Socio-Economic Conditions Affecting Small Farmers' Management of Wetland Agro-Biodiversity in Dongsan Village, Akat Amnuai District, Sakon Nakhon Province, Thailand.

Yupaporn Siribut [1], Kamol Ngamsomsuke [2] and Budsara Limnirankul [3]

Abstract

Socio-economic conditions that would affect farmers' management of wetland agro-biodiversity were studied at Dong San Village, Akat Amnuai District, Sakon Nakhon Province. The objectives of the study were a) to identify management and utilization practices of wetland agro-biodiversity resources, b) to estimate direct use values of wetland agro-biodiversity products and c) to explore major socio-economic factors that would affect wetland agro-biodiversity resources management activities. The socio-economic conditions were emphasizing on food resources, income generating activities and social participation in the community. Participatory Rural Appraisal (PRA) and survey of farmers' resource management and utilization were used as key tools in data collection. The sampled population consisted of 40 households in Dong San Village. Qualitative description and relevant statistics were employed for data analysis. The study found that 21 (53%) households had owned land for growing wet seasonal rice; another 19 households had fields for other crops as consequence of annual flooding, the land productivity was usually low. Annual rice harvest averaged was 362 kg/ rai. Therefore the rice supply from the village itself did not meet the demand. So, villagers adapted their livelihood strategies accordingly to maximize the benefits from wide range of ecosystems, such as seasonally flooded forest (paa bung paa thaam), reservoirs and natural ponds. The wetland agro-biodiversity was a significant source of additional income for farmers in this area. On the average, it provides as much as Baht 114,868 of income per house per annum (Baht 84,066 from fishery products, Baht 4,574 from bamboo shoots, Baht 7,743 from edible mushrooms, Baht 2,620 from edible wild vegetables and Baht 15,865 from earthworms' products). Analysis of major socio-economic factors affecting wetland agro-biodiversity resources management activities using poisson regression revealed that household head education, household head residential time, income from wetland products and number of livestocks were significantly contributing to higher level of farmers' participation in wetland resource management activities.

Key words: Wetland Agro-Biodiversity, Socio-Economic, Wetland Resource Management, Poisson Regression Analysis

Introduction

The Songkram River is an important branch of the Mekong River in the Sakon Nakhon basin in Northeast Thailand, government considers it as a wetland site of international importance (OEPP, 1999). The Songkram River Basin covers an area of approximately 12,700 km^2. It flows through four provinces; Sakon Nakhon, Udon Thani, Nongkhai, and Nakhon Panom (MWBP, 2005). That has long been known for its abundance of resources. The large and widespread annual inundation replenishes the fish, the fertility of soil, and the productivity of the inundated forests. Local people earn their living through a combination of fishing, farming, and collecting wetland products (Blake and Pitakthepsombut, 2006). So, wetlands

[1] M.S Student, Agricultural Systems Program, Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University

[2] Department of Agricultural Economics, Faculty of Agriculture, Chiang Mai University

[3] Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University

provide very important goods and services to the society and help in sustaining critical livelihoods of wetland communities, which can be classified as a) direct use values such as fish, tourism and agriculture; and b) indirect use values such as flood control, and watershed protection (MWBP, 2003). However, high levels of human population and usage have led to increasing unplanned development pressures within the wetlands, causing many direct threats to most of the important ecosystems and endangered species for which the region is renowned. This poses a significant threat to biodiversity and environmental sustainability, and thereby to the livelihoods of the peoples.

Dongsan village, Akat Amnuai district, Sakon Nakhon where villagers are used to annual flooding and have adapted their livelihood strategies accordingly to maximize the benefits from wide range of ecosystems, such as seasonally flooded forest (*paa bung paa thaam*), reservoirs and natural ponds, and paddy fields (Limnirankul and Gypmantasiri, 2007). It is one of poor villages; people in this village depend on agriculture activities. They can grow rice only one time per year with low productivity, so two thirds of income which comes from direct harvest of wetlands, and only one-third from rice cultivation. Local initiative on aquatic resources conservation and utilization has been found to be good management in this village.

This is worldwide concern that lost of agro-biodiversity would affect rural livelihoods. Agricultural intensification has led to widespread decline in agro-biodiversity across different levels, from reducing number of crop species and varieties, to decreasing natural enemy species. On the contrary, agro-biodiversity enhancing land use systems are multifunctional, producing a whole array of ecosystems services, besides biomass production. Those systems have socio-economic impacts on livelihoods of smallholder farmers. The lack of knowledge about socio-economic dimensions of agro-biodiversity has constrained the knowledgeable management of valuable resources.

