REPORT

Watershed Characterization of Prek Thnot Watershed

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Contents

I. INTRODUCTION

1.1 Background

Prek Thnot is one of the important watersheds in Cambodia due to its economic and ecological functions and cornering that its tributaries drain towards Phnom Penh. The watershed catchment is also the site where the forests connects to the Cardarmom mountain and serve as a habitat of some important flora and fauna. At the same time, the watershed is also the site for important economic developments such as rice production and industrial crop development such as cassava, sugarcane and potato. The watershed is also the site for the production of Kampong Speu Palm sugar that has gained Geographic Indication (GI) certification. Prek Thnot watershed covers the Kampong Speu and Kandal provinces and Phnom Penh Capital City. The upstream part of Prek Thnot watershed are located in Kampong Speu province and play a very important role in providing ecosystem goods and services and support the livelihoods and production systems of the upstream and downstream communities.

However, Prek Thnot Watershed is among the watersheds that is having highest risk of impairment (*Hou et al., 2004. P viii*) which leads to different disaster. In recent years Kampong Speu province has increasingly been exposed to hazards and disasters, in particular to droughts, flood, pest and diseases, and storms that affect people's food and nutrition security (*Provincial Department of Agriculture. 2013: p 2*). Managing the Prek Thnot watershed is very complex considering that the watershed is subject to various incompatible land uses. As the population increases, some of the development extends to critical area (i.e. in areas that are in steep slopes, in biodiversity-rich areas and in riparian areas). Without the sustainable use of the site may undermine the ecosystem function of the watershed. Water and water resources shall be managed and developed based on an integrated water resources management (IWRM) (*RGC. 2007. P 2)*.The IRD is currently implementing the project entitled "Landscape Approach to Sustainable Management of Forest in Prek Thnot Watersheds". The general objective of this project is to develop a spatial plan for sustainable management of the whole watershed so that a range of ecosystem services from this crucial watershed can be maintained for the benefit of all stakeholders. Furthermore, sustainable management of this watershed will provide not only the direct benefit to local community but also a range of benefit to response to climate change that we are now experiencing, storing more carbon stock in the forest, and soil erosion control.

In order to contribute to the general goal/objective of the above mentioned project, biophysical and socio-economic characteristics of the watershed are important information for planning process. The watershed characterization will complement the land allocation model and provide good information in coming up with robust land use and land allocation plan for sustainable Prek Thnot watershed management. Furthermore, the watershed characterization

will help in adjusting the land allocation based on the consultation conducted with the stakeholders (upstream and downstream of the watershed) in the watershed.

The main objective of this assignment is to describe Prek Thnot watershed through conducting the bio-physical, socioeconomic survey and risk assessments in the environmentally critical areas in Prek Thnot watershed. Thus, this study aim at answering the following questions: i) What are the bio-physical, socioeconomic characteristics, risk (areas prone to erosion/disaster) and risk reduction plan in the environmentally critical areas in Prek Thnot watershed, ii) What are the proposed developments activities of the province of Kampong Speu, the Districts and selected communes in Prek Thnot Watershed, iii) What are the socioeconomic conditions and iv) What are the major land uses of the selected communes?

1.2 Objectives

The general objective of this assignment is to characterize the watershed in term of bio-physical and socio economic characteristics as well as other development activities. Specifically, this assignment aims at answering the following questions:

- What are the bio-physical (topography, slope, etc.), socioeconomic characteristics (income, crops, livelihoods) and risk (areas prone to erosion/disaster) in the environmentally critical areas in Prek Thnot watershed?
- What are the risks reduction plans of Kampong Speou Province and Districts located in Prek Thnot Watershed, if there's any? Any risk reduction plan should show as much as possible be reflected in the map.
- What are the proposed developments of the province of Kampong Spoeu, the Districts and selected communes in Prek Thnot Watershed?
- What are the socioeconomic conditions of the villages in Prek Thnot watershed?
- What are the major land uses of the watershed?

1.3 Limitation

This study tried to capture the bio-physical data and existing maps. Therefore, most of the secondary data or existing data/maps are collected. These data come from different sources. Thus, some maps/data are recently updated while some have not yet updated.

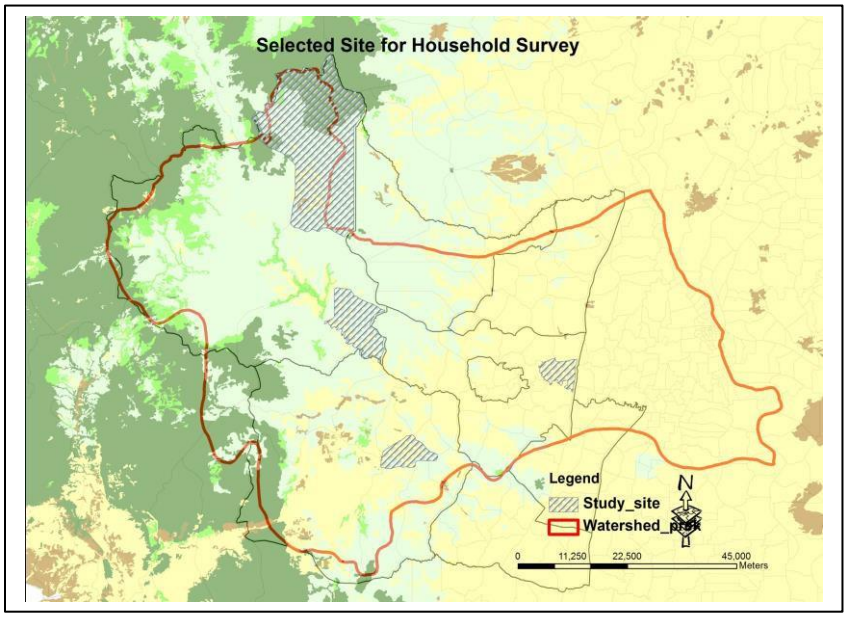
Prek Thnot Watershed located in two provinces, Kampong Spoeu and Kandal provinces, and one capital city, Phnom Penh. However, most parts and upstream part are located in Kampong Spoeu province. Household interviews are conducted only the areas within Kampong Spoeu province.

II. METHODOLOGIES

To full fill the objectives mentioned above, a team consisted of 6 people was formed up for carrying out this study. A range of activities below were employed. These activities included collecting secondary and primary data/information. The secondary data/information includes existing maps, development activities in the provinces and districts within the watershed, existing land use, and existing plan for risk reduction. The primary data includes socio-economic data/information and risk and risk reduction strategies. The socio-economic data was collected from household interview in the commune as shown in Figure 1 below while risk prone area was collected from group discussion with commune council and existing documents.

The main criteria for selection of these study sites were to represent from the watershed (upstream and downstream) within Kampong Spoeu province. The site in upstream was mostly forested area or the area that are close to forest area while downstream sites are located in non-forest area.

Figure 1: Map showing site for data collection/survey



Four communes were selected for this study. These communes include Tranpeang Kong and Haong Samnam of Aral district, Ou of Phnom Srouch district, and Tranpeang Chour commune of Samraong Tong district.

Tranpeang Chour is located in the North and the upstream of Prek Thnot Watershed was selected. This commune consisted a lot of evergreen and deciduous forest. The households from 8 villages which are namely Krang Tbeng, Plov Kor, Chrok Teak, Svay Teab, Ou Tong, Chan Ping, Chhoeu Teal Chrum, and Por Meas were selected for interview.

Haong Samnam is located in the middle of Prek Thnot Watershed. This site was mostly covered by deciduous forest. The household from Prey Totoeng, Krang, Krang Tava, Dey Chnang, Toul Thnong, Cham Pey, and Tang Robong villages were selected for interview.

Ou commune is located in the South of Prek Thnot Watershed. There were two main land use/land cover in this site, namely non-forest and deciduous forest. The households from Ou Lvea, Prey Totoeung, Svay Chrum, Krang Pnov, and Ampov villages were selected for this study.

Tranpeang Kong commune is located in the East of Kampong Spoeu province and share the border with Ang Snoul of Kandal Province. The land use in this commune is only non-forest land. The households from Trapeang Khchong, Trakeat, Thmor Bang, Lumpeng Prah Ream, and Onlong Korng villages were selected for interview.

2.1 Bio-physical data collection

The data on land use and other bio-physical data were collected from different stakeholder such as Forestry Administration, provincial, district and commune office, and other ministries such as ministry of land use, urban planning and construction, and other organization such as Mekong River Commission, CNMC, NGOs, and previous studies. The data/information related to development activities and plan for risk reduction will be collected from provincial, district and commune office, and existing documents.

