with size of the influence of independent variables. *Eta* value, which comes from sum of square root of predictor variable and square root of total variables, presents the relation between predictor variable and dependent variable and it values between 0 and 1. In this sense the high number means the high relationship. *Beta* is also similar to *eta*, but it name after covariate variable had been controlled.

Ranking the *eta* value of all predictor variables, the result suggested that partnership is more influence on women participation than communication approach and attitude (*eta* = .153, .170, and .629 respectively). When controlled with deviation of covariates variables, namely age, education, occupation, living year, area holding and income, it showed that value of partnership is still higher than the others at the 95 percent of confidence level (*beta* = .146, .148, .148 and .601 respectively).

When comparing *eta* and *beta* value in MCA, which come from the following formula (Prasiteratasin, 1980: 153):

$$4\left\{\sum_{i=1}^{p} C_i + \left[\sum_{i=1}^{p} C_i.\right]^2 - \sum_{i=1}^{p} C_i{}^2\right\} \; / \; 2 \leq 12{,}000$$

Where C_i = Number of independent variable group

P = Number of independent variable

The result showed that deviation value of predictor variable after adjusted covariate variable is a little bit decreased than those with unadjusted. It means that size of relationship between partnership, communication approach and attitude and women participation is relatively low (.007, .022 and .028 respectively). In short, it can say that partnership, communication approach and attitude are still influenced on women participation.

However, when considering the number of cases and unadjusted deviation value, which presents the difference of each mean value by average mean of all variables' mean or the so-called grand mean (117.74), it shows that 25 cases responded that partnership is the best relationship (+10.62); where as the distribution of other cases reported that it is slightly poor, poor and well poor (-1.49, -.12.38, -18.32 and -31.65). It is obvious that this prediction is not stable because of a wide distribution value. In some area, it should consider other related factor.

Beside, the overall relation value of predictor and covariate variable or R^2 value is equal to .667 or 66 percent. It means that a statistical relationship between dependent variable - women participation and predictor variable (partnership, communication approach and attitude) have been strengthened for creating model. It was relatively high.

It is because women in the Khwai Noi Upper River stick with traditional society, they are muted group for century. Cooperation with agencies help women expresses their opinion through organization; moreover it is easily accepted by other people in their community. Communication approach is also the media channel convey information to women, so it influence on women's idea. The other factor is attitude, which means controlled behavior to watershed management. The detail is shown in table 5.33.

Table 5.33: Multiple Classification Analysis of Women Participation by Controlling Variable with Predictor Variables (Grand mean =117.74)

Variable	N	Unadjusted		Adjusted for Factors and Covariates	
		Deviation	Eta	Deviation	Beta
Attitude					
Very Poor	8	23.26		6.95	
Poor	37	-6.39		-9.24	
Sufficient	166	-.96		-1.58	
Well	124	2.12		4.06	
Extremely Well	10	-5.24	.153	4.59	.146
Partnership					
Very Poor	31	-31.65		-29.38	
Poor	61	-18.32		-17.43	
Sufficient	55	-12.38		-12.48	
Well	47	-1.49		-.96	
Extremely Well	25	10.62	.629	7.33	.601

Table 5.33: Multiple Classification Analysis of Women Participation by Controlling Variable with Predictor Variables (Cont.)

Variable	N	Unadjusted		Adjusted for Factors and Covariates	
		Deviation	Eta	Deviation	Beta
Identity					
Very Poor	18	2.87		-3.30	
Poor	58	-9.66		-8.44	
Sufficient	151	-.47		1.53	
Well	104	5.36		1.70	
Extremely Well	14	1.54	.171	10.06	.148
Communication Approach					
Very Poor	3	-24.08		-6.63	
Poor	163	4.29		3.33	
Sufficient	141	-2.06		-2.16	
Well	31	-7.68		-2.97	
Extremely Well	7	-13.89	.170	-18.09	.148
Multiple R Square					**.667**
Multiple R					**.445**

*statistically significant = .05

When considered each stream reach, it is found that women in upstream, middle and downstream have difference characteristic:

- Upstream. Form figure 5.21, the graph showed that women participation differently distributed among three levels. In terms of predictor variable, diamond diagram of women in Sangkhla Buri, which comprise of attitude, identity, communication approach and partnership, showed that the axis of attitude is almost full. It means that women have good watershed ecosystem knowledge, understanding about the change in their habitat and willingness to manage watershed. As, the axis of

identity is nearly full, which means that women in Sangkla Buri have concept of self reliance, ability in solving problem and leadership at good level. In contrast, the axis of communication approach and partnership is slightly thin when comparing to the others. It showed that communication approach that women used is only one - way communication and not variety. Moreover, the number of agencies like Government organization, Non-Government organization and Academic Institute support and suggest or work with women in upstream area is low level. The triangle above the diamond diagram showed details in each axis; the detail is shown in figure 5.26.

However, it can be described in terms of gender socialization theory that the culture that surrounds them shapes women's patterns of behavior. It is oriented by values that assign women a subordinate place in the sphere of public life. Although, this finding found out that traditional habit in household support them to manage watershed. Women not only have limitations on public sphere but fail even to accept by social, since they are socialized to become primarily wives and mothers. Moreover, women defend that tradition through their roles and passed this idea to their offspring.

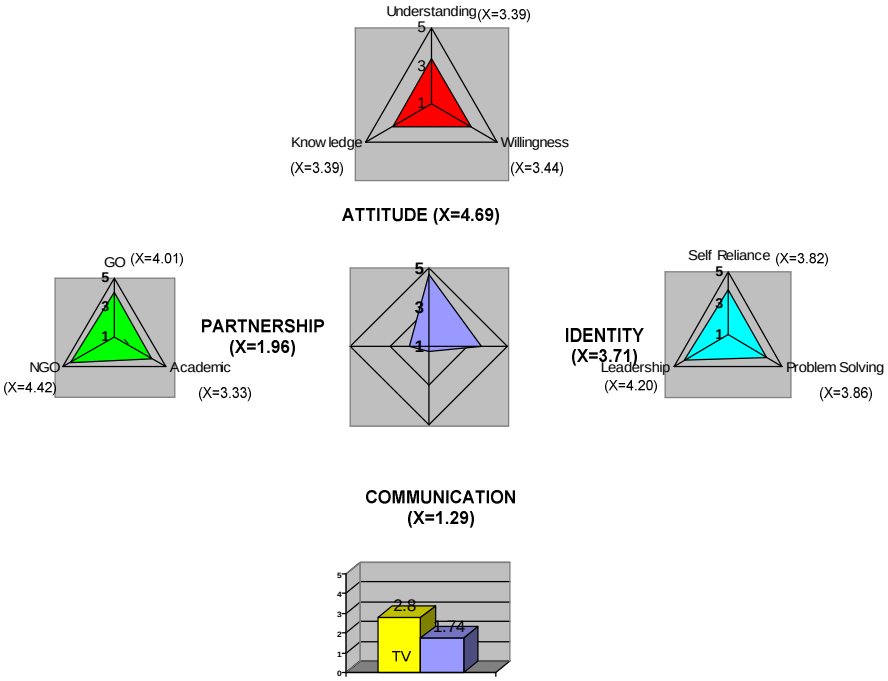


Figure 5.26 Diamond Diagram Showing Predictor Factor of Women Participation in Upstream

- Middle stream. Likewise the upstream area, the shape of diamond diagram in Thong Pha Phum is slightly thin in the axis of communication approach and partnership. It showed that women in middle stream have good attitude in watershed management and identity. One reason is women here come from the same root of ancestor blood. The way of living is the same pattern, which is from *spiritual* base. Spirituality is the highest form of consciousness, and spiritual consciousness is the highest form of awareness. Their awareness depends on relationship between humans and nature and between visible world and the invisible spirit world, which expressed through local knowledge of the environment. In addition, socialization has moulded patterns of behavior to their offspring. However, women tie with the domestic work more than public area; so, the communication channel is not variety and they are not accepting to cooperate with many agencies. Figure 5.27 show that the diamond diagram is not full scale.