Objectives

The objectives of the study were:

1. To identify management and utilization practices of wetland agro-biodiversity resources in DongSan village, Akat Amnuai district, Sakon Nakhon Province, Thailand.

2. To estimate direct use values of wetland agro-biodiversity products;

3. To explore major socio-economic factors affecting wetland agro-biodiversity resources management activities.

Research methods

Study site

The study site, Dongsan Village, is located in Phone Ngam sub-district, Arkat Amnuai district, Sakon Nakhon province and it has approximately 250 families (preliminary survey, 2007) who are mostly farmers and engaged in fishing. More than 90% of farmers in village practice subsistence agriculture, and their livelihoods depend wetlands agro-biodiversity resources.

Field survey

Both primary and secondary data were conllected in this study. The field survey was used to understand the context of study site and also the survey was carried out to gain understanding about resources management and patterns, current farmers' practice in cropping systems, crop productivity and yield, socio-economic constraints for production. Participatory Rural Appraisal (PRA) and key informant interview were employed. Socio-economic data consisted of the information on household, land holdings and tenure, land use and cropping pattern, production cost, sealable products and food situation. Data was collected by administering the structure questionnaire to the randomly sampled households. Forty households in village were randomly chosen for formal survey. The primary data were collected through interviews with two dimensions;

1) Household survey covered the following issues: a) Background information on income, livelihood activities, etc. b) Household coping strategies, etc.

2) Focus group discussion was held in village. The group consists of 7-10 people to get perspectives of actors, Villagers included in following group discussion were fisherman, rice farmers, women, elders, and leader of the village.

Data analysis

Microsoft Excel program and SPSS version 12 were used to enter the individual household data.

1. To fulfill first objective of the study, the data from the formal survey and interview was analyzed by using descriptive statistics, to address management and utilization practices of wetland resources management in study area.

2. For of the stated second and third objective, the socio-economic analyses will be emphasized on agro-biodiversity use values, and social participation in resources management. The detailed data analysis are given below.

Agro-biodiversity use values

In order to understand the values and benefits of agro-biodiversity according to FAO (2004), there are two main categories of values have been identified to: use-values and non-use values.

1. Use-values can be divided into:

- Direct use-values refer to the benefits resulting from actual use, such as for food, fodder, shelter, ritual, medicinal and commercialization. These values can be further divided into *income values* and *non-income values*.

- Indirect use-values are the benefits derived from ecosystem functions; including adaptability to marginal environments and contribution to nutrient cycling. Also, the cultural and social values obtained from agro-biodiversity (e.g. social status).

- Option values are derived from the value given to safeguarding an asset for the option of using it at a future date. These may be seen as a type of insurance value, against the occurrence of new diseases or climate change.

2. **Non-use values** include the *existence value*, for biological communities or areas of scenic beauty. The existence value is relevant to a much wider stakeholder group as it is not linked to any direct uses. For example, people may pay to see plant or animal life in another country or region that they cannot see in their own.

This study of agro-biodiversity use is part of a larger research program examining agro-biodiversity resource use in Dong San village. To forecast the agro-biodiversity use values, I had taken account only direct use value to answer the question that how many percentage of wetland resource that contribute to household. Family income including farm and off-farm income is the main economic parameter (Doppler *et al.,* 2007). It gives the economic power of a family and income generated in one year. Family income is defined as the economic benefit a family receives for the use of family owned resources (e.g. labour, land) and managerial skill of the family. So, family income was computed as follows;

Family income = (Farm income + Off-farm income)   (1)

Where income parameters describe as below;

- Farm income   - Off-farm income

  ✻ crop revenue   ✻ revenue that get from work outside of agriculture sector

  ✻ animal revenue   ✻ Social participation and resources management

  ✻ wetland product revenue

Participation in utilizing and conservation of agro-biodiversity were chosen for presentation of resources management in the community. Poisson regression analysis was employed to assess the socio-economic factors that affecting to frequency of participation in wetland resources management activities by using SPSS program, poisson regression model that can be used to predict a response variable that is affected by one or more explanatory variables. A Poisson regression model is sometimes known as a log-linear model, the regression parameters are estimated by the method of maximum likelihood.

