

An interdisciplinary study on existing land use and natural resource management in Klong Sathorn village, northeastern Thailand

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Abstract: This paper presents the results from interdisciplinary research project entitled “Existing Land Use and Socio-economics in KhaoPhuLuang-Wang NumKhieo Forest area: A case study on KlongSathorn Village, Northeastern Thailand”. The project was interdisciplinary problem oriented and put the emphasis on participation of local communities and relevant institutions. Researchers from various disciplines including geographic information system (GIS), agriculture, forestry, environmental science, social science and economics worked together and closely cooperated with local people in the study area during late 2001 and early 2002. The outputs from the project have been used as teaching materials in the master program on Sustainable Land Use and Natural Resource Management at Kasetsart University (KU-SLUSE) and are expected to be useful to the relevant agencies.

Key words: Interdisciplinary study, GIS, land use, natural resource management, local community.

Introduction

In spite of a high economic growth rate during 1983-1989 problems of income distribution and rural poverty in the Thai economy remained (Punpiumrath, 1990). Sustainable development required alleviation of rural poverty. Most rural people were still poor and had to rely on natural resources to make their living. The main source of income was agriculture. Inappropriate land use resulted in natural resource degradation. Increasing the area of farm land via forest conversion and the application of agricultural technology had an adverse impact on the environment. Moreover, a lack of good farm management resulted in degradation in land as well as other natural resources. Examples included soil erosion, lower soil fertility, lower water quality and a poor water supply. Farm costs were higher while farm prices were lower leading to unsustainable development. In the eighth National Social and Economic Development Plan (1997-2001) the emphasis was upon an improved quality of life and better natural resource management. In the present plan (2002–2006) the focus is on economic recovery through a self-sufficient economy according to the Royal concepts. The targets were on poverty alleviation and uplifting life quality. The KhaoPhuLuang – Wang Nam Khieo Forest Area is an example of an area with problems of land use. Communities in this area were settled in the buffer zone adjacent to the Kao Yal national park. There are various types of land use including housing, agriculture and recreation. These activities have had an impact on natural resource abundance including forest, water, land, and the environment. Klong Sathorn Village was selected as a case study area and investigated in order to determine recommendations for sustainable land use and natural resource utilization. In order to support the national strategy on capacity building of human resource related to land use and natural resources management, an area base with the interdisciplinary approach was used as a guideline. The project was problem oriented and put the emphasis on participation of relevant stakeholders. Researchers from various disciplines worked together and closely cooperated with local community in the study area. The outputs of the project were used as teaching materials in the master program on Sustainable Land Use and Natural Resource Management at Kasetsart University

(KU-SLUSE) and are expected to be useful to the relevant agencies.

The study attempts to gather basic information from a selected study site to compliment planning on sustainable land use and natural resource management. A geographical information system database will be developed. Problem identification and prioritization will be made and used in a further detailed study. Immediate objectives of this study are: (i) to collect and analyze data on physical and biological resources, (ii) to study livelihood of villagers living in buffer zone of the Kao Yai national park, and (iii) to identify and prioritize problems on land use and natural resource conservation and utilization of the community.

Materials and Methods

A preliminary survey was conducted in five sub-districts of Wang Nam Khieo district, Nakorn Ratchasima province, northeastern Thailand. Community leaders and relevant government agencies were interviewed. Basic information was collected. After analysis of the basic information, the team agreed to select Klong Sathorn village, Moo 5, Wang Hmee sub district to be the first study site with the objective to expand to other locations in further studies.

Klong Sathorn village, located in LumPhraPleung watershed was selected as a case study on land use and natural resources management at community level in the KhaoPhuLuang - Wang Nam Khieo forest area due to the reasons were as: (i) it is an agricultural land reform area, (ii) it is on the buffer zone of KhaoYai national park, (iii) there were immigrants coming into the area for agricultural land use, (iv) there are problems with water supplies, and (v) the community depends on forest resources.