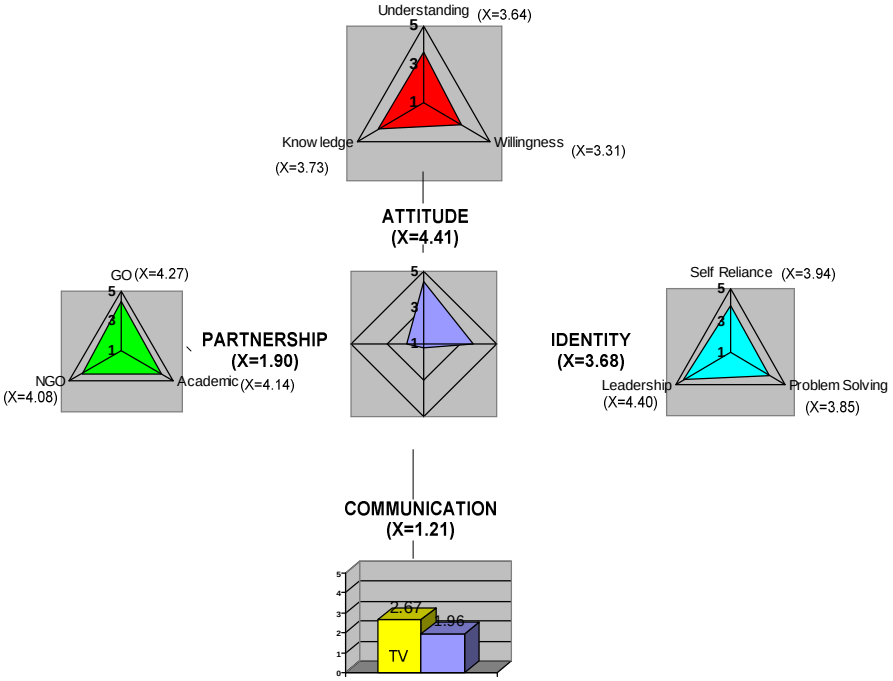


Figure 5.27 Diamond Diagram Showing Predictor Factor of Women Participation in Middle Stream

- Downstream. Diamond diagram in Sai York district is mostly similar to the upstream and middle stream. There is two exceptions, namely the axis of communication approach and partnership is severe thin, when compared by those of two areas. The reason is 1) number of cases in Sai York is only 28 cases, which is very low when comparing to 148 cases in Sankla Buri and 169 cases in Thong Pha Phum. As a result, the average mean value is so little. 2) Women in this area tie with rural traditional culture. Women were expected that they were good at domestic work. Thus the cooperation with other agency is in low level, especially non-governmental organization. The detail is shown in figure 5.28.

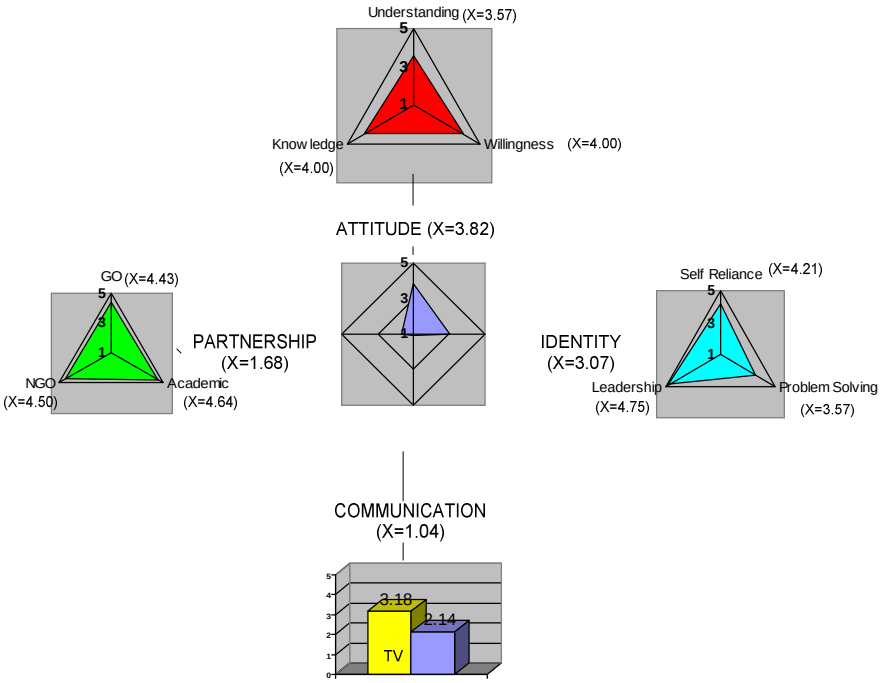


Figure 5.28 Diamond Diagram Showing Predictor Factor of Women Participation in Downstream

5.4 Acceptance the Influence of Variables by Local Women

To recheck the validity of predictor variables used in this study, the characteristic of each diamond diagram is evaluated by volunteer in remote area. The volunteer is comprises of 13 women who have title in community, 10 women in agricultural career and 9 women in non agricultural career. It is apparent that the predictor variables – partnership, identity, communication approach and attitude - were accepted by majority of volunteers in terms of power of prediction, reliable and correction and situation covering. Detail is shown in table 5.34.

Table 5.34: Acceptance Variables Used by Volunteers in the Khwai Noi Upper River

	Number of agreements			Total (N=32)
	Sanghkla Buri (N=13)	**Thong Pha Phum** (N =15)	**Sai York** (N=4)	
1. Power of prediction				
Partnership	12	15	4	31(96%)
Identity	8	10	4	22(60.7%)
Communication	9	9	3	21(65.6%)
Attitude	7	9	4	20(62.5%)
2. Reliable and correction				
Partnership	13	15	4	32(100%)
Identity	10	9	4	23(71.8%)
Communication	9	10	4	23(71.8%)
Attitude	10	15	4	29(90.6%)
3. Situation covering				
Partnership	10	11	4	25(78.1%)
Identity	7	9	4	20(62.5%)
Communication	8	14	4	26(81.2%)
Attitude	7	13	4	24(75%)

5.5 Empowerment Priority in the Khwai Noi Upper River

As mention in chapter II, Blanchard, Carlos and Randolph (2002: 12) revealed that indicator of participation is level of decision making. In addition, decision making is also interpreted in terms of ‘power over’ in empowerment theory. Thus, in this stage, decision making data of women in the Khwai Noi Upper River in table 5.24 and figure 5.13 -5.15 was used to compare and convert to empowerment priority. In figure 5.29 majority of women in middle stream participate at extreme high. Upstream come second, followed by downstream.