2.2 Socio-economic data collection

The main primary data collection was mainly on socio-economic data and risk reduction information. In order to capture this data, household interview and group discussion were conducted within the boundary of watershed which is located in Kampong Speou Province. More than 300 households from at least 15 villages of 4 communes within the watershed area were selected for interview. Equal proportion of households/families and villages in each commune were selected. The socio-economic data was focused on income from different sources of each ecosystem in the communities and other income such as wage labour. The questionnaire was developed, trained to the enumerators, and tested before survey. The detail questionnaire is shown in Annex 1.

The Key Informant Interview were also conducted with commune councils for better understanding on risk prone area and discuss the risk reduction strategy in the selected commune.

2.3 Risk and risk reduction strategy

The data on development activities and risk prone area were collected and stored as a point in Shape file which can be used for overlaying with some other data such as land use/land cover, slope, and other biophysical data.

Biophysical data such as land use/land cover; slope, elevation, soil type, geology, and other available data were collected and stored in the form of Shape files so that they can be easily used for further analysis.

Since the socio-economic data was collected from around 300 households/observations, excel format was used for data entry and storage. The data will be then analyzed in STATA software. The analysis was focused on descriptive statistic in the form of frequency and mean.

Figure 2: Key Informant Interview with commune council

Figure 3: Household interview

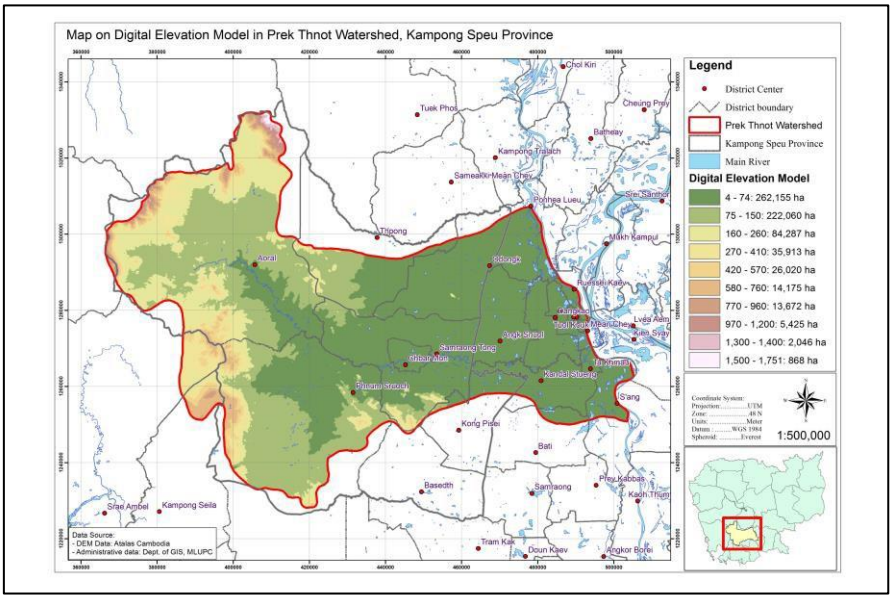
III. FINDING

3.1 Bio-physical characteristics

3.1.1 Elevation

As shown in Figure 4, most part of the watershed area are low elevation which ranges from 4 to 260 masl[1]. These areas are located mostly in the East, South, and Middle which cover 85.3 % of the total area. The second majority area is under the elevation from 270 to 960 masl. This class covers an area of 13.5% of the total land area and located along the boundary of watershed from the North, West and South-West of the watershed. The smallest portion of the watershed which covers 1.3% of the total land area fall into the classes of the elevation that is higher than 970 masl.

Figure 4: Elevation classes in Prek Thnot Watershed



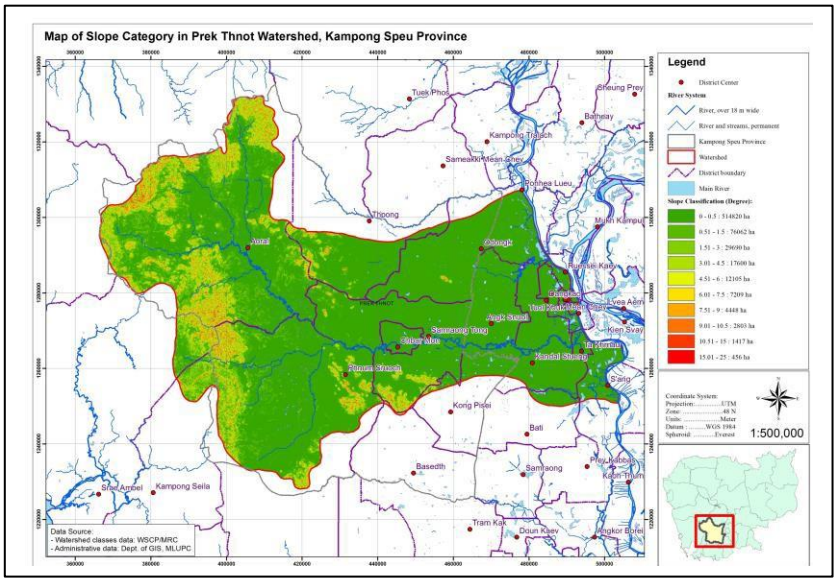
Source: Atalas Cambodia

3.1.2 Slope

The majority of the areas are very gentle slope. As shown in Figure 5, most of the area which accounted to 93.1% of the total area is within the slope range of 0-3 degree while the second majority of the area is within the slope of 3.1-7.5 degree. It is covers an area of 5.5% of the total land area. The slope ranging from 7.51-25 degree covers a small area, especially in the upstream of watershed, which accounted to only 1.4% of the total land area of watershed. The steep slope areas are mostly located in the Northwest, West, and the Southwest of the watershed along the boundary.

[1] masl= meter above sea level

Figure 5: Slope class in Prek Thnot Watershed

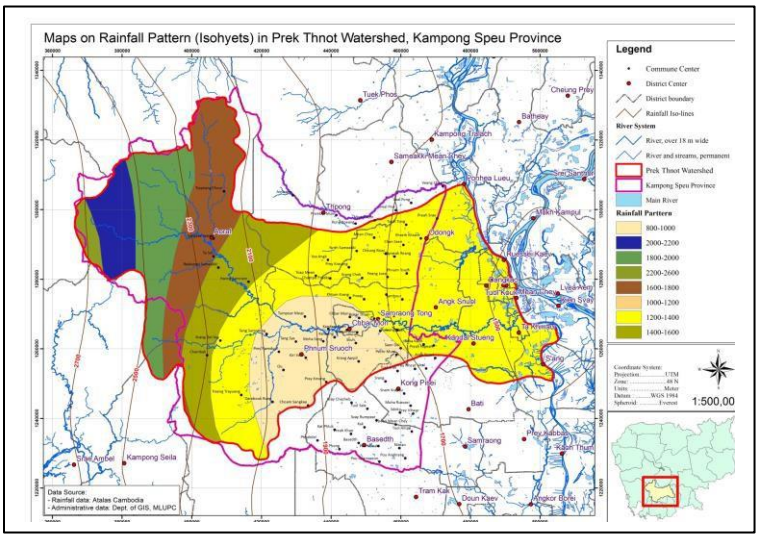


Source: WSCP/MRC

3.1.3 Rainfall

The average annual rainfall in Prek Thnot Watershed ranges from 800-2600mm. The majority of the area is under rainfall class from 1,200 to 1,400mm. This area is located mostly in the East and Northeast as shown in Figure 6. In general it is shown that the area in the Northwest and the West which is the upstream of watershed received more rainfall than the other area of the watershed while the East and the South of the watershed which is the downstream of watershed received less rainfall (800-1000mm).