Once the study site had been agreed upon, the researchers from each discipline collaborated in determining the research framework (Fig. 1) and developed a structured questionnaire for the village’s household survey. A number of 127 samples households from the total of 133 households in the village as reported in GorShorShor 2 Kor (Department of Community Development, 2001) was interviewed. Overall picture of households including household structure, land tenure, income, living expenses,

agricultural practice, and community problems was investigated during November 2001 to May 2002. Information from the survey was employed for further detailed or in-depth study in each discipline as:

Geographical Information System: Spatial, non-spatial (attribute) and other data were collected from the maps of various institutions. Interpretation of remote sensing imagery and field survey using GPS were conducted. The ARCVIEW and PC ARC/INFO were used for establishment of data base system. The data were classified and grouped following data dictionary made. The baseline data helped to facilitate efficiency among the researcher in each discipline.

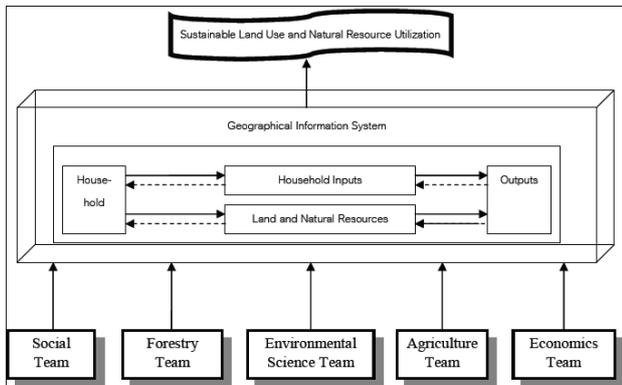


Figure 1. Conceptual framework.

Agriculture: Team together with the economic team selected 37 farm households from the 127 in the previous household survey. A questionnaire for in-depth interview was developed. The selected households were interviewed. The study covered preparation of data on cropping and agricultural land use. Constraints in land use were identified

Forestry: Team conducted preliminary survey of the community. 92 sample households from the 127 households were selected to study the relationship between forest and villager's livelihood using a structured interview. Forest dependency and potential on farm forest development were investigated using rapid rural appraisal (RRA) techniques e.g. direct observation, mapping, etc. Group discussions were organized to wrap up the findings.

Environmental Science: Team collected and analyzed data on weather, hydrology, geology, water quantity and quality; they surveyed plants and animals in a community forest near by the village.

Social: Team conducted a social survey on 127 households and conducted semi-structured interviews with key informants including local officials and community leaders, in-depth interviews, nonparticipatory observation, a historical study, geographical ground survey, community mapping and topographic modeling.

Economics: Team collected secondary data about the study site and assessed the economic conditions from RRA, interviewing local officials and community leaders. General data from the 127 household surveys were analyzed. The analysis of farm household was conducted from the in-depth interviews with 37 farm households, in collaboration with the agricultural team. The analysis

covered household structure, land tenure, revenues, living costs, debts, agricultural problems, farm costs and returns, and economic problem of land use. During the completion report preparation, research teams collaborated in organizing a community meeting to present their findings to the community and relevant agencies in the area, as well as to brainstorm for feed back to the problems identified. Together, the research teams compiled research results and integrated problems of land use and natural resource management in Klong Sathorn village; synthesized the issues; and analyzed their causes, effects and inter relation.

Results and Discussion

The findings of each study team were elaborated in the six final reports (Duronget *et al.*, 2002; Jintana *et al.*, 2002; Narangajavana *et al.*, 2002; Saksoong *et al.*, 2002; Srijantr, *et al.*, 2002 and Tongpan *et al.*, 2002).

The advantage of GIS technology for contributing towards natural resource management is related with the spatial extent of the area. In this study, the general information was separated into three levels as shown in Fig. 2. The first was the basic information at the watershed level, which consisted of province, district and sub-district, in map A, such as Wang Nam Khieo district. The second was the sub-watershed level, which consisted of many villages, in map B, such as Lam Phra Phloeng 1 catchment area. The third was in the community level, which consisted of one village (many households), in map C, such as Klong Sathorn village.

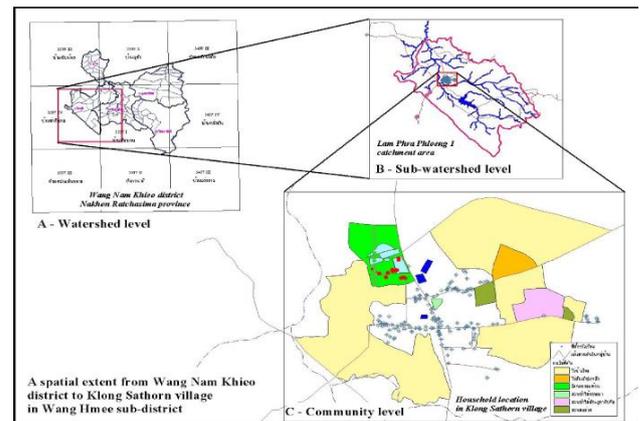


Figure 2. A level of information related with a spatial extent.