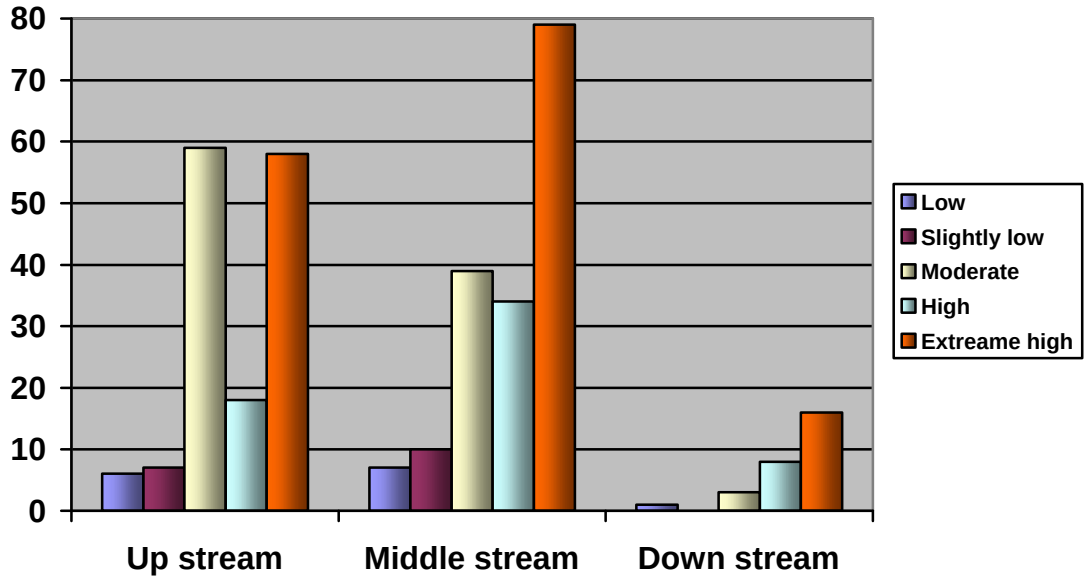


Figure 5.29: The Comparison of Decision Making Level of Women in the Khwai Noi Upper River

Mean value is continually presented to rank priority of decision making. It is found that women in upstream participate at moderate level, while middle stream and downstream participate at well level. It is, then interpreted in terms of empowerment. High score means last priority to empower. Thus, the result revealed that women in upstream should empower first. The detail is in table 5.35:

Table 5.35: **Empowerment Priority in the Khwai Noi Upper River**

Watershed Area	Decision Making			Empowerment priority
	$\overline{X}$	S.D.	Interpretation	
Upstream (Sangkhla Buri)	3.28	1.489	Moderate	I
Middle stream (Thong Pha hum)	3.69	1.422	Well	II
Downstream (Sai York)	3.96	1.105	Well	III

CHAPTER 6
CONCLUSION

The key objectives of the study were to investigate the conditions of the Upper River Khwai Noi sub watershed in terms of watershed situation, affected to local communities and explore the role of women in watershed management. The vital aim is to identify empowerment factors that can be enhanced women participation in watershed management. In this study, an attempt is made to use remote sensing and geographic information system to assess the watershed situation. Multiple classification analysis is also used to determine the influence of predictor variable – partnership, identity, communication approach and attitude - on women participation. However, the results of this study are baseline data for the relevant agencies in supporting natural resource management.

6.1 Summary of Research Results

6.1.1 Situation of the Khwai Noi Upper River. Physically, most area of the Upper River Khwai Noi watershed comprises of hilly topography ranging between 100 - 1800 meters above mean sea level. In addition, the original parent rock is limestone and the geographical structure is Karst topography. As a result, Latosol soil has been noted and evergreen forest and mixed deciduous forest are found widespread in the whole watershed.

Bee Kee river, Run Tee river, and Songgalia river is the major source of water with many perennial. They form to be Khwai Noi River at Sangkla Buri district and flow down to the south and west. Due to the fact that this area is Thailand – Myanmar borderline, there are international migrations over times. Ethnic minority group such as Karen, Mon, Myanmar, Lao and Nepal have settled their community in

reserved area, especially in the valley between river and creek. They converted natural resources for their survival for example they change forest land for their settlement as well as alluvial flood plain for performing agricultural activities. When the population grows, they expand more land for their food and shelter. Hence, the environment has been changing through time.

One best indicator of watershed verification is soil erosion. Indeed, soil erosion is natural phenomenal but when a large volume of natural vegetation is rapidly cleared for agricultural purposes or the so-called land use change, the natural protection that the soil had is disturbed and the soil detachment and movement occurs at great speeds. RS/GIS technique has been used to access annual soil loss of the watershed and its situation; the results showed that:

1.) There have been tremendous changes in the Upper River Khwai Noi during 1990-2000. The significant changes were an increase in the size of water bodies and a decrease in the size of forest areas and agriculture lands. In particular, natural forest land was replaced by agricultural area with fruits orchards and forest plantations. Thus, the pattern of land cover changes are as follows: forest area into agricultural area and settlement area, increased agricultural land caused by deforestation, decreased agricultural land caused by human settlement, and conversion to reforestation and agricultural land.

2.) The soil loss area in the Khwai Noi Upper River is 91.95 percent of soil loss area (2,413,951.90 rai) or 93.60 percent of total area. In upstream area the total soil loss area is 54.01 percent of soil loss area, while 30.5 percent is in middle stream area and 7.39 percent in downstream area. The result is confirmed by the study of Office of Environmental Policy Planning, Ministry of Science and Technology in 1996.

3.) There is no disturbance in watershed structure and function in most of upstream area or 77.28 percent of total area, 8.88 percent in warning and 1.86 percent in crisis level. It is found that in middle area a quarter of area is in crisis level and there is only nearly half of total area is in nature, while most of most area in downstream is

in crisis level which most disturbance had been destroyed watershed structure and function until it can not restore and 49.21 percent is in warning level or there is disturbance in watershed's structure and function, but it can restoration.

6.1.2 Role of Women in Watershed Management. Ecofeminist said that because women are closed to the nature in terms of food provider and household function, they always have consciousness about the change of natural resources in their watershed. Moreover, women, the first person affected by the negative environmental impact through their household role, perceive the change and situation happen in their habitat. This study found that women in the Upper River Khwai Noi have good knowledge in hydrological cycle, energy flow, and nutrient cycle, except green house effect, which most of them did not believe that growing rice is the major source of green house gases and impacts the earth's temperature.

Besides, women understand about three basic natural resources change in watershed – land/ soil, water and forest. Compared to five years ago, most of women feel that soil quality is bad; there is moderate volume of sediment in their stream, and they must put more fertilizer in their farm. In terms of water quantity and quality, majority of women feel that the volume of water and flow of water in year round is moderate. The transparency of water in first half year is good, but in second half year is worse; moreover, the water is not safe to drink. Finally, in terms of forest, most of they feel that there is a lot of deforestation and number of tree species in the forest is decreased. The finding is a little bit different in understanding about the soil – change. Women in upstream area do not feel much about the change. In contrast, women in middle stream and downstream area perceived that the quality soil is slightly worse. It is because upstream area is rich of natural resources and in reserved forest, while some part of middle stream and downstream area is in reserved forest and land cover is changed according to human's survival factor.

Nevertheless, women are willing to manage their watershed by cooperating activities with reputation environmental organizations. This is because the activities of reputation environmental organizations were trusted by social and in turn, social

process shape that idea to women they can better manage watershed situation than those without name.

In terms of the influence of household role on watershed management, the results showed that although, most of women in the whole watershed involved with domestic responsibilities, childcare and family farm and off-household work, both of them participate in watershed at the same level.