Figure 6: Rainfall pattern of Prek Thnot Watershed



Source: Atalas Cambodia

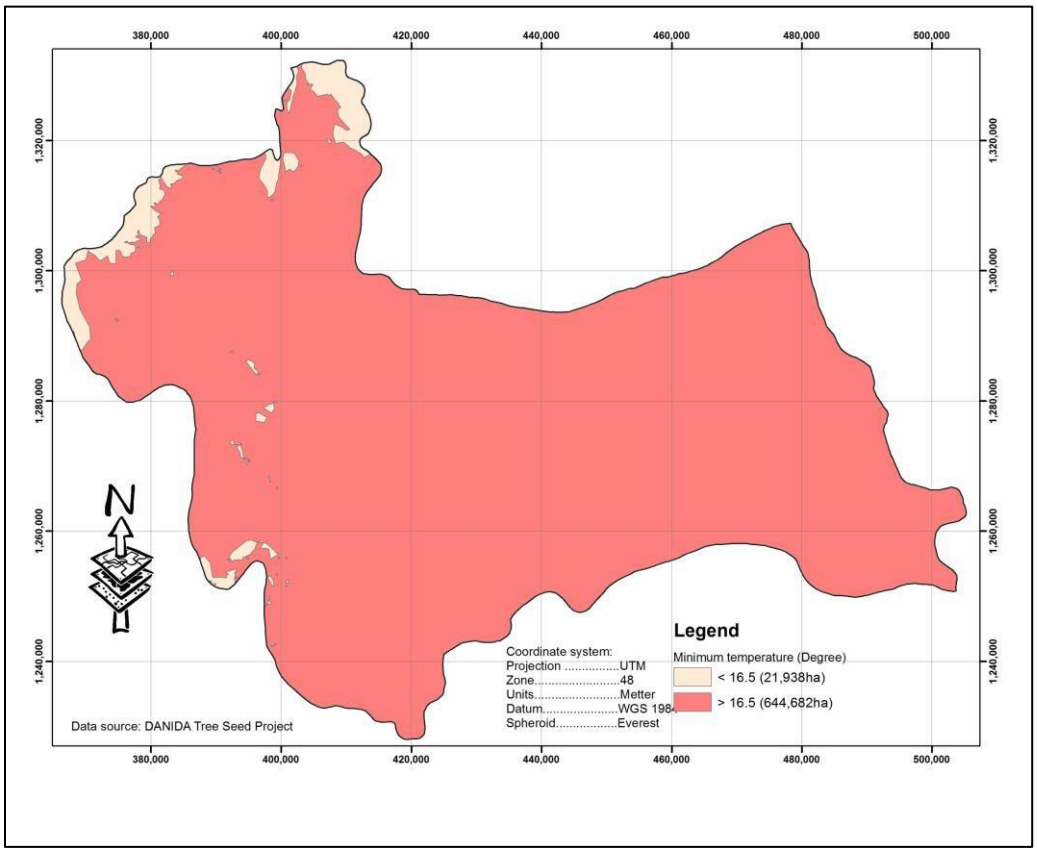
3.1.4 Temperature

The majority of the watershed areas which accounted to 96.7% of the total area are under the minimum temperature of greater than 16.5^{o}C while the small portion of the watershed which accounted to only 3.3% of the total land area are under the minimum temperature less than 16.5^{o}C. These areas are located in the North, West, and the Northwest of the watershed area as shown in Figure 7.

3.1.5 Land cover/Land uses

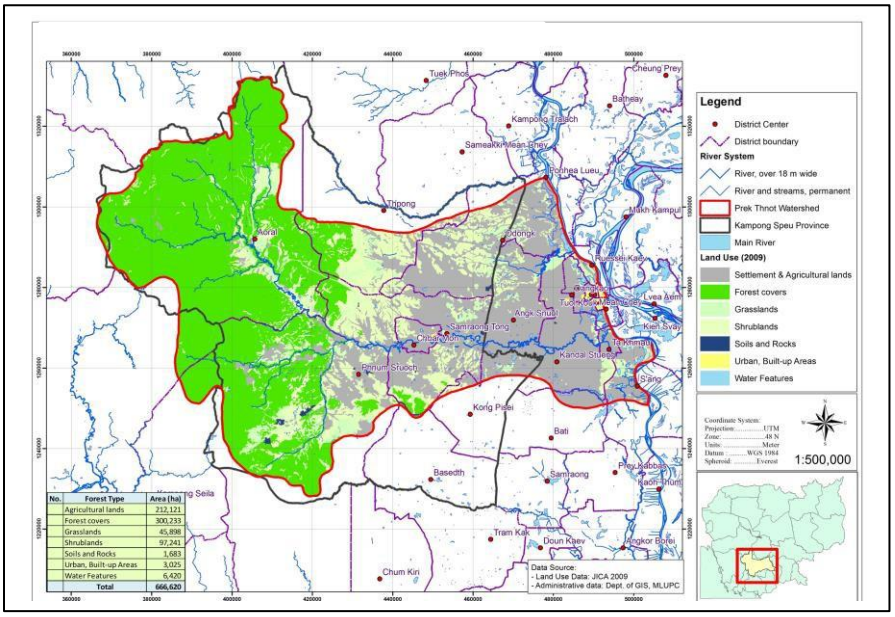
The Figure 8 bellow shows 6 main land cover/land uses, namely: agriculture and settlement, forest cover, grassland, shrub land, soil and rock, urban build up area, and water body. Among these main land use/land cover, forest area was the main land use which covers an area of 300,233 ha or 45 % of the total land ara while agriculture was the second main land use in the area which covers an area of 212,121 ha or 31.8% of the total land area of watershed and it is followed by shrub land which was accounted to 14.6% of the total land area of watershed.

Figure 7: Minimum temperature of Prek Thnot Watershed



Source: DANIDA Tree Seed Project

Figure 8: Land use/land cover in Prek Thnot Watershed



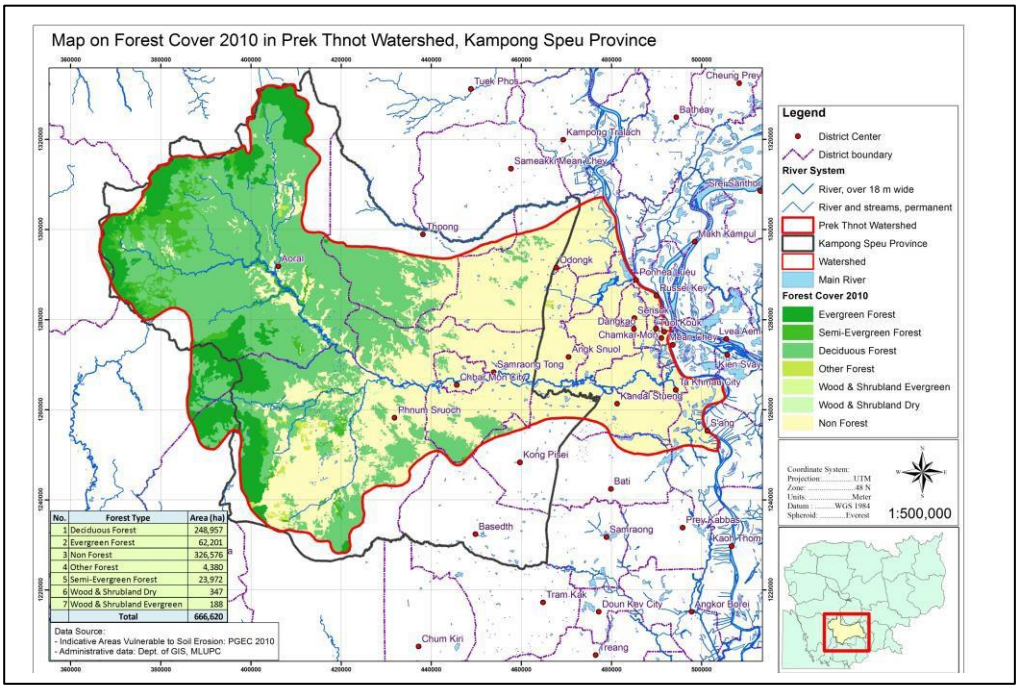
No.	Forest Type	Area (ha)
	Agricultural lands	212,121
	Forest covers	300,233
	Grasslands	45,898
	Shrublands	97,241
	Soils and Rocks	1,683
	Urban, Built-up Areas	3,025
	Water Features	6,420
	Total	666,620

Source: JICA 2009

Phnom Aural Wildlife Sanctuary is located in Prek Thnot Watershed. The sanctuary is covered an area of 253,750 ha of dry Dipterocarp, semi-evergreen forest, and small parts of evergreen forests. Aural mountain is famous due to its highest point, 1848masl. Based on the forest cover that was released by Forestry Administration (FA) in 2010, the forest cover in Prek Thnot Watershed was classified into 4 main forest cover type, namely: evergreen forest, semi-evergreen forest, deciduous forest, and other forest. Deciduous forest was the majority of forest cover in this watershed and it is followed by semi-evergreen forest (Figure 9).