Poisson regression model;

The basic model formulation is that the mean of the poisson random variable is a function of predictor information,

$$Log_e(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 ...$$

So, $Y = \left(e^{\beta_0}\right)\left(e^{\beta_1 x_1}\right)\left(e^{\beta_2 x_2}\right)..$ (Long, 1997)

The result of Poisson regression analysis from SPSS program by GENLOG procedure is described below:

[In Analyze $\rightarrow$ Loglinear $\rightarrow$ General $\rightarrow$ Distribution $\rightarrow$ Poisson]

That can estimate function as;

$$Y = \alpha + \beta_{X_i} + X_i + ... + \beta_{X_n} + X_n + \varepsilon$$

Where

Y = observation value in T_i (time period)

y_i = frequency of observation

x_i = independent variables

α = constant

β = coefficient

ε = error term

Results of the study

   This compilation contains a summary of information gathered between June 2007 and February 2008 during a village case study in Dong San village, Phone Ngam sub-district, Arkat Amnuai district, Sakon Nakhon province. This village was chosen because of its location at the confluence of Songkhram Rivers and its use of the floodplain as a resource of vegetable, mushrooms, bamboo shoots, fishery as well as its changing land use from a former rich and dense forest into an area with cropping fields and bamboo forest.

   The study was compiled by using data from different sources. During the village stay observations and day to day talks with people provided basic information. Data were also obtained by conducting semi-structured interviews with the village headman, teachers and other villagers on specific topics. Furthermore, some people with specific professions and middlemen in the village were interviewed on their occupations. The questionnaire was developed as a preliminary survey tool before applying an action research methodology in the village. In Dong San village, 40 households gave detailed information on their household structure and family economy within this survey.

   1. Wetland resources management in Dong San Village

   The results from the formal survey and interviews were analyzed using descriptive statistics, to address management and utilization practices of management in Dong San village.

   The following Table 1 is a summary of observations and information given during interviews. It is not complete, but shows the season of the most important activities, giving an overview of different land and water uses according to the season and the environmental setting. During the rainy season (May to October) the Mekong water level rises fast and its tributaries, like the Songkhram river, overflows and spills over the edges and the low lying floodplains get flooded for three to four month (August to November).

   1.1 Land use pattern and characteristic

     1) Elevated Area (Noon, Don**)** - the area that flooding occurs in some years

    Agricultural land use:

    - Animal raising

    - Field crops (long bean, chili)

    - Rainfed rice field (first crop)

    Forest use:

    - Collecting firewood

    - Collecting mushroom, bamboo shoots, wild tuber plants

Table 1 Seasonal calendar of selected land and water use in the Dong San village

| Activities	Calendar 2007/2008											
	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Season	hot	rain						Cold			hot	
Water level in lake	lowest	highest									lowest	
Agriculture												
- Wet season rice			Planting				Havest					
- Dry season rice	Havest								Planting			
- Livestocks (buffalos)	Tam (Thunk Pan Khan)					Nhong hae/ Home		Nhong Pla Pak/ Don Pu Ta				
- Wetland products	Bamboo Shoots				Flood				Bamboo Shoots			
	Mushrooms											
	Wild vegetables								Wild vegetables			
						Earthworms						
	Fishery											

Source: from survey, 2007
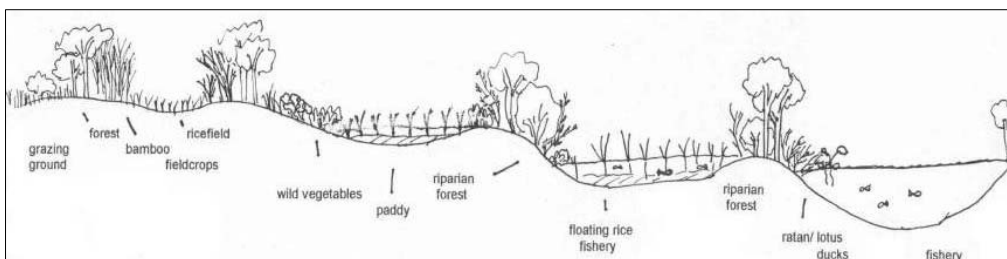
Figure 1 Land use pattern at Don San Village adapted from Thaam Moon Project ,1995

        2) Higher river terrace (Loeng) - short flooding periods occurs every year for about 4 to 6 weeks

        Agricultural land use:

        - Vegetable fields (chili, eggplants)

        - Rice fields (na seang) without plowing and replanting of seeding

        - Wetland fruit trees (Kradon, Madan, Magok Nam)

        3) Low river terrace (Nong, Hong) -- flooding perioud up to 4 months per year

Agricultural and aquacultural land use:

- Rice fields, second rice crop, plowing or replanting

- Rice field in flood-prone area(na nong) with floating rice varieties

Fishery:

- Trapped fish released in the flood-prone area after harvesting the rice, before water subsided

4) Shallow lakes on low terraces (Gud) – water available all year

Agricultural use:

- Pregrowing of rice seedings during dry season for first crop and second crops, without plowing

Fishery:

- Fishing with hooks and small nets

- Collecting of craps, shrimps, snails

1.2 Cropping strategies

1) **Cultivating Rice** The villagers in Dong San village started to grow rice for their own consumption. Now 21 of 40 households had dry season rice fields on low level land, where the second rice crop was planted during the dry season, when the flood water subsided. Before the introduction of dry season rice cultivation, farmers organized barter trade between fish and fish products for rice with other villages. The cultivation of dry season rice, which was made possible with construction of village reservoir, had improved rice sufficiency. And yet a few household with low rice productivity did not produce enough for home consumption.