6.1.3 Empowerment Factor on Women Participation. Multiple Classification Analysis was used to find out the influence of predictor variable, namely attitude, partnership, identity and communication approach. The results revealed that except identity, the other three factors influence on women participation. Among them partnership is the most influence. Communication approach comes second, followed by attitude. However, it can conclude in form of table below:

Table 6.1: Summary of Hypothesis Result

Hypothesis	**Result**
1: Women perceive the situation of their watershed through women groups meeting within watershed site.	**- Accept**. Women in the whole watershed perceived the change of three basic natural resources in their watershed (mean scores of understanding the change are rather moderate to high level). Besides, unofficial women group meeting is the information path way.
2: Women manage natural resource through their household role.	**- Reject.** The finding showed that neither women work in household nor off-household, they manage natural resource through their role at the same level (P. value is higher than 0.5).
3: Attitude, Partnership, Identity and Communication Approach are related to women empowerment in support of watershed management	**- Partial Accept**. The results showed that only Partnership, Communication Approach and Attitude are strongly influence in women participation (*eta* and *beta* value is significant).

6.2 Major Finding of the Study:

In sum, as indicated by feminist environmentalist theory, domestic work is vital agent to drive women know surrounding's situation at a matter of fact that social expected them to be a good mother. Their responsibility in food provider, child care and offspring education were shaped through the long socialization. In transmitting traditional knowledge through value system about the environment management – social culture, women are vital agent, which all value is passed down and fortified with each child she has. Role of women in household according to the gender socialization theory should be understand and support.

The other issue is location and fertility of resources. It seemed that women who lived in the further area and rich of resources have low participation. Due to the fact that they have no problem about their survival, there is no need to participate in any program. Moreover, type of community is the driven agent to support participation. Communication is not convenient; so the information circulation is limited in sparse village. Women in that community can not receive the validity knowledge.

6. 3 Recommendations

Based on the results in this study, the recommendations are:

- Promote women knowledge, especially greenhouse gas effect. Informal education group is established in local area to help women develop skill and confidence to voice their respond to watershed resource management. Women in upstream is the first priority to promote this knowledge.
- Senior citizen should be first priority to educate because they pass down their knowledge to their offspring.
- Local academic institute should guidance and support technical and knowledge to women by setting permanent natural resources management group in this area.

- Creating opportunity for women by established women self – help group in community activity including natural resource maintaining.

- Government and Non government organization should support training program about leadership and self reliance in problem solving to women, especially cooperating with other agency.

- Monetary contribution to support women activity in watershed management.

6.4 Research Limitations

This study has some limitations that warrant consideration. The primary limitation was language communication. In some area, for example Sangkla Buri district, women can not speak Thai and they are too shy to communicate with strangers. Despite the best efforts of the local translator, this opened up the possibility of miscommunication. In addition, in group discussions are also subjected to limitations. Volunteer responses are limited to their personal perceptions and perspectives, which may be subjected to personal bias, anxiety, anger, political factors, self-serving responses, recall error or simply a lack of awareness. Solution is trust of volunteer. Trust was also established by explaining the objective to volunteer and the conductor dressed and spoke in a manner designed to put the volunteer at ease. Another possible limitation of this study is possible biases in selecting volunteer from the first stage. However, the limitation is summarized below:

- There are several occupations in sample, which it makes blur picture of women's attitude. Therefore, next study should focus on each occupation such as farm women and off – farm women.

- In this study, it was found that respondents who are student could not present any clear ideas about their attitude. The more problematic issues included difficulty in getting information about their real income (they earn money from their parents) and their final education level (they have been studying). Next study should exclude this type of respondents.

- This study focused on women in the Upper River Khwai Noi – sub watershed where ethnic minority women live, so the output is not covering the whole Mae Klong Basin.

- Variation of women's economic status, which is an influenced variable, is not included in this study. The rich and the poor affected to predictor variable, albeit in this study, the economical status of respondent is presented in total.

- Location of village and direct access to natural resource are another factor, which influence on women participation. Therefore, next study should separate the group of respondent, namely village that is in 5 meters from water source or 5 meters far from the national park.

- Multiple Classification Analysis totally predicts the influence of predictor variables and dependent variable under controlling variables. It can not give detail that what variable is positive influence or negative influence; thus future study should include Path Analysis.

6.5 Research Opportunities

This research presents a basis for many further research opportunities. It provides an initial empirical understanding of the relationship between women and watershed management. To answer the study question as described in chapter 3-5, future research is suggested into two subsections:

6.5.1 Inside the Khwai Noi Upper River Watershed. Future research could distribute the same survey to similar sample or survey both side of gender because it is proved that men have influence to women behavior. In addition, it develops a balanced insight into gendered responses to watershed management participation and helps to reaffirm that women are important agent to manage watershed if women play a significant role in the process.

6.5.2 Outside the Khwai Noi Upper River Watershed. Although this study focused solely on participation, it can be modified easily for application to many other behaviors of interest to manager researches such as the cooperation of watershed stakeholders, the implementation of environmental management plans or the adoption of sustainability strategies. It is useful to environmental management researcher because it offers a means to link the action to the action plan, which the social system linkage is common in many environmental management studies.

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APPENDIX

QUESTIONNAIRE No☐☐☐

Questionnaire on

WOMEN EMPOWERMENT IN WATERSHED MANAGEMENT OF THE KHWAI NOI UPPER RIVER, KANCHANABURI PROVINCE

.....

Thank you for agreeing to be interviewee. This questionnaire will take 30 minutes to complete. The purpose of this study is to explore women's participation on watershed management. Your participation is completely appreciated. Your name and your answers will be known only by the interviewers and all responses are strictly confidential.

Instruction: ❶. Interviewee is women who can make decision or whose age is more than 15 years old and live in village not less than 1 year.

❷. Please read the following statement and mark √ according to your understanding

A: Demographic Features

1. Interviewee's name…….Family name: ……Date of interview……
2. Address: ……..Moo…..Sub district……City …….Phone…….Age……
3. Caste……..❑ Thai… ❑ natively born ❑In-Migrate from (province) ……

❑ Karen ❑ White I.D. card* ❑ Orange I.D. card**

❑ Mon ❑ Pink I.D. card *** ❑ Blue I.D. card****

❑ Burma ❑ No I.D. card

❑ Other…….

NOTE: * Thai Nationality **Legal immigrants labor ***Refugee **** Living in Border line

4. Marital Status ❑ Single ❑ Married ❑ Widow ❑ Divorced ❑ Separated

5. Number of children……Age of children…….. (Please specify)

6. Religious ❑ Buddhist ❑ Christine ❑ Islam ❑ Rishi (Hermits) ❑Animism

7. Educational background ❑ No education ❑ Educated ……..…..(Please specify)

8. Current primary occupation with details (choose only one item)

❑ 1. Agriculture (Please mark √ and specify number in block)

Type of Agriculture	**Area (Rai)**						
	Land Ownership					**None Right**	
	PBT5	KNS3	KNS5	SK1	SPK	Personnel Rent	Community Rent
❑ 1. Paddy field ❑ Paddy Rice ❑ Upland Rice ❑ Sticky Rice ❑ Upland Sticky Rice ❑ Other……	…..Rai	…..Rai	…..Rai	…..Rai	…..Rai	……..Rai	……..Rai
❑ 2. Farm ❑ Corn ❑ Cassava ❑ Soy bean ❑ Cotton ❑ Hot Pepper ❑ Other…	…..Rai	…..Rai	…..Rai	…..Rai	…..Rai	……..Rai	……..Rai
❑ 3. Orchard ❑ Rambutan ❑ Orange ❑ Longan ❑ Lime ❑ Mango ❑ Other	…..Rai	…..Rai	…..Rai	…..Rai	…..Rai	……..Rai	……..Rai
● Type of cultivation ❑ Traditional in household ❑ Cash crop farm							

❑ 2. Commerce ❑ Private Business ❑ Community product selling

❑ Restaurant ❑ Others……..