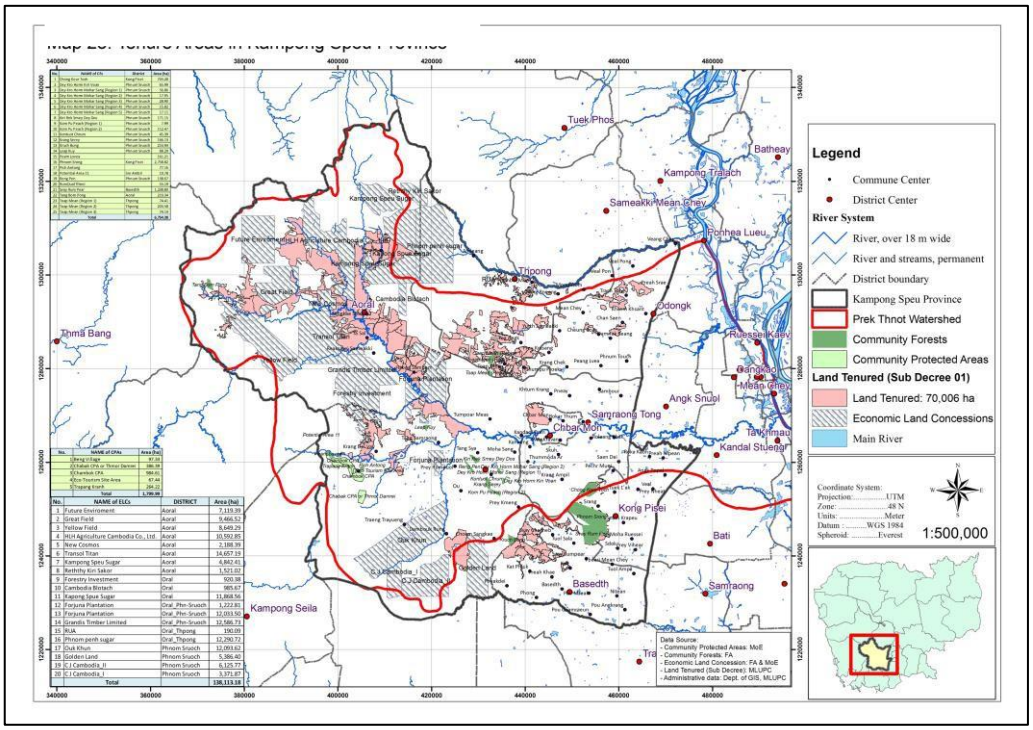
It is observed that some areas which were classified as forest cover in Figure 6 above has been allocated for Economic Land Concession (ELC), household distribution through sub-degree 01, and community forestry (Figure 10). During the field visit, most of ELCs are for industrial crop such as cassava and sugar cane while some areas have been allocated for forest tree plantation such as teak, *Techtono grandis*.

Figure 9: Forest cover in Prek Thnot Watershed



Source: Forestry Administration

Figure 10: Land uses in Prek Thnot Watershed

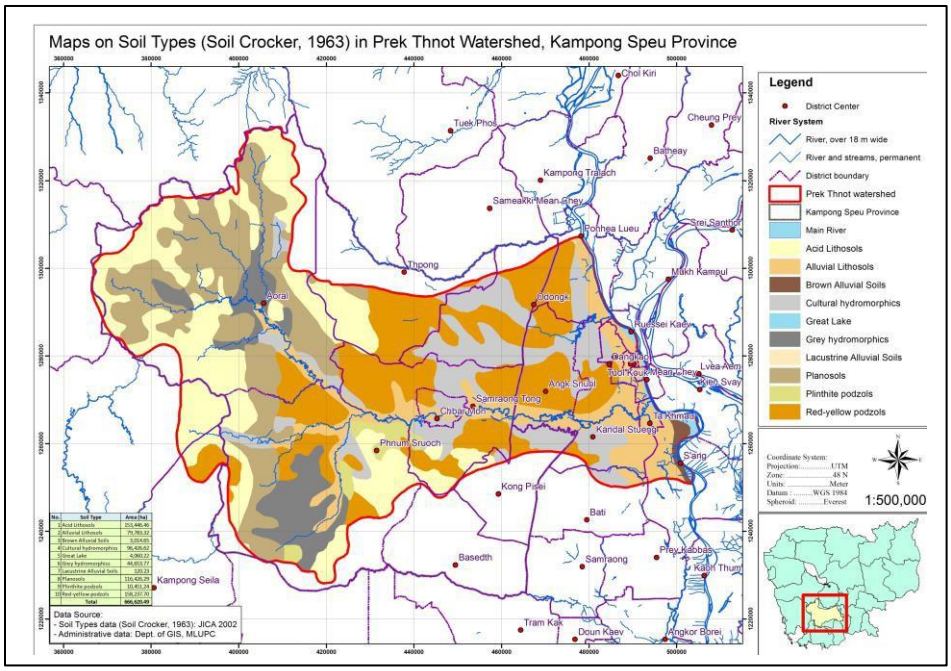


Source: Forestry Administration (community forestry), Ministry of Environment (Community Protected Areas), Ministry of Environment & Forestry Administration 2012 (ELCs), MLMUPC (Land tenure).

3.1.6 Soil types

There is no new soil survey in the watershed available during the study period. However, the old soil data that was reported by Crocker 1962 is available. Based on this soil type, the area consisted of 9 soil types as shown in Figure 11. The majority of soil type which accounted to 23.7% of the total area of this watershed is Red-yellow podzols and it is followed by Acid Lithosols and Planosols which are accounted to 23.01% and 17.47% of the total land area, respectively. Lacustrine alluvial soil type is the only smallest part in the watershed which covers an area of 120.2 ha or 0.02% of the total land area of the watershed.

Figure 11: Soil type in the watershed

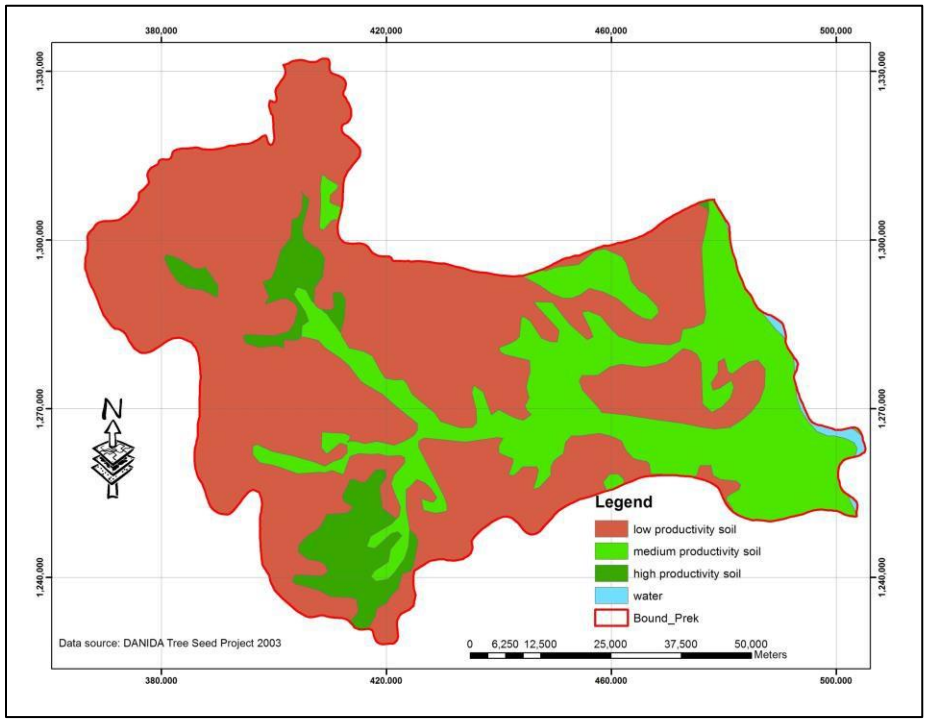


Source: Crocker 1963

3.1.7 Soil fertility

The majority (441,040 ha) of soil fertility in Prek Thnot Watershed are generally low fertility which accounted to 66.2% of the total watershed area. Only small portions (44,738ha) of the watershed are considered as high fertility soil which accounted to only 6.7 % of the watershed area (Figure 12). High fertility soil is mostly in the Northeast of watershed where the elevation is low.