Most of the land in Klong Sathorn village is located in an agricultural reform area, the degraded forest area which the government allocated for farming. Nevertheless, according to this study there were land use problems that led to the farmers' inability to keep their farmland. Low farm income, inappropriate agricultural systems, weak community organization, and dependency on forest resources were found to be the major problems relevant to sustainable land use in the village. The following results give a synthesis of the problems as observed by each discipline. Important problems are considered together with their causes and effects as well as their interrelation. Solutions to the problems are recommended. The synthesis conducted as indicated in the diagram showing the relations of problems of land use and natural resource management in Klong Sathorn village (Fig. 3).

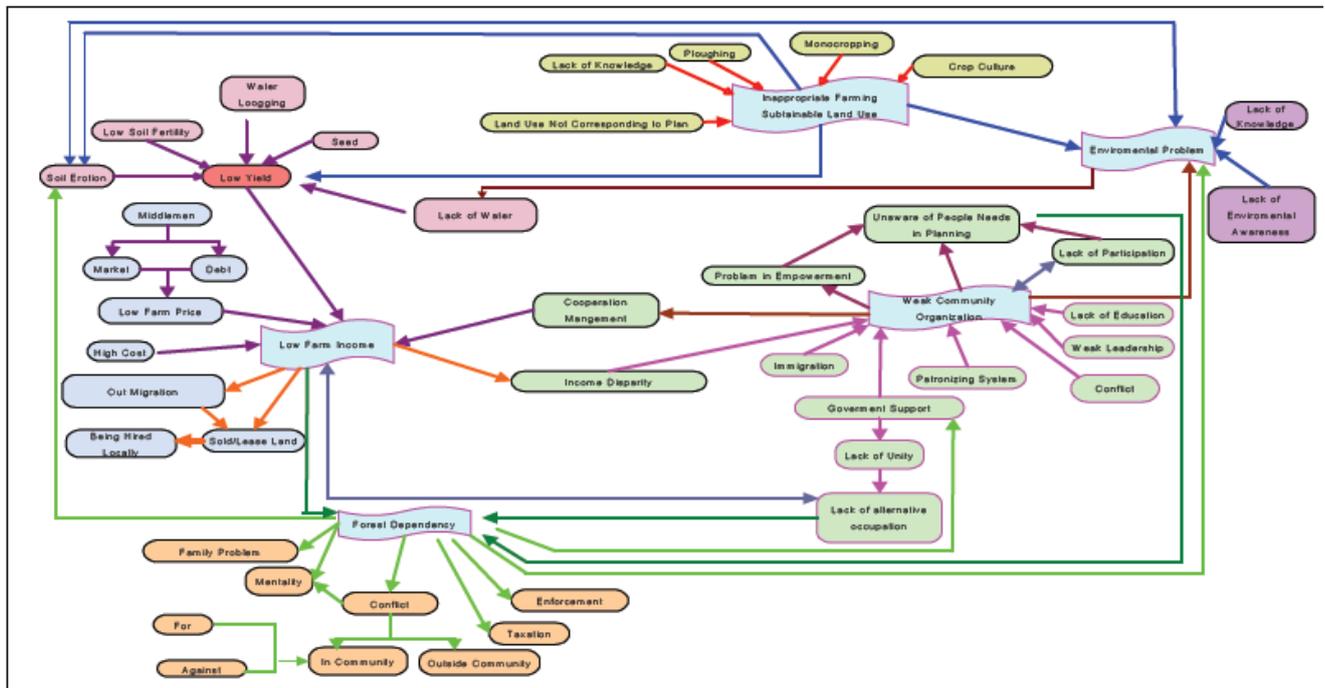


Figure 3. The relations of problems on land use and natural resource utilization in KlongSathorn village

Inappropriate farming systems: Most of the farmland was upland. None of the field areas were irrigated. The soil types were mainly sandy and loamy sand with a clay layer at a depth of 50-70 cm (Anurakpongsathorn, 1996). The rain absorbed underground accumulated over the clay strata. Farmland was obstructed by road and farm dikes, this resulted in water logging. Heavy rainfall induced water logging which resulted in growth and yield of fruit trees and other perennial crops.