❑ 3. Hired Labors ❑ Industry ❑ Agriculture ❑ Service ❑ Skill labor

❑ Forest plantations ❑ Feed Silk Worm ❑ Others……...

❑ 4. Livestock ❑ Cow ❑ Buffalo ❑ Duck ❑ Hen ❑ Pig ❑ Fish ❑Others….

❑ 5. Other……

9. Please tell me your secondary jobs now……

10. Your Average Income…… (Baht/Head/Year)

(If you are in agricultural sector and can not identify, please specify productivity per year and price per unit e.g. sugar cane 100 ton/year and each ton costs 400 baht, so total income = 400*100/12)

11. Do you respond off-farm works? ❑ Community work ❑ other…….(Please specify)

12. Are there women networks or alliances in watershed management ❑ No ❑ Yes….

Please specify……..

13. Number of Living Year in community .....

14. What are your responsibilities in your family? ❑ Family Agriculture

❑ Family Domestic Work (cleansing, cooking) ❑ Childcare ❑ other……...

B: Attitude in watershed management

Instruction: Read the following items listed below, according to your affection, Mark √ on the appropriate response number using the following code.

1 = strongly disagree

2 = disagree

3 = neither disagree nor agree

4 = agree

5 = strongly agree

1. Are the three basic natural resources -soil, water and forest – interrelated? ……..... [1] [2] [3] [4] [5]
2. Water reaches the biosphere in form of water vapors …… [1] [2] [3] [4] [5]
3. Water infiltrates to the soil …...……..…… [1] [2] [3] [4] [5]
4. Water comes on land as rain water ……..……[1] [2] [3] [4] [5]
5. Is soil in your farm fertility? ……..……. [1] [2] [3] [4] [5]
6. When you grow plant in your farm, you put more fertilizer…[1] [2] [3] [4] [5]
7. There are more weed in your farm ……..[1] [2] [3] [4] [5]
8. Plants in your farm look more growth ……[1] [2] [3] [4] [5]
9. There is enormous increasing soil erosion in farm ……[1] [2] [3] [4] [5]
10. There is increasing agricultural productivity in your farm... [1] [2] [3] [4] [5]
11. Less productivity means more economic status (Reverse)... [1] [2] [3] [4] [5]
12. In case of finding food in nearby forest i.e. fired wood, vegetable and mushroom, you go further to find them or it takes a long time to find ... [1] [2] [3] [4] [5]
13. There is a lot biodiversity in the forest …… [1] [2] [3] [4] [5]
14. There are several forest fires than the past five years ……. [1] [2] [3] [4] [5]
15. Agriculture makes severe droughts and high temperature ....[1] [2] [3] [4] [5]

Could you please compare the following incidents in your area with the five years ago and mark √ according to your understanding?

16. The quality of soil ……..……..Good ...[1] [2] [3] [4] [5]…Worse
17. The volume of deforestation ……...…… Much ...[1] [2] [3] [4] [5]…Less
18. The volume of sediment in stream …..... Much ...[1] [2] [3] [4] [5]…Less
19. The chemical fertilizer utilization …..... Much ...[1] [2] [3] [4] [5]…Less
20. Volume of water in the 1st half year ….. Much ...[1] [2] [3] [4] [5]…Less
21. Volume of water in the 2nd half year …...Much ...[1] [2] [3] [4] [5]…Less
22. Transparency of water in the 1st half year…Much ...[1] [2] [3] [4] [5]…Less
23. Transparency of water in the 2nd half year... Much...[1] [2] [3] [4] [5]…Less
24. Flow of water in the 1st half year ……... Much ...[1] [2] [3] [4] [5]…Less
25. Flow of water in the 2nd half year …….. Much ...[1] [2] [3] [4] [5]…Less
26. The decreasing of plants species …...…..Much ...[1] [2] [3] [4] [5]…Less

27. The water in stream is clean enough to drink. Much ...[1] [2] [3] [4] [5]…Less

28. I would participate in soil, water and forest conservation program with agency that has a good record of environmental performance, i.e. green peace. ……... [1] [2] [3] [4] [5]
29. I would contribute money and time to conserve soil, water and forest ……...……... [1] [2] [3] [4] [5]
30. I would make personal sacrifices for the sake of reducing the damage of soil, water and forest. ...…….... [1] [2] [3] [4] [5]
31. I am willing to follow community laws concerning soil, water and forest conservation. ……... [1] [2] [3] [4] [5]

C: Participation in Natural Resource Management

How frequently do you respond in these actions in your household?

Item	**Do** (level)					**Do not**	**Note**
	1	2	3	4	5		
I. THE FIRST LEVEL 1. Water acquisition for household's member							1 = 1 time / year
2. Efficiency water use in household							2 = 1 time/6 months
3. Controlling waste water drainage in household							3 = Did not count
4. Wild plant collecting from forest							4 = 1 time/ 3 months
5. Fuel wood collecting from forest							5 =1 time/ month
6. Medicine herb collecting from forest							
7. Growing garden crops for family consumption i.e. coconut, banana and root crop							
8. Seed Bank keeping							
9. Plant coverage growing i.e. vetiver grass (*Vetiveria spp.*)							
10. Teaching how to organize household budget i.e. water supply, fertilizer and seed buying							
11. Teaching how to use sufficient resource							

Item	Do (level)					Do not	Note
	1	2	3	4	5		
12. Teaching how to protect and safeguard soil, water and forest							
13. Teaching how to transfer traditional management knowledge pertaining to natural resources through story telling in folk lore							
II THE SECOND LEVEL 14. Number of official meeting regarding to watershed management in community							
15. Number of natural resource treatment training from agency							
16. Number of involving in water quantity problem							
17. Number of involving in deforestation problem							
18. Number of involving in soil infertility problem							
19. Persuade neighbor joining watershed management activity							
20. Joining community water resource development program							
21. Raising cultivated technique problem							
22. Establishing inter and intra group/ network pertaining to natural resource management							
23. Be Public Relation in watershed management							
III THE THIRD LEVEL 24. Policy setting in watershed management i.e. reforestation, New Theory application							
25. Problem analysis of natural resources within watershed							
26. Monitoring and evaluating natural resource condition within watershed							
27. Be budget allocating committee							
28. Be core agent in watershed management network							
29. Be leader in calling meeting or discussion forum							
30. Other … (Please specify)…….. ……							

D: Partnership. Identity and Communication Approach in watershed management

Please specify the number that you involve.

Item	Do (level)					Do not	Note
	1	2	3	4	5		
- PARTNERSHIP 1. Technical support, knowledge suggestion, and cooperation in watershed management by NGO i.e. Patanarak group, Mae Klong group							
2. Technical support, knowledge suggestion, and cooperation in watershed management by GO i.e. Forestry Department, MOI							
3. Technical support, knowledge suggestion, and cooperation in watershed management by Academic Institute i.e. Rajabhat Kanchanaburi							
- IDENTITY 4. Lack of land for agriculture							
5. Low income for household survival							
6. Water shortage in agriculture							
7. Daily life problem solving ability							
8. Ability in all problems analysis							
9. Watershed management knowledge degree							
10. Stick with self reliance concept							
11. Authority in making decision of household							
12. Brave to think							
13. High responsibility							
14. Cooperation with other people							
- COMMUNICATION APPROACH 15. How often do you get information through T.V. and radio?							
16. How often do you get information through newspaper?							

Suggestion……...
…….....