Figure 12. Soil fertility in Prek Thnot Watershed



Source: DANIDA Tree Seed Project

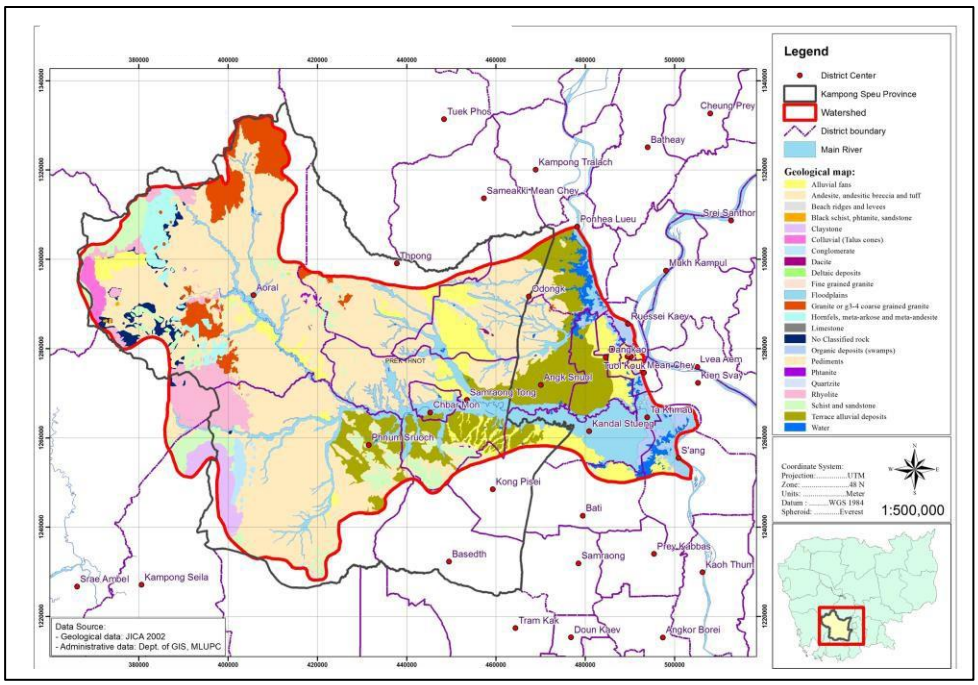
3.1.8 Geology

The watershed area formed up from different type of geology. As shown in Figure 13, more than 20 types of geology have been found. The majority of geology type in this watershed is Pediment which covers around 47% of the total land area of Prek Thnot Watershed and it is followed by Terrace alluvial deposits.

3.1.9 River system

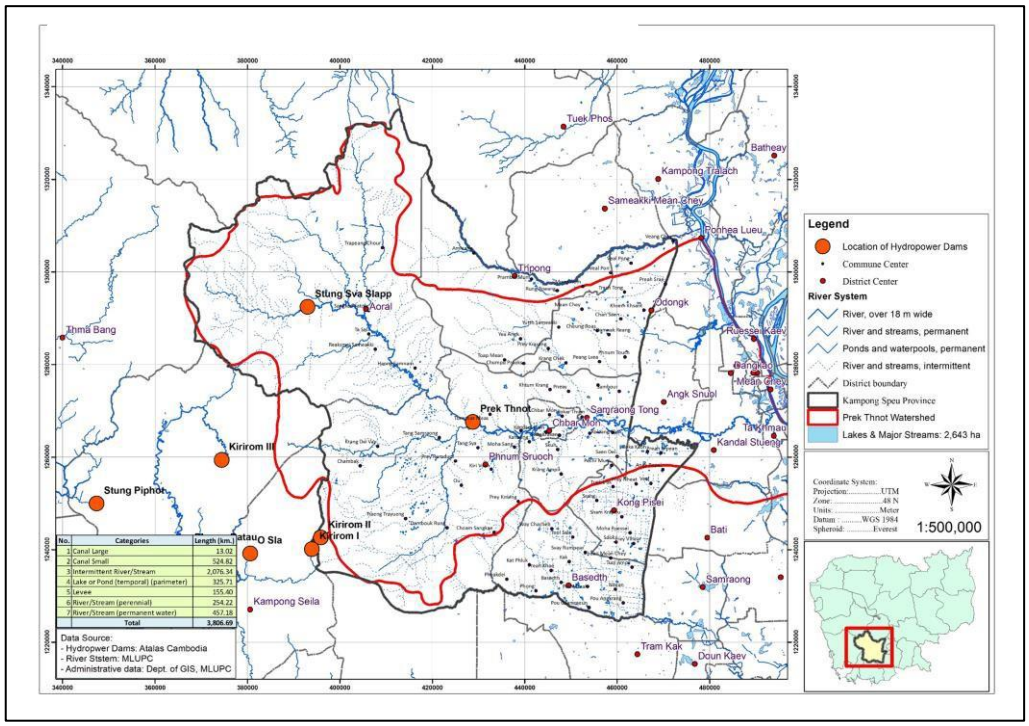
The Prek Thnot Watershed consists of different type of river system as shown in Figure 14. These river/stream system can be classified as canal, river/stream, levee, intermittent river/stream, Lake or pond. Among different type of river/stream system, the intermittent rivers/stream is the majority river system in term of its length in the watershed. This intermittent river has the total length of 1,872 km across the watershed. However, the density of this intermittent river is high in the upstream while it is low in the down stream. The Figure 14 also shows that canals are mostly observed in the downstream of the watershed in Kandal Province. This may due to active agricultural activities in this downstream area.

Figure 13. Geology of Prek Thnot Watershed



Source: JICA 2002

Figure 14. River system in Prek Thnot Watershed



Source: Atalas Cambodia for hydropower dam and MLUPC for river system

3.1.10 Biodiversity

The majority of watershed area is located in Kampong Spoeu province. Phnom Aural (Aural Mountain) which is the highest mountain around 1,813masl has been defined as Wildlife Sanctuary formed an essential part of the Prek Thnot Watershed. Because of the land use change, some forest areas have been allocated to industrial crop plantation or agriculture. Therefore, the remaining forest area is the Phnom Aural Wildlife Sanctuary. According to Birdlife (www.birdlife.org), Non-bird biodiversity in this wildlife sanctuary include: Pig-tailed Macaque (Macaca nemestrina), Slow Loris (Nycticebus coucang), Silvered Langur (Semnopithecus cristatus), Pileated Gibbon (Hylobates pileatus), Asian Elephant (Elephas maximus), and Gaur (Bos gaurus). In addition to these important non-bird species, the wildlife sanctuary is known as habitat for many other bird species as shown in Table 1.

Table 1. Important bird species within Phnom Aural Wildlife Sanctuary of Prek Thnot Watershed

No.	Species	Population estimate	IUCN Category
1	Chestnut-headed Partridge *Arborophila cambodiana*	rare	Least Concern
2	Silver Pheasant *Lophura nycthemera*	unknown	Least Concern
3	Siamese Fireback *Lophura diardi*	rare	Least Concern
4	Coral-billed Ground-cuckoo *Carpococcyx renauldi*	unknown	Least Concern
5	Blue Pitta *Pitta cyanea*	unknown	Least Concern
6	Yellow-breasted Magpie *Cissa hypoleuca*	unknown	Least Concern
7	Grey-eyed Bulbul *Iole propinqua*	common	Least Concern
8	Asian Black Bulbul *Hypsipetes leucocephalus*	common	Least Concern
9	Streaked Wren-babbler *Napothera brevicaudata*	unknown	Least Concern
10	Blue-winged Minla *Minla cyanouroptera*	unknown	Least Concern
11	Slaty-backed Forktail *Enicurus schistaceus*	unknown	Least Concern
12	Black-throated Sunbird *Aethopyga saturata*	unknown	Least Concern
13	Moustached Barbet *Psilopogon incognitus*	common	Least Concern

Source: www.birdlife.org

Phnom Aural Wildlife Sanctuary formed a very important part of the upstream of Prek Thnot Watershed where forests were in a good condition compared to other forest area within the watershed. This area was low human population density. However, due to the development activities, especially road access, people from other areas have moved in to the area within this watershed. It is observed that forests have been degraded since the 1990s due to timber harvest and land encroachment. Local villagers and immigrant cleared forests for their new-born children, settlement, and agriculture in agricultural suitable lands and at the same time

land speculation occurred along new or improved roads, thus, threatening to biodiversity resources in the watershed.

3.2 Socio-economic characteristics

3.2.1 Socio-demography

Kampong Spooeu province consisted of 151,391 families (14.8% were women headed household) or 765,302 people with the population growth rate at 2.0%. The majority of families which was accounted to 92.06% of the total families engaged in agriculture activities (*Kampong Spoeu. 2011: p 6*). After 3 years, the population was increased to 812,290 or 161,162 families in 2013 and the people involved in agriculture were decreased to only 67.61 % in 2013 (*Kampong Spoeu. 2013: p 5*) According to Kampong Spoeu Data base in 2011, there were 406,656 women which accounted to 51.2% of the total population. The average size of household was estimated at 5 persons per family.