2) **Livestock** According to the group discussion other on-farm income generating on-farm activities were buffalo raising (21 households own 288 buffaloes, among them 11 households earns around Baht 84,000 from sold for last year) and cattle raising (2 families own 21cows). During the dry season, when the water level in the river was low, the cattle was guided through the river to the public land (Nhong hae). Also water buffaloes were brought there. During the flooded season, cattle and buffaloes were fed with hay harvested on planted meadows. If feeding with hay is not sufficient, they were brought to the non-flooded (Nhong Pla Pak, Don Pu Ta) land on higher level areas and to the neighboring villages.

3) **Wetland Products** The floodplain and its vegetation are often compared with the traditional food storing cupboard by the villagers. To enrich the daily diet villagers bring home various leaves, fruits, flowers, mushrooms, and roots, which are eaten fresh or used with curry dishes. Even during the flooded season people collect these vegetables and bamboo shoots by boat. Most important eatable plants are bamboo shoots, the floodplain mushrooms, and leaves of wild vegetables.

2. Agro-biodiversity products and estimate direct used values of its

After survey, according to management and utilization of people in this village were classified wetland agro-biodiversity products to 5 groups as follows;

2.1 Fishery

The village areas occupied by water bodies (lakes, reservoirs, rivers) as mentioned above. The water bodies in the flooded area are used as fishery areas and also for irrigation purposes. After the annual flood decreases in October, water remains in small lakes and artificial ponds on the floodplain. These small lakes belong to the village's public land and the village headman is in charge for setting up an auction, where villagers can bid for the use of lakes during the next seasons until it is flooded again in July or August. The bidding prices depend on the size of the lakes and also on their richness of fish, according to villager's experiences. The villagers' way of life relied on fishery, which is still the main occupation with peak and low seasons. Throughout the year fish was caught mainly for home consumption. During the flooded season, and especially when the flood decreases, fishery reached its peak and fish was sold or processed.

2.2 Bamboo shoots

Collecting of bamboo shoots for selling starts in mid January, the most and best shoots are available from mid of April to June. In July, Shoots are collected mainly to meet the families' needs. In the early season, people collect the real shoots and also the sprouts at the branches. In Dong San village, paid 15 Baht for the shoots and 10 Baht for the other sprouts. In the peak season, when the shoots are easier to find, the prices decreased to 2 or 3 Baht per kg. A good collector can get 10 to 15 kg per day in the early season, and up to 40 kg in the peak season. Majority of households (98%) colleted bamboo shouts for home consumption.

2.3 Mushrooms

The important good for gatherers is mushroom specie called Hed Phueng Taam (Floodplain Honey Mushroom). Mushrooms are much rarer than bamboo shoots at the markets, but the prices are high with 60 to 80 Baht per kg. In June and July, mushroom collectors can find up to 2 kg per day.

2.4 Earthworms

During October till mid of December, collecting earthworms is the most important source of income in Dong San Village. When water level decreases, Dong San people collect earthworms and dried it for sold to middleman at the village. Prices for dry product are about 120 per Kg.

2.5 Wild vegetables

Vegetables gathered on the floodplain are leaves of trees like Pak Kradon *(Barringtonia acutangula.)* (Prayawanadon, 1960), which is eaten fresh with the local minced meat. Pak Kradon is sold all over the year and a hold (150 gr.) costs only 1 Baht. Also used as wild vegetables are flowers of some trees and climbers growing on the floodplains. Examples are flowers of Mai Khae Ba (*Dolichandron serrulata)* (Prayawanadon, 1960) these vegetables are also found in the District markets. They are very cheap, mostly one grip or bunch, enough for one dish, costs only one or two Baht.