Guideline Question in Focus Group Discussion

In

WOMEN EMPOWERMENT IN WATERSHED MANAGEMENT OF THE KHWAI NOI UPPER RIVER, KANCHANABURI PROVINCE

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1. Do you think women are the direct person to access to natural resource and which way i.e. food preparing?
2. Do they know whether the natural resources change in their area?
3. In your opinion who is the priority person that was affected by that change? How?
4. Does your community have rituals pertaining to the three basics natural resources conservation i.e. soil/land, water and forest?
5. As women, who told about that rite or knowledge? By which channel they share the understanding information?
6. Do women allow being part of that activity or core agent? Why?
7. Do you agree with the idea of women should have ‘Self Reliance’?
8. Do your community have women group regarding natural resources?
9. What are the problems face women in maintaining resources?
10. Are there outside technical assistance and support from many agencies to women? How?

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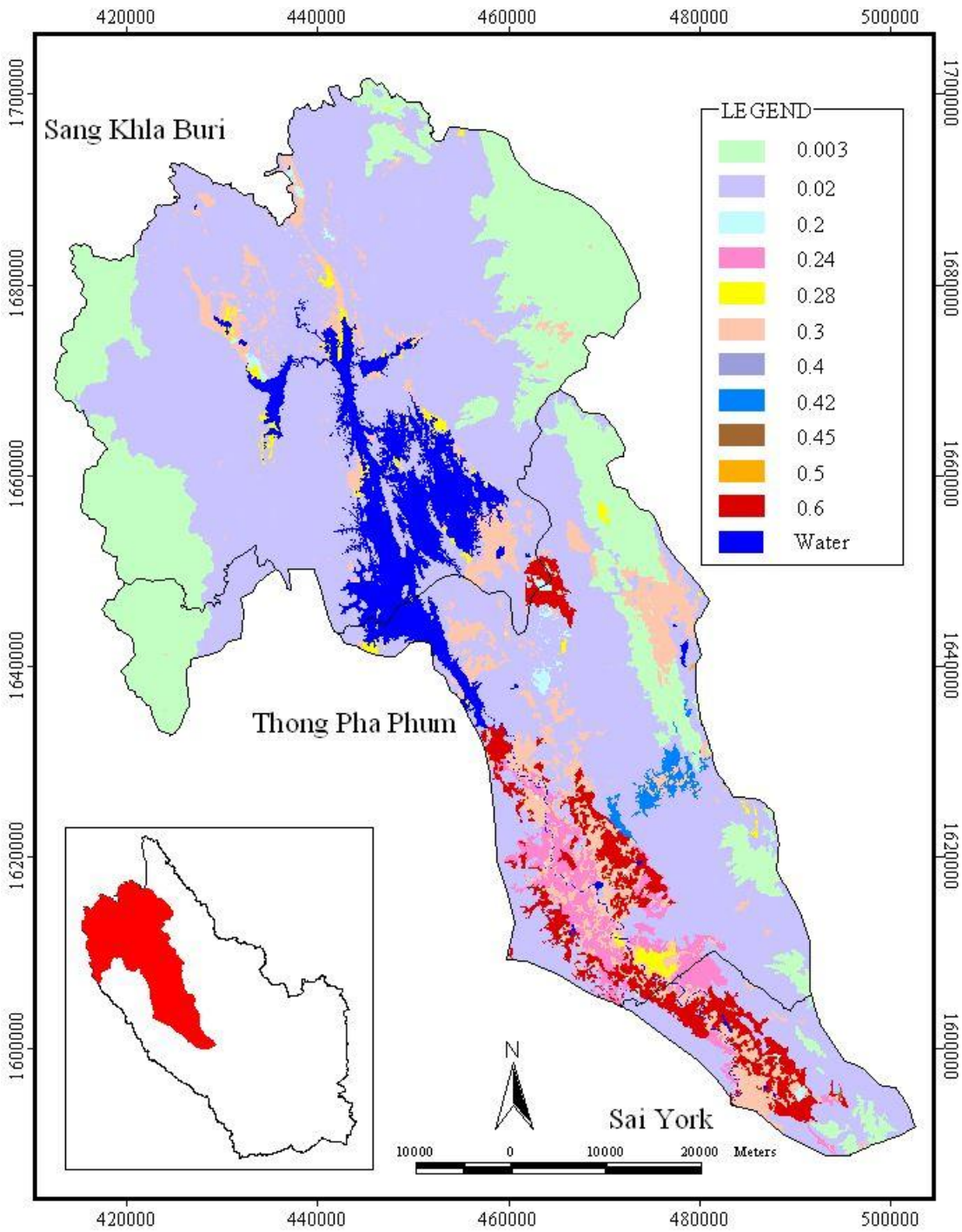
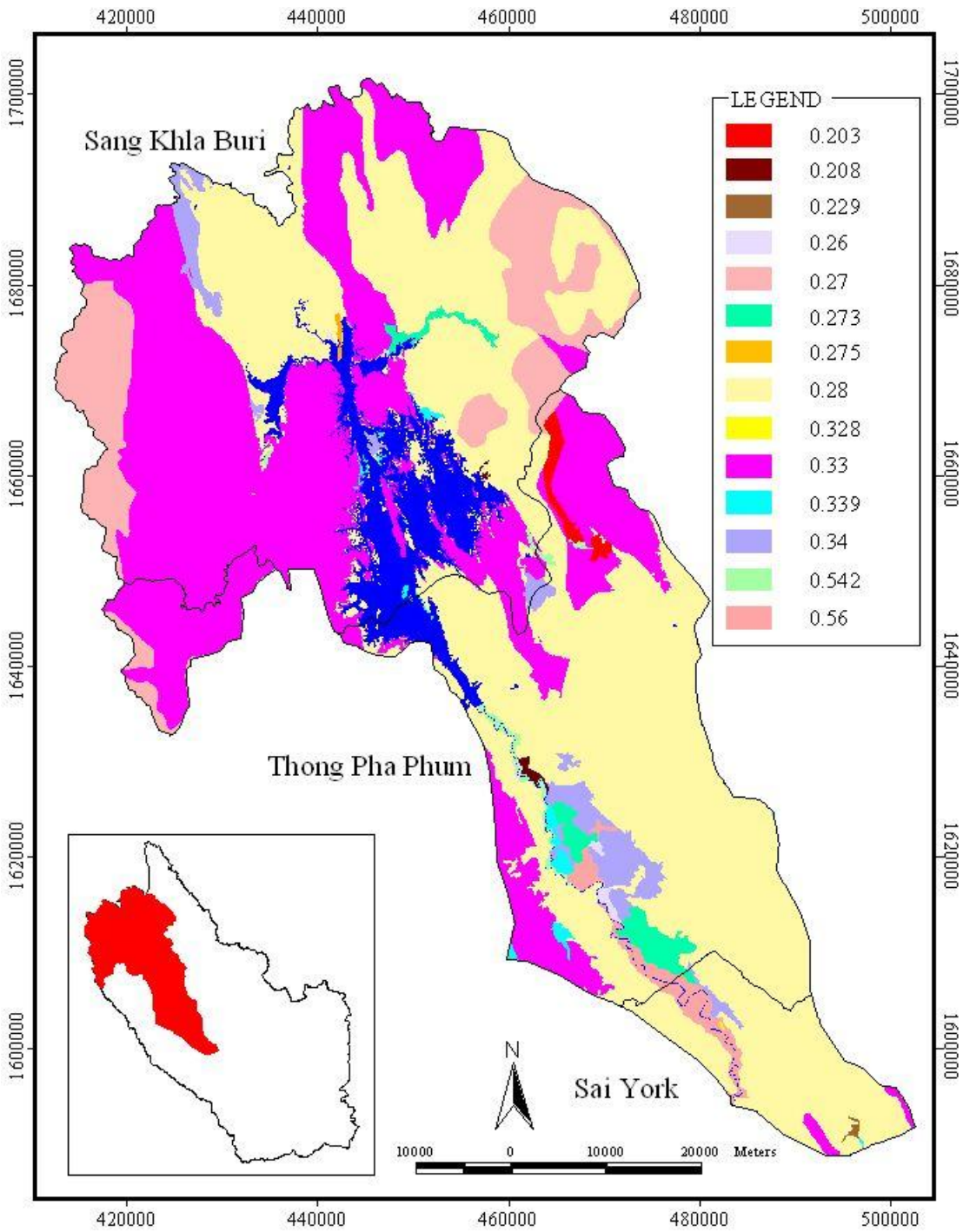
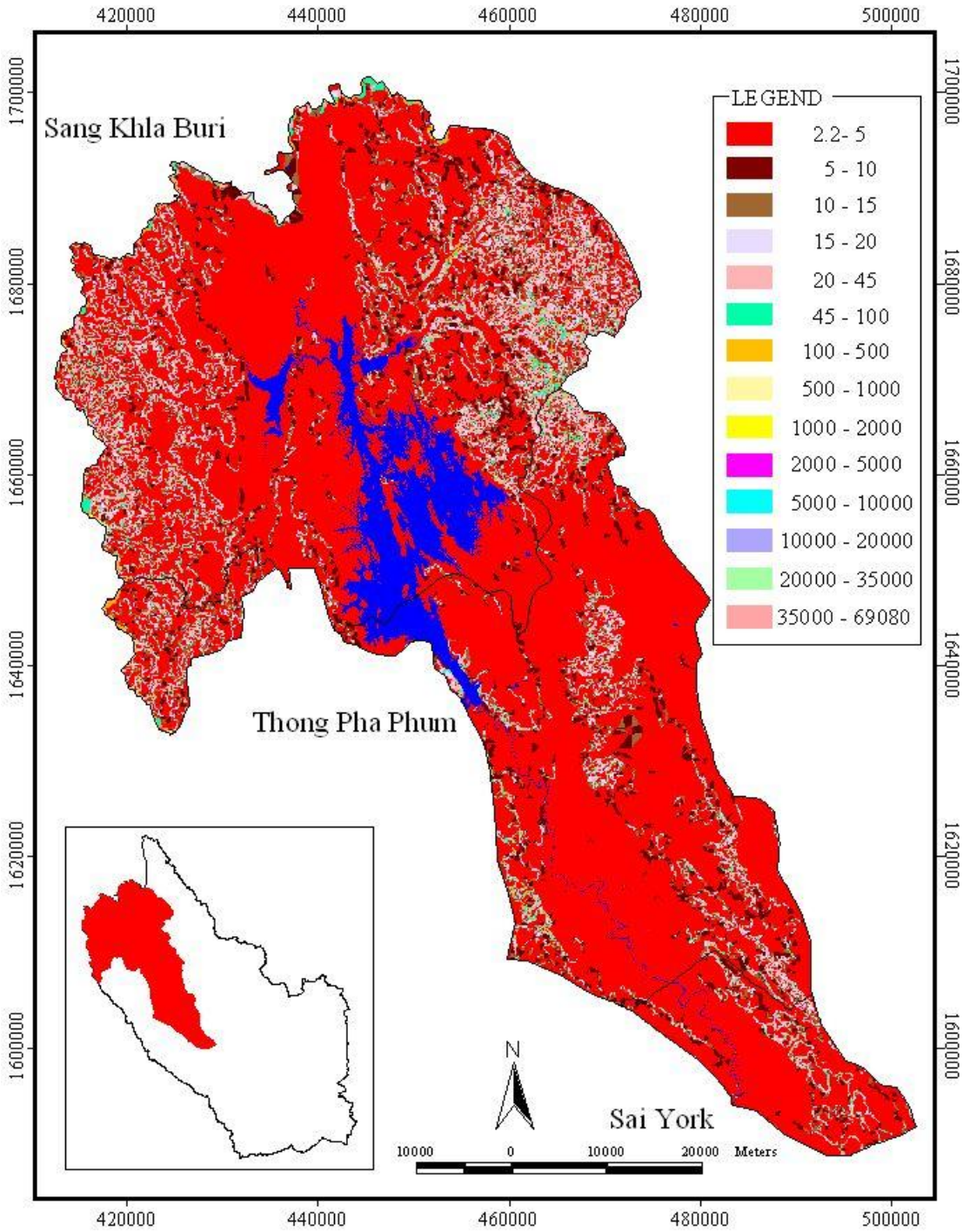