It was also shown that the age class between 18-60 was the majority population in Kampong Spoeu Province which accounted to 53.0% of the total population while it was followed by the young generation with the age class from 0-17 which accounted to 38.9% of the total population. The rest which accounted to 8.1% of the total population was the population in the age class of greater than 60 year old *(Kampong Speou data based, 2011)*.

There were 14,121 people within the age class of 15 to 45 year old was illiterate while the students in high school was 3,873 students and university student was 1,585. The adult people who was not able to pursue their university degree go to skill training. It was reported that there were 2,622 students was register and study in the skill training in 2011 *(Kampong Speou data based, 2011)*.

Among the total families in Kampong Spoeu province, there were only 23,213 families which accounted to 14.7 % of the total families were able to access the irrigation system. It was also reported that there were 99,505 families which accounted to 63% of the total families were able to access/use chemical fertilizer.

The majority of the population are Khmer. However, it is noted that there are also Kuoy ethnic group who live in Aural district which is mostly in the middle or upper part of Prek Thnot Watershed. The areas have been known to *Kouy* ethnic people for centuries. This ethnic group consisted of 137 families in 2010. Moreover, *Kouy* populations had been increased and spread out to its northern areas of Sangke Satob commune of Aural district. The *Kouy* population in the Sangke Satob, however, was small which was accounted to only 9.9 % of the total families in Sangke Satob Commune or only 2.0% of the total families in Aural district. This is due to immigration competition from Khmer people into this area.

There were two dirt roads from Aural connect to outside world: one from Aural district town to Kampong Speu town, another from Aural to national road number 4 at Treng Traying village. The two roads, however, had never been smoothed to be able to drive a car or truck up until

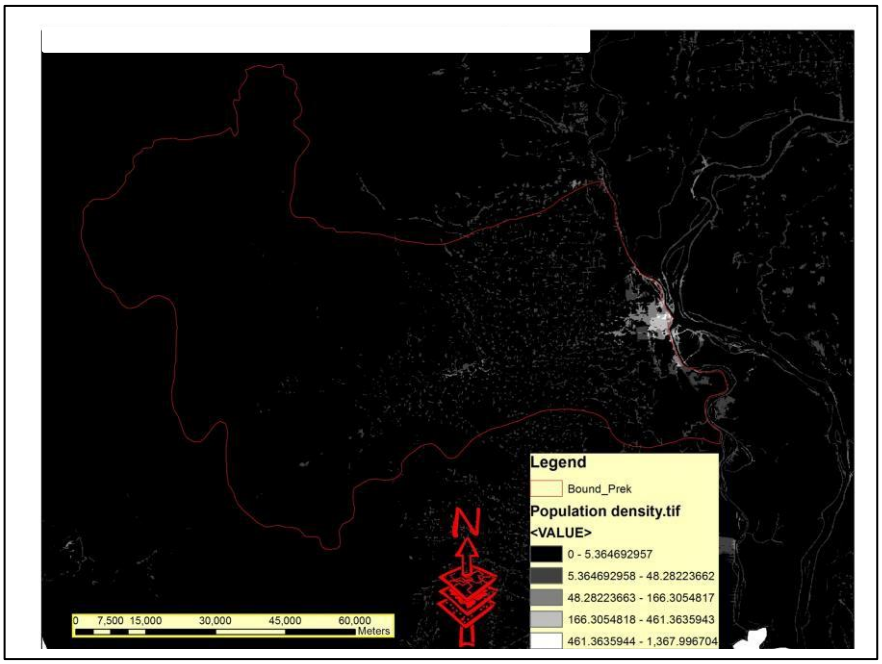
1990s. Because of roads improvement, many more Khmer ethnics came in the areas. Also, because Khmer is a national language, the young generation of Kouy ethnic people speak Khmer so the Kouy language was not heard during the survey time. All *Kouys* speak Khmer nowadays. Some of those cannot even speak their ancestors' language.

3.2.1.1 Population density

The people of Kampong Speu live in 7 districts and 1 Krong (City) composed of 82 communes , 5 Sangkat and 1,373 villages. The population density of the province was estimated at 109 persons/km^2 in 2010 (*Kampong Spoeu. 2011: p 7*) compared to an average population density for Cambodia with 82 persons/km^2 (*RGC. 2013: p i*). This population density was increased to 116 persons/km^2 (*Kampong Spoeu. 2013: p 1*)

The upstream of Prek Thnot Watershed used to be a strong hole of Khmer Rough till 1997-1998 and there were no good road access to the these area. Therefore, the population density in the upstream area was low compared to downstream part of the watershed. As shown in Figure 15, the population density in the upstream was mostly less than 6 persons/km^2 while the downstream was much higher than the upstream, even up to 1,367 persons/km^2. This high density is located in Phnom Penh Capital City. This means that activities, especially land use allocation, in the upstream would affect to many people in the downstream of Kampong Spoeu and Kandal Town as well as Phnom Penh Capital city.

Figure 15: Population density of Prek Thnot Watershed



Source: Open development Cambodia

However, due to the improvement of road access recently, people start migrating to the upstream, especially in Aural district where used to be low density and quiet place. This would lead to the degradation of natural resources in the watershed area.

3.2.1.2 Cultural characteristics

Most part of the watershed, especially in the upstream area, was difficult to access until late 2005-2006. Therefore, the people in the upstream were mostly depend on agricultural crop production and diversity of forest resources. In some commune such as Sangke Satob commune were established hundred years back, the villagers got a stable time only after last defection of Khmer Rouge in 1998. The areas were used to be fighting camps between Khmer Rouge guerrilla troupes and Phnom Penh government.

Even there are some Kuoy ethnic group in the upstream area, all of this ethnic group is now practicing livelihood activities the same as Khmer people. Most of people rely heavy on agriculture and forest product. In some districts, such as Oudong district, palm juice collection have been practiced for long time and have been encourage. Sugar palm from this district has been registered for Geographic Identification (GI) Product. Till recently with the development of road network, factory and many other industrials, many people start working with these new development project. It is noted that the older generation working industrial crop plantation while the younger generation working in garment factory and construction work. Figure 16 shows the main livelihood activities in Kampong Spoeu province, especially people in the upstream.

Figure 16. Seasonal calendar of main activities

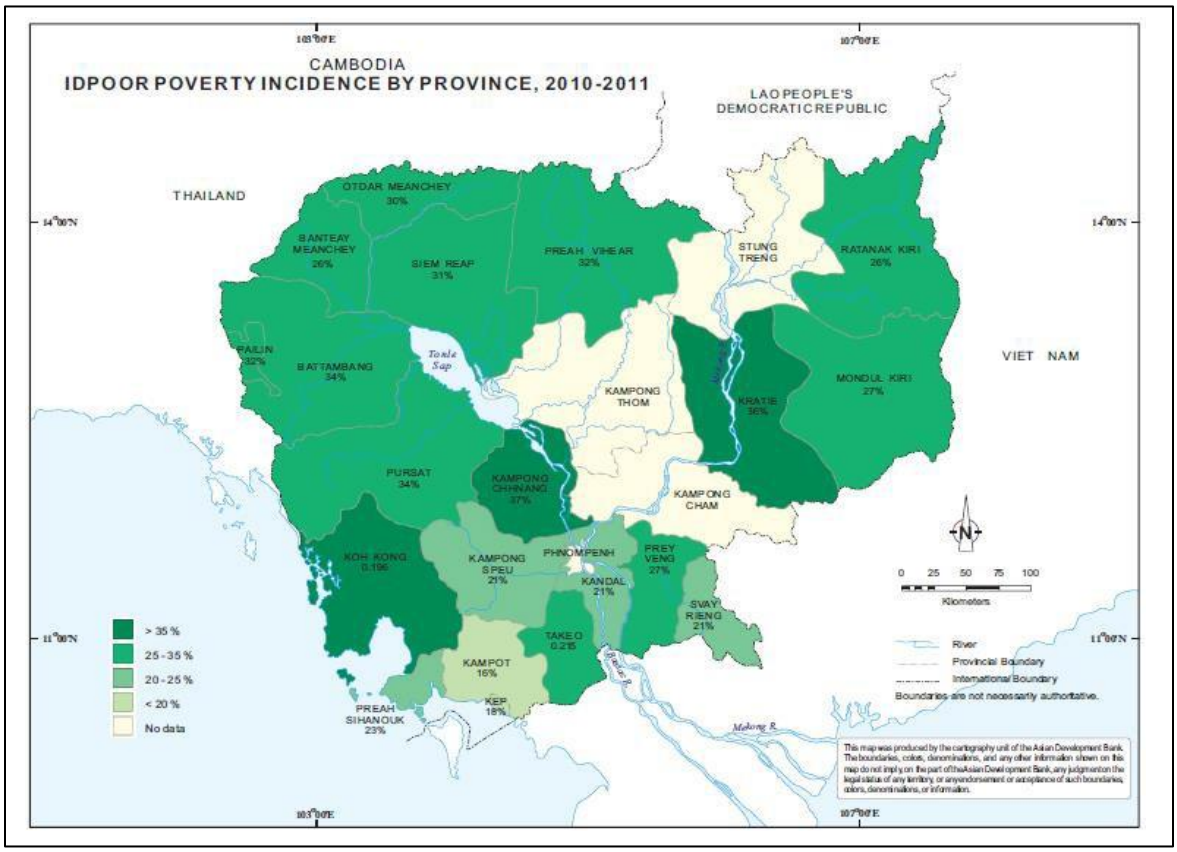
Activities	Mar	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice production												
vegetable and cash crop production												
NTFP collection												
Fishing												
Firewood collection and charcoal production	**High production**						**Low production**					
Migration to sell labour and seek employment												