Table 2 shows economic value of wetland products, which are gathered from wetland area. This direct use value of wetland products could be estimated by using available village price, their market price and quantities of use in one year in term of cash income and non-cash income. Price of wild plants which were used as vegetables in the household was between 1-15 baht per kilogram and value of these wild vegetables were 2,620 baht per year per household. Price of edible mushrooms was between 40 to 80 baht per kilogram, the estimated value of use was about 7,743 baht per year per household. Price of bamboo shoots was 10-15 baht per kilogram in peak season (April) and 2-3 baht in rainy season, the estimated value of direct use value was 4,574 baht per year per household. Fishery, the activity that doing during the year, price depends on kind of fish was 20 – 160 baht per kilogram, the estimated value of use about 84,066 baht per year per household. Price of dried earthworms was around 120 baht per kilogram, the estimated value of it was average on about 15,865 baht per year per household. So, total economic value of wetland products was about 114,868 baht per year per household.

Table 2 Economic value of wetland products

Activities	Cash Income	Non-Cash Income*	Total value
Fishery	11,374	72,692	84,066
Earthworms	15,865	-	15,865
Mushrooms	2,743	5,000	7,743
Bamboo Shoots	985	3,589	4,574
Wild vegetables	810	1,810	2,620
Total value	31,777	83,091	114,868

Source: from interviews, 2007

Note: *estimated from household consumption as price at Dong San Village

Thus, wetland products contributed around 80 % for livelihood of Dong San villagers, 16% from another source as rice cultivation that economic value of use was average on about 23,190 baht per year per household. And 4% from off-farm income, that economic value of it was 5,600 baht per year per household.

3. Socio-economic factors that affecting of wetland agro-biodiversity resources management activities in study area. The socio-economic analysis was emphasized on social relations and resources management given below.

In the study area, it was found that sample household, there average household size were 4 persons. Most of household head had primary education. Farming was the major work of the household in this area. Thus, mainly their income earned from farming and utilization of wetland agro-biodiversity. This study focused on both cash and non-cash incomes. Villagers earned more income from wetland products than wages from off-farm activities. It was found that agriculture investment was the main expenditure included many items such as fertilizer, fuel, rice seed, and adjustment of plot, average agriculture investment was about 21,080 per year per household. So, they have adapted their livelihood strategies accordingly to maximize profits from wetland area. Community participation in wetland agro-biodiversity resource

management under present investigation included four activities. These were 1) fish sanctuary 2) wildlife conservation, 3) Spiritual forest protection, and 4) annual tree planting on special occasions. Based on the observations, major socio-economic that influence on frequency of participation in wetland resources management activities and estimated equation are as given in Table 3.

Table 3   Socio-economic factors that affecting to frequency of participation in wetland resources management activities.

Variables	Poission Regression*	
	Coefficient	Probability
Constant	1.116	.0000
HHH_E	.2652	.0001
HHH_R	.6968	.0000
AGPI	.8234	.0673
NOB	.452	.0154
Observations	40	
Log-Likelihood	-62.25331	
R-squared	0.363	

Source: calculated by SPSS

Note: * applied poission regression analysis at significant level 0.1

So, the estimated equation;

$$PC\_F = \alpha + \beta_{HHH\_E}HHH\_E + \beta_{HHH\_R}HHH\_R + \beta_{AGPI}AGPI + \beta_{NOB}NOB + \varepsilon$$

$$= 1.16 + (.2652)HHH\_E + (.6968)HHH\_R + (.8243)AGPI + (.4520)NOB$$

at significant level is 0.10

In Model summary tells that 36.3% of the variance in frequency of participation in resource management activities is explained by four predictor variables (independent variables). When PC_F is predicted frequency of participation in wetland agro-biodiversity resources management activities in study area.

Household members who had benefited most from the wetland resources would participate in community based resource management, including utilization and consumption. There household were early setters and engaged in on-farm activities, either cropping, gathering fish or livestock raising , herding buffalos to greener pasture for feed, either on free-grazing or bringing animals to and from residential areas required knowledge on ecosystem richness, labor allocated between male and female members. The analysis also showed that education level had certain influence on farmer parturition in community resource management. However, it was also found that local regulative systems had strong impact on community participation.

Conclusion

This study found that there were land use of four patterns in study area including; *Elevated area* base on rainfed rice field, animal raising, field cropping, collecting mushrooms; *Higher river terrace* base on vegetable field and wetland fruit tree; *Lower river terrace* base

on second rice field, trapped fish; *Shallow lakes on low terrace* base on pregrowing of rice seeding and fishing with hook and small net. In this study most of household in this village are colleted and gathered some wetlands products such as bamboo shots, mushrooms and other wild plants for household food consumption but also some of them collected it for the main source of income. The villagers earned on the average 23,190 baht per year per household from rice production. The main household's expenditure concerning agricultural, investment on the average about 21,080 per year per household. So, the villager's life relied on all of agro-biodiversity wetland resource. The main socio-economic factors that influenced to frequency of participation in resource management activities were household head education, household head resident time, income from wetland products and number of buffalos was found in this study.

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