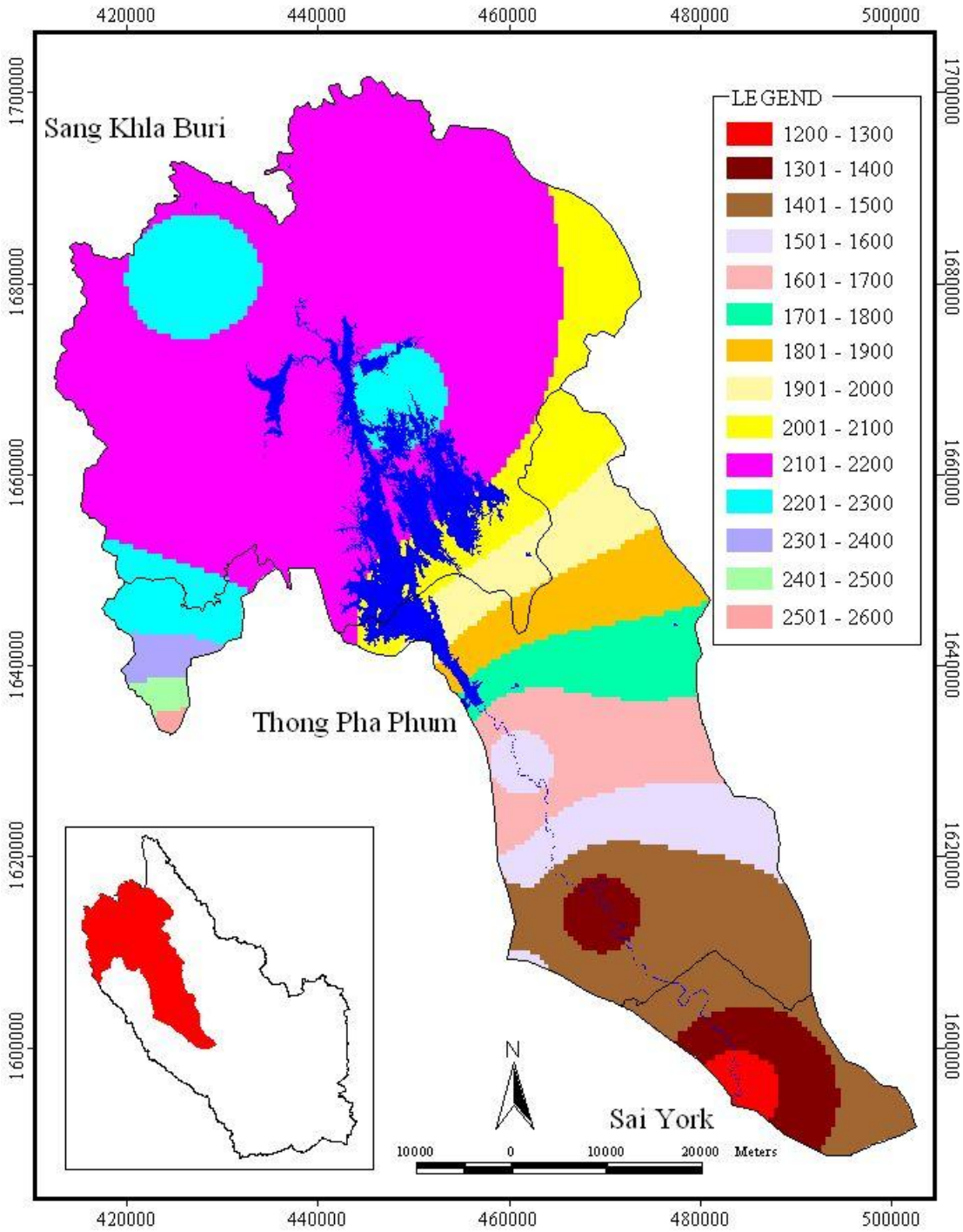
Appendix D-1: The C layer in the Kwai Noi Upper River
Source: Prepared by Author, 2004