Source: *Ra et al.2010: p 27*

3.2.2 Poverty

IDPoor was implemented in 2010-2011 based on participatory approaches reported that the poverty incidence in Kampong Spoeu Province was estimated at 21% as shown in Figure 17. This poverty incident is lower than most of other provinces nearby such as Koh Kong, Kampong Chnang, Takeo, and Pursat provinces.

Figure 17. Poverty incidence by province 2010-2011

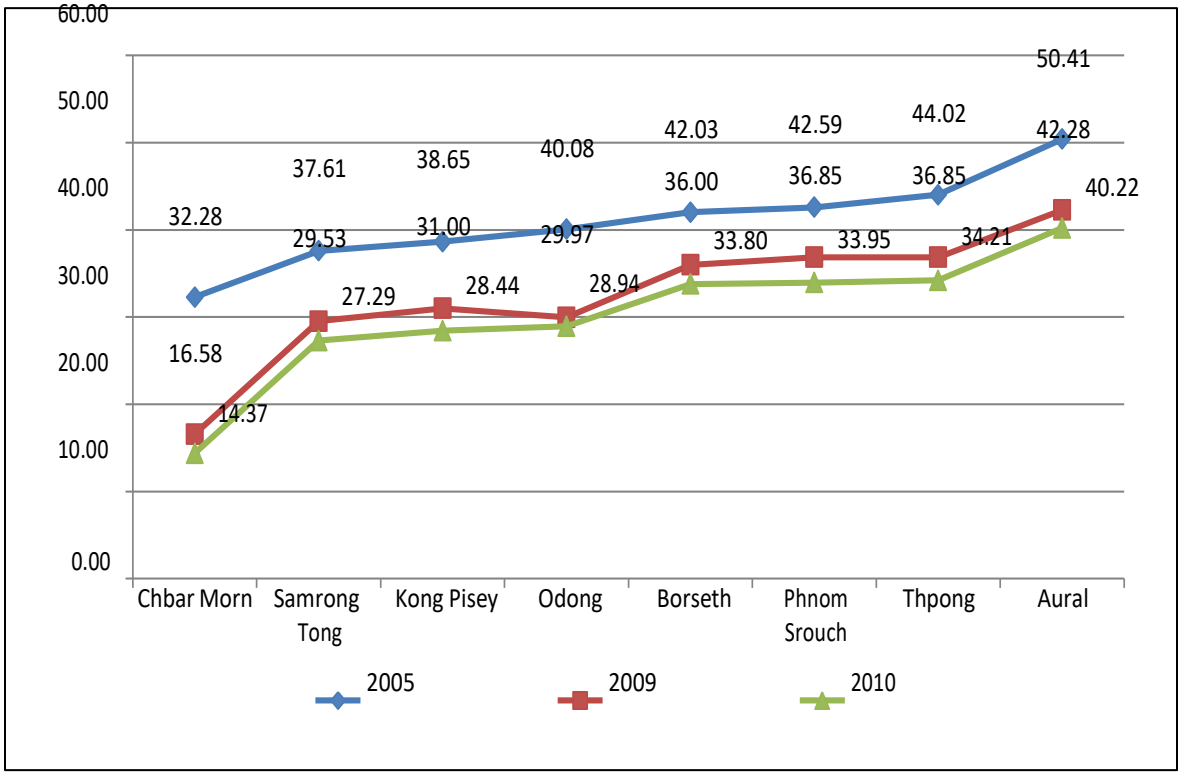


Source: *ADB. 2014: p 29*. Cambodia poverty analysis 2014.

The poverty was broken down into district level in Kampong Spoeu province. The poverty in all districts within Kampong Spoeu province was dropping down from 2005 to 2010 (Figure 18). This Figure shows that the two districts in the upstream of Prek Thnot Watershed, namely Aural and Phnom Sroch districts, had highest poverty rate than other districts within the province.

It is noted that the poverty reduction have been achieved from 2005 to 2010. However, rate of poverty reduction was slow which need to work harder from all stakeholders for achieving better results. There are many reasons that lead to poverty. These include chronological disease, limited agricultural land, illiteracy, low agricultural production, and limited irrigation system.

Figure 18. Poverty rate by districts in Kampong Spoeu province from 2005 to 2010



Source: *Kampong Spoeu. 2011: p 25*. Five year (2011-2015) development plan of Kampong Spoeu province

It is noted that Kampong Spoeu had many cases of land conflicts. These conflicts include the overlapping land title, illegal land grabbing, and unclear boundary. In 2010, there were 1,173 cases of land conflict (Kampong Spoeu, 2011). However, this land conflict was reduced from 10.04% in 2008 to 8.6% in 2010 (*Kampong Spoeu. 2011: p 31*). It was also reported that there are 10% of total population are landless because of poverty (*Kampong Spoeu, 2011: p 32 & Kampong Spoeu, 2013: p 36*)

3.2.3 Livelihood and income

3.2.3.1 Source of income

There are many different sources of income. However, these income sources are grouped into six-main income sources, namely: forest, agriculture, fishery, other environmental income, livestock, and non-farm income. The non-farm income refers to the income from selling labour and their own business. However, due to the area are mostly rural area, the income from their own business is very small while the selling labour such as working in the construction, garment factory, and also the selling their labour in economic land concession companies.

There are different incomes from forest, however, the majority of respondents which were accounted to 48.1% reported that they have collected firewood while bamboo shoot, mushroom, and charcoal production were the second, third, and fourth majority incomes from forest resources, respectively, Table 2.

Table 2. Detail of income sources

Income sources		Frequency	%
Forest			
	Charcoal	70	8.3
	Firewood	408	48.1
	Pole (for construction material)	23	2.7
	Pole (for fencing)	10	1.2
	Bamboo shoot	161	19.0
	Mushroom	130	15.3
	Meat	34	4.0
	Bamboo	12	1.4
Agriculture			
	Groceries	462	36.0
	Paddy rice	312	24.3
	Maize	164	12.8
	Pumpkin	143	11.2
	Luffa gourd	49	3.8
	Wax gourd	18	1.4
	Bean	15	1.2
	Morning glory	46	3.6
	Cassava	14	1.1
	Mango	20	1.6
	Cucumber	17	1.3
	Watermelon	2	0.2
	Banana	13	1.0
	Sugar cane	2	0.2
	Spinach	5	0.4
Fishery			
	Fish	547	52.1
	Crab and snail	374	35.6
	Frog	120	11.4
	Eel	9	0.9
Other environmental income			
	Firewood	443	44.7
	Fish	28	2.8

	Crab and snail	92	9.3
	Frog	265	26.7
	Bamboo shoot	105	10.6
	Mushroom	9	0.9
	Other vegetable	43	5.0
Livestock			
	Cow	288	40.1
	Chicken	298	41.4
	Duck	19	2.6
	Pig	114	15.9

There are varieties of agricultural products that were reported by interviewed households. The majority product which was accounted to 36% of the interviewed household that were reported was groceries. Paddy rice, maize, and pumpkin were the second, third, and fourth agricultural production in the watershed area, respectively.

Fishery is also one income source for people in Prek Thnot watershed. There are four main products from fishery. These are fish, crab and snail, frog, and eel. The majority of people which accounted to 52.1 % reported that they have collected fish from streams while the second majority was crab/snail which was accounted to 35.6% of respondents.