Usually the cultivated land was left uncovered during the dry season. Farmers ploughed along the slope. Heavy rain during the early cropping season led to washing and erosion of top soils, thus reducing soil organic matter. Soil erosion caused increasing of sediments in natural water sources and reservoirs. Artificial ponds and reservoirs of the households became shallow within a short period. Though KlongSathorn village locates close to a reservoir namely LamPhraPhloeng 1 but the villagers could not obtain water for farming. The reservoir was constructed mainly for trapping sediments and no irrigation canal was available. Cultivation of maize and other crops was reliant upon rainfall. In the case of drought or a long dry season, those crops would be damaged.

In KlongSathorn village, rice was grown for household consumption. Limiting of land, the rice planting area was small. Maize was the main cash crop. Most villagers grew maize once a year and repeated cultivation on same land for a long time. Such practices led to high risk of disease and pest spreading. They had to apply more chemicals to get rid of diseases and to control pests, leading to negative impacts on the environment e.g. water quality. A lack of household's labour increased the number of hired labours, thus farm costs increased. Though the yield and price of maize was relatively low, villagers were bound to grow maize. Due to lack of investment funds, farmers relied on middlemen who advanced seeds, pesticides and chemical

fertilizers for growing. After the harvest, they had to sell maize to merchants who were their lenders, thus they did not have any bargaining power. This practice continually on the same land without any soil maintenance and resulted in soil erosion and low soil fertility e.g. phosphorous and potassium contents were found particularly low. Farmers had to increase the application of fertilizers year by year to maintain crop yields. Slashing and burning of crop remains and weeds before ploughing occurred and this was mismanagement as it led to soil degradation and lower soil fertility. Ploughing and growing maize up and down the direction of slope resulted in increasing soil erosion and rapidly decreasing soil fertility.

Inappropriate agriculture, mono-cropping system had a high risk of a low price for farm production and of causing environmental deterioration. Multiple cropping and integrated farming including livestock could recycle farm resources. Farmers would be less dependent on inputs from non-farm sources. In spite of a smaller cash income from the products and more complications in marketing their produce, multiple and integrated farming could yield a better overall income, in cash and in kind. These methods also reduced the risk from lower prices and environmental damage. Villagers would have more agricultural activities, thus reducing out migration to the non-agricultural sector as well as outside the village. Growing a main crop followed by a marketable short-lived nut crop would increase farm income and on the other hand increase soil fertility.

Forest dependency: Klong Sathorn villagers had been long accustomed to gathering forest products from KhaoYai national park both for household consumption and for sale, especially among the first settlers. Economic and social land development via commercial agriculture or mono-cropping did not lessen the necessity of the villagers'

forest dependence. This led to problems in natural resource management through the years.

Being adjacent to KhaoYai national park, the villagers were familiar with the utilization of forest products for their living, for commercial, and for recreation purposes. While waiting for the maize harvest, they looked for work outside the community. If they could not get any job, they would go back into the village and gather forest products to make their living. Allocating land for agriculture did not lessen forest dependence. A number of farmers sold their land to wealthier people who had access to better social opportunities. These landless farmers turned to rely on forest resources for their survival. It is a burden for the government to monitor and capture those violating the Royal Decree on National Parks B.E. 2504 (1961). Some illegal forest product gathering had negative impacts upon biodiversity in the area, e.g. cutting agar wood trees and hunting. This became a social indirect tax as the number of government forest guards had to be increased. When violators of the law were captured they could be jailed which might cause family problems and adverse impacts upon the family. For example, when the father was jailed, the family leader could not earn income for the family and children might be unable to attend school.

At the same time, there was conflict in the village since some villagers did not agree with illegal forest products collection in the national park as some government agencies could cut their assistance for community development. On the other side those violators lacked alternative job opportunities, especially among those landless and hired farm workers who were unemployed when the maize cropping and harvesting season was over. A lack of understanding between the villagers who had to rely on forest products and the priest who tried hard to increase public awareness on resource renewal (including timber products from agar wood and *Hopea*, and a calm natural scene) for the community was clearly observed. Studies in many areas have indicated that dependence on natural resources was related to the size of land holding and income. Social and economic conditions had clear impacts on the intensity of natural resource dependence (Beer and McDermott, 1996). From this study it was also found that the volume of household forest product gathering was inversely related to size of land holding and income. Households gathering more forest products were those with small land holdings or without farmland and low income households. Due to a lack of alternative job opportunities, some farmers changed to earn income from illegal forest product gathering in the national park. It was noticed that the first settlers insisted on utilization of forest from the national park which could be explained by their usual practice as well as their culture.