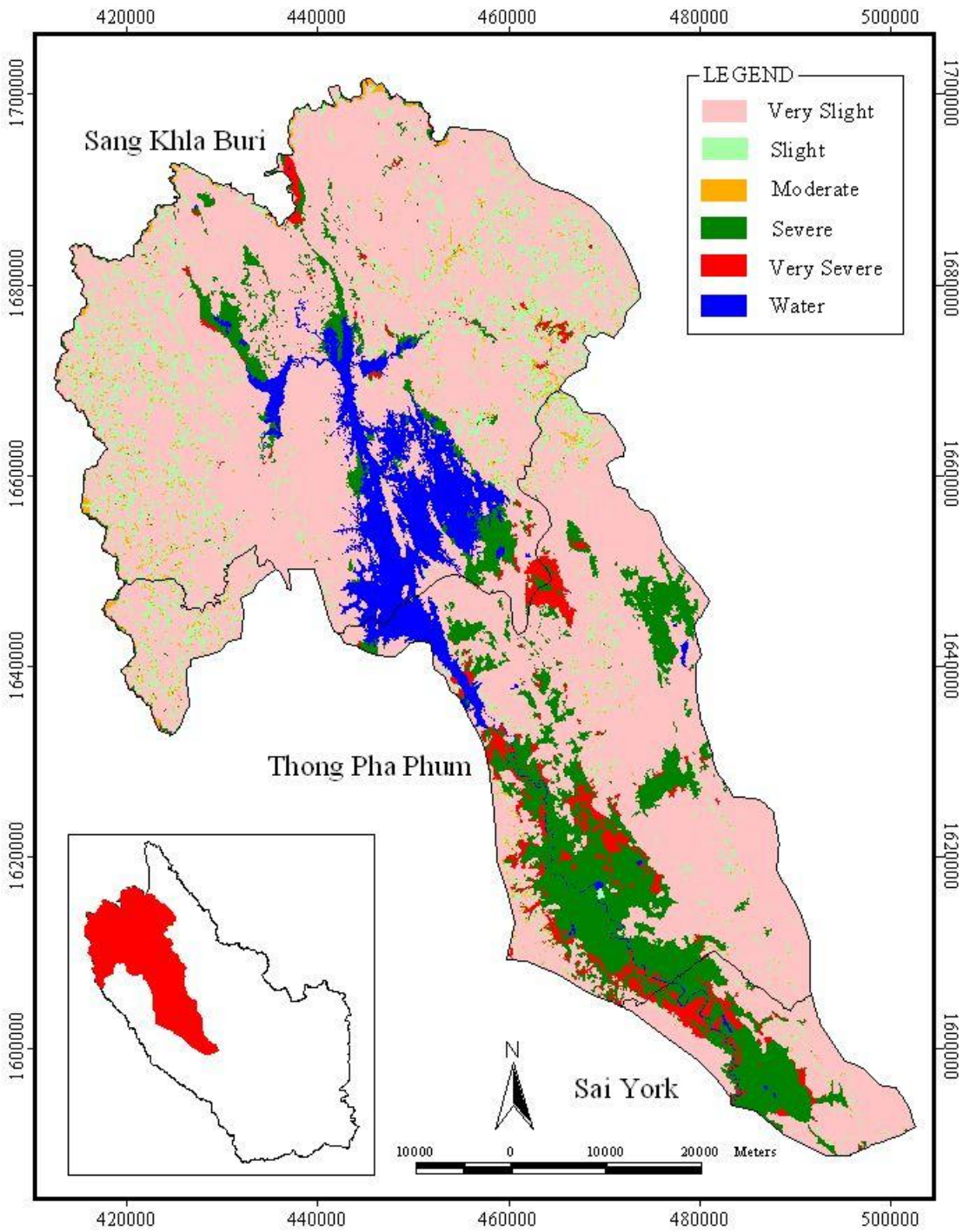
Appendix D-2: The K layer in the Kwai Noi Upper River
Source: Prepared by Author, 2004



Appendix D-3: The LS layer of the Kwai Noi Upper River
Source: Prepared by Author, 2004



Appendix D-4: The R layer in the Kwai Noi Upper River
Source: Prepared by Author, 2004



Appendix D-5: Actual Soil Loss Based on Five Criteria by DLD in the Khwai Noi Upper River

Source: Prepared by Author, 2004

Appendix D-6: National Watershed Classification of 1983

Watershed Class	Physical Environment	Proposed Management
Class 1; subdivided into	High elevation (>500 m), very steep slopes	Protected or conservation forest, headwater source
Class 1A	High elevation and very steep slopes	Permanent forest cover
Class 1B	Similar to 1A, yet partly cleared for agriculture and settlement	Should be reforested or kept as permanent agroforestry
Class 2	High elevation and steep to very steep slopes	Commercial forest, with logging and grazing allowed
Class 3	Uplands (200-500 m) with steep slopes	Fruit tree plantation, grazing, agricultural crops
Class 4	Gentle sloping lands	Upland farming, row crops, grazing, fruit trees
Class 5	Gentle slopes, flat areas	Lowland farming, paddy fields and other crops

Source**:** Tangtham (1992: 5)

Appendix D-7: Watershed Classification Topography

Slope	WSC	Geography	Soil type	Suitable
>8 %	5	Flat plain	Very shallow	Agriculture (paddy field)
8-16 %	4	Flat land	Shallow	Agriculture (agronomy, fruit tree, crop production)
16-35%	3	Foothill	Medium shallow	Agriculture (economical forest, fruit orchard)
36-60 %	2	High mountainous	Medium soil	Forest plantations (national park, wildlife sanctuary)
<60%	1A, 1B	Highest mountain	Deep soil	Preserved forest area

Source: Chankaew (1983).

Appendix D-8: Watershed Management Unit Characteristics

Watershed Management Unit	**Typical area , mi^2**	**Influence of impervious cover**	**Primary planning authority**	**Management focus**
Catchment	0.05-0.50	Very strong	Property owner (local)	BMP and site design
subwatershed	1-10	Strong	Local government	Stream classification and management
Watershed	10-100	Moderate	Local or multi-local government	Watershed based zoning
Subbasin	100-1,000	Weak	Local, regional, or state	Basin planning
Basin	1,000-10,000	Very weak	State, multi-state, or federal	Basin planning

Source: Schueler (1995) and Reimold (1998).

BIOGRAPHY

NAME	Mrs.Shanana Rodsoodthi
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