Promotion of resource renewal for the villagers' own utilization, e.g. domestication of wild species and agroforestry could reduce forest degradation. Government and relevant agencies could offer support and assistance for organizing an agroforest group among those interested, and recommend appropriate integrated land use and natural resource utilization from production through to utilization and marketing. The target should be on sustainable local ecosystems and uplifting the

community's social and economic status. Development of alternative job opportunities for better income among households with limited or without farmland could decrease destructive forest dependency. For example, the community should participate in ecotourism in the national park and in forest co-management in the protected area including forest fire control, protection and rehabilitation of the forest.

Environmental problems: Villagers in Klong Sathorn migrated from diverse locations including the upper central and north-eastern provinces. Struggling for survival led to a lack of interest in environment and natural resource conservation. Most of these villagers did not adequately realize the importance of environment relevance to their life quality. Moreover, a weak local organization made collaboration difficult on community activities. Natural resource utilization was forced by forces from outside the community.

Besides being located in a low rainfall area, the change from forest into agricultural land had an impact on the soil properties, the quality of topsoil which used to be abundant in organic matter and had good water absorption changed. According to the GIS, the area was sloping with underlying laterite clay which had a limited capacity to retain rain water for agriculture. Runoff quickly flowed into streams. Agricultural land lacked sufficient water resulting in low yields. The hydrological potential of agriculture in Klong Sathorn village was low.

Weak community organization: An important social problem in Klong Sathorn village was a weak community organization. The causes of this problem diverted including of settlement, the patronage system, improper government support, weak community leadership, limit of knowledge as well as education among the villagers, and income disparity resulting in different social status. Villagers migrated from various areas at different time and were of different status. The background of the villagers was varied, thus it was difficult to collaborate and establish a strong community organization. There was a patronage system within groups of villagers. Groups were numerous. The patronage system constrained co-operation in the overall community, and limited efficient collaboration. Different social status and income disparities among the villagers were found also to be a cause of failure in community collaboration.

The villagers were not highly educated. They had to work hard to make their living, thus they could not participate regularly in collective activities. A weak leadership and a lack of absolute decision making resulted in an inability to develop strong community organization.

Government support which did not accommodate community needs also led to conflict in the community due to inequities in getting support. This was another cause of community organization weakness. Government planning which did not take into account the needs of the community, local empowerment where the community had not been ready to take charge of administration and management, as well as a village development project which was politically oriented resulted in government support being a constraint on the building capacity for community organization in Klong Sathorn village. The

effects of weak community organization resulted in problems in empowerment and lack of local participation which resulted in planning which could not accommodate local needs. These were obstacles for community development. A lack of participation led to an inability to develop community organization. Weak community organization resulted in inefficient extension of job opportunities, adverse impacts on household income and living conditions, forest dependency, and environmental conditions since there was natural resource extraction but lack of proper management.

Low farm income: The most important economic problem of land use in Klong Sathorn village was low farm incomes. This problem was related to two other economic problems i.e. income disparity and a lack of alternative job opportunities. These problems were also related to other non-economic problems.

Low yields, high costs of production, and low farm price were the causes of low farm incomes. Inappropriate farming, an agricultural problem, was the cause of low yields and high costs. Weak community organization, a social problem, resulted in low income. Weak community organization also led to management problem in agricultural co-operation and a lack of alternative job opportunities which were the other two causes of the problem on low income. The impacts from low income were household income disparity, land leasing and/or selling land, working outside the community. A lack of local job opportunities was both a cause and effect of low income.

Besides low yield, a low farm price was another cause of low farm income. Villagers were bound, being in debt, to sell their harvests to a limited number of buyers. Their market opportunity was restricted. A high cost of production was another factor of low farm income. Villagers had to pay high interest on their farm loans in terms of lower farm prices. They had to apply chemical fertilizers. These were the results of inappropriate farm practices. Lack of efficient agricultural cooperation was another factor of low farm income leading to the inability in input procurement, lack of market opportunity, and lack of bargaining power. Inefficient agricultural co-operation was a result of weak community organization which was a social problem of Klong Sathorn.

Other social impacts of low income were improper government intervention and a lack of unity in the community. Some government interventions such as the Village Fund which was introduced into the village while community organization was still weak led to conflict among villagers. Diversity among villagers constrained collaboration of economic activities which could provide villagers alternative sources of income. Due to a lack of local job opportunities, villagers had to rely on farming. They selected crops according to the middlemen's demands. The main crop was maize which earned low income. Lack of alternative job opportunities was also a result of low income. Poverty made it unaffordable for householders to invest in a better occupation. In spite of the existence of higher earning jobs, the farmers did not have access to invest in such opportunities.

Due to low farm income, some farmers leased or sold their land. Leasing land earned an assured income. Farmers did not have to take risk in cropping. Nevertheless there were small farmers whose income from leasing or selling their land (or land rights) could not cover their living costs. These farmers became hired workers, and so changed their social status. Due to low incomes in Klong Sathorn, some capable family member chose to work outside the community earning higher incomes. Currently some households in the village relied on income sent to them by their family members who worked outside the village. Such behaviour reflected unsustainable land use. Local people had to leave home to work in the other areas to secure their income.

Furthermore, low farm income resulted in income disparity between former settlers and new comers. Low income households were usually farm households. Some households sold their land and turned to be hired farm workers.

New settlers, when transportation was more convenient, were usually richer, being capable of earning higher incomes than those who previously lived in the community.

Their incomes were different. Income disparity resulted in difficult collaboration among these villagers. There was social conflict, thus weak community organization. Low income in Klong Sathorn village was the main economic problem. It was a result of inappropriate agricultural systems, the main agricultural problem, and weak community organization, the main social problem. Causes of low income were low farm prices, high costs, low yields, inefficient agricultural co-operation, and lack of alternative local job opportunities.

Low farm price was a marketing problem, the farmers were bound to their middlemen. To solve this problem, there should be a search for new market opportunities and releasing farmers' debt burden with the middlemen. New market opportunities may be possible if the community could collaborate to perform economic activities. Nevertheless, weak community organization was a hindrance to such opportunities. High costs and low yields resulted from inappropriate agricultural practices. Recommendations for appropriate agricultural systems are a key to reducing the problem. Inefficient co-operative management and a lack of alternative job opportunities were results of weak community organization which was a social problem.

Solutions to low income are to find higher earning job opportunities locally. Recommended alternatives are agro-wood forest gardening, rattan processing, and ecotourism. There was a need to strengthen the community organization as well as correcting the problems in agricultural co-operative management to increase the bargaining power and economic opportunities. Agricultural practices should be improved using appropriate farm technologies in correspondence with location, market and profitability.

Conclusions and Recommendations

Results of the study reflect unsustainable land use in Klong Sathorn village. Low incomes, especially farm incomes, resulted from inappropriate farming leading to

low yields and high costs. Weak community organization was the other cause of low incomes. Farmers had to farm as demanded by the middlemen. Low incomes and poverty increased forest dependency and natural resource utilization, a tendency to negative environmental impact. Klong Sathorn village is a case study elaborating unsustainable development. In spite of government allocation of land, farmers could not maintain their land. They sold land rights to those who were wealthier and became hired workers or moved to work in other areas.

Integrated farming in place of mono-cropping (which was maize according to the middlemen's demands) is one of the solutions to low farm incomes. Nevertheless, cultivating alternative crops requires investment funds and market opportunities. Better transportation provides market opportunities for farmers from Klong Sathorn village. They have the opportunity to deliver their merchandise to nearby markets. There are several markets i.e. at Pak Chong and Wang Nam Khieo districts which are whole sale markets. To deliver merchandise to such markets, they must gather an adequate large volume to cover transportation costs. If the villagers can collaborate for such economic activities, market opportunities can be developed.

Problems of indebtedness and a lack of investment funds should be alleviated. Actually, there are various funds available in Klong Sathorn village, e.g. the Village Fund, the Economic Community Fund, and the Agricultural Development Fund which were allocated by the government. Due to weak community organization, management of these funds has not been adequately efficient. If these problems could be lessened, these funds could be available to reduce the debt burden and for investment for better earning economic activities.

Strengthening the capability of community organization is an immediate solution. The diversity of community members, variety of immigration from different locations, times and status make collaboration difficult. Nevertheless, from the report of the social team, there was social interaction among nearby neighbours and relatives. They regularly got together for social events. This collaboration was within different settler groups. Collaboration can be initiated at this level. Government should take a coordinating role and provide villagers with the necessary infrastructure as the starting point for collaboration among such groups. Strengthening community organization will increase awareness on the values of natural resources and environment since group ownership is more valid than individual ownership. This will lead to alleviating environmental problems and maintain forest resources for sustainable utilization.

Appropriate agricultural systems, extension services for local job opportunities, building up opportunities in income generation, and adding value to village products will increase the income and thus quality of life in correspondence to the improved infrastructure. These will lessen the problems of selling land rights, thus maintain villagers in the area, to protect their land and natural resources.

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References

- Anurakpongsathorn, I., Wannarak, C. and Phoasrithongkom, P. 1990. Report of Land Use for Cash Crops in Nakorn Ratchasima: Official Document book no. 139, Land use project in accordance with land use planning, Division of Soil Survey and Classification. Land Development Department, Ministry of Agriculture and Co-operatives, Bangkok.
- Beer, de J.H. and McDermott, M.L. 1996. The Economic Value of Non-Timber Forest Products In Southeast Asia. 2nd ed. The Netherlands Committee for IUCN, Amsterdam.
- Department Community Development. 2001. Database Questionnaires at village level (Koe Cho Cho 2 Koe). Copied document.
- Durongdej, S., Na-Tharang, S., Stiramom, O. and Sinthunawa, S. 2002. Research Report on Existing Land Use and Socio-Economics in Khao Pu Luang-Wang Nam Khieo Forest Areas: Sub-project 6: Social Research: KU-SLUSE, Kasetsart University, Bangkok.
- Jintana, V., Maneekul, R. and Sunthornhao, P. 2002. Research Report on Existing Land Use and Socio-Economics in Khao Pu Luang-Wang Nam Khieo Forest Areas: Sub-project 2; Forest resources. KU-SLUSE, Kasetsart University, Bangkok.
- Narangajavana, P., Arunpraparatanana, W. and Sijantr, P. 2002. Research Report: Existing Land Use and Socio-Economics in Khao Luang-Wang Nam Khieo Forest Areas: Sub-project 1; GIS database system for Phu Luang-Wang Nam Khieo Forest Areas. KU-SLUSE and KURDI, Kasetsart University, Bangkok.
- Punpiumrath, K. 1990. Natural Resources vs Rural Development. Office of National Economic and Social Development Board, Bangkok.
- Saksoong, P., Daungpatra, J., Charubhun, N., Udomchock, V., Kaveeta, L., Pityont, B., Kermanee, P., Ngernsangsalui, C., Rungsin, W., Senawong, C., Hutacharern, C., Choldumrongkul, S. and Dhongboon, K. 2002. Research Report on Existing Land Use and Socio-Economics in Khao Pu Luang-Wang Nam Khieo Forest Areas; Sub-project 4; Resource potential and existing environment of Lum Pra Peng basin, Wang Nam Khieo district, Nakorn Ratchasima province. KU-SLUSE, Kasetsart University, Bangkok.
- Srijantr, P., Duangpatra, J., Sarobol, E., Mala, T., Sangkhasila, K., Kumlung, A., Varamit, N., Pakoktom, T., Pintarak, A., Junrungrueng, S. and Thongtuam, B. 2002. Research report on existing land use and socio-economics in Khao Pu Luang-Wang Nam Khieo forest areas: Sub-project 3; Agricultural system and land use. KU-SLUSE, Kasetsart University, Bangkok.
- Tongpan, S., Tokrisna, R., Kantangkul, P., Pongthanapanich, T., Pattana, R. and Kanjanalerk, Y. 2002. Research Report on Existing Land Use and Socio-Economics in Khao Pu Luang-Wang Nam Khieo Forest Areas: Sub-project 7; Existing socio-economics study of community and household in Klong Sathorn village, Wang Hmee sub-district, Wang Nam Khieo district, Nakorn Ratchasima province. KU-SLUSE, Kasetsart University, Bangkok.