Other environmental income refers to income from products that were collected from natural ecosystem nearby their house or villages. Such as fish, snail, crab, frog can be collected from streams. However, these products can also be collected from rice field. Among different products that were collected from other environment, firewood was the majority product which accounted to 44.5% of respondents. Frog and bamboo shoot collection were the second and third majority products in this income source, respectively.

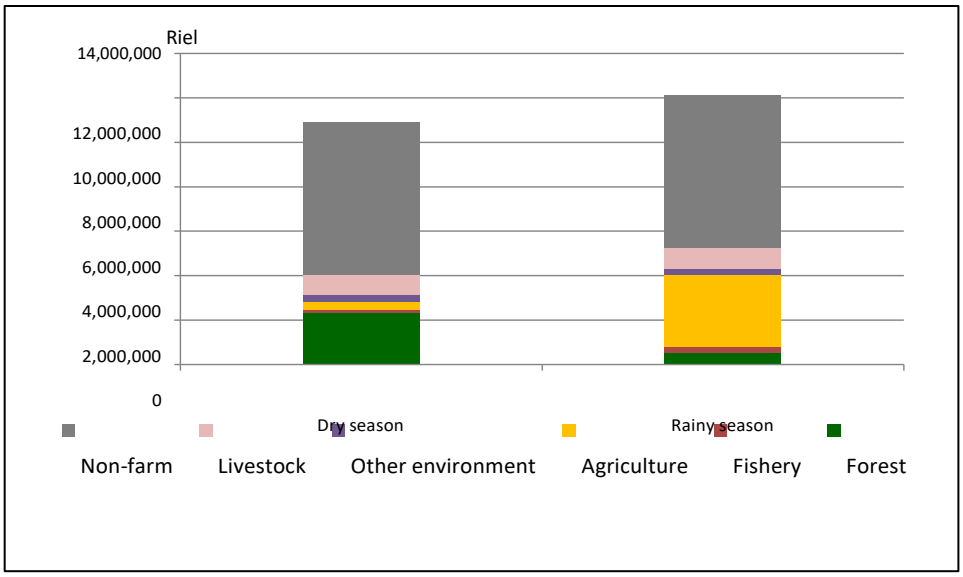
There are four main products in livestock income source. These are cow, chicken, dug, and pig. 40.1 % of respondents reported that they had sold their cow. There are many reason involve with selling their cow which used to be the main power in plowing for paddy rice production. Those reasons include i) there is limited ground for browsing their cattle, ii) the young generation which suppose to take care these cattle migrated to other places for employment opportunity or they find another job in factory.

3.2.3.2 Household income

The average annual household income was estimated at 23 million Riel. This income is much higher than in past, during 2007, which was recorded only around 2.4 million Riel (*Ra et al. 2011: p 51*). Therefore, it was about 10 times higher than in the past 10 years. This higher income contributed mainly from non-farm income. The income during rainy season was around

12 million Riel which was higher than the dry season that was only around 11 million Riel (Figure 19).

Figure 19: Annual household income share by source



The forest resources play the second main income source during dry season after non-farm income which was contributed around 22% of the total income. However, this income source was dropped down to only 4.5 % during rainy season as shown in Figure 18. It is observed that the income shares from agriculture and forest is highly fluctuated seasonally between the rainy and dry season. During dry season forest play the second main income source while the rainy season agriculture become the second main income source which shares around 27% of the total income in rainy season (Figure 20).

It is noted that non-farm income plays the first main income source for both seasons, rainy and dry season. During the dry season, this income source contributed around 63% of the total income in dry season while during rainy season it dropped to only around 57% of the total income. The variation of this income source in different season due to many new job opportunities have been created in dry season, especially construction work which are more active during dry season.

As shown in Figure 21, the annual household income shares from non-farm was around 60% of the total income and it was followed by agriculture which was accounted to around 16%. There are varieties of products produced for agriculture income source as discussed previously. Forest

resources play the third main annual income source which was contributed around 13% of the total annual income of the respondents.

Figure 20. Share of different income sources

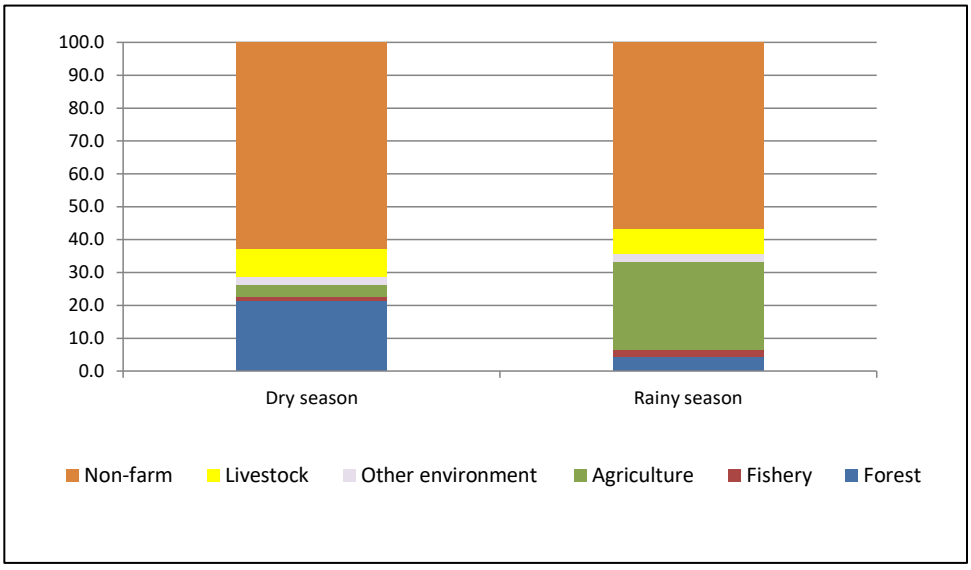
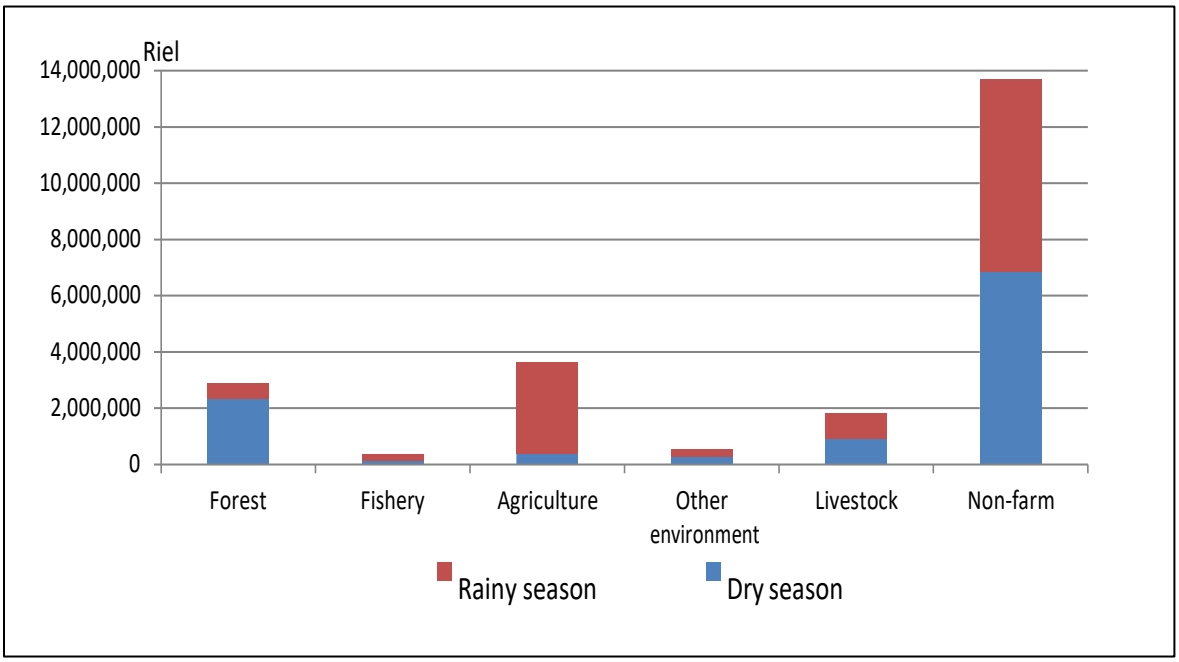


Figure 21: Annual household income share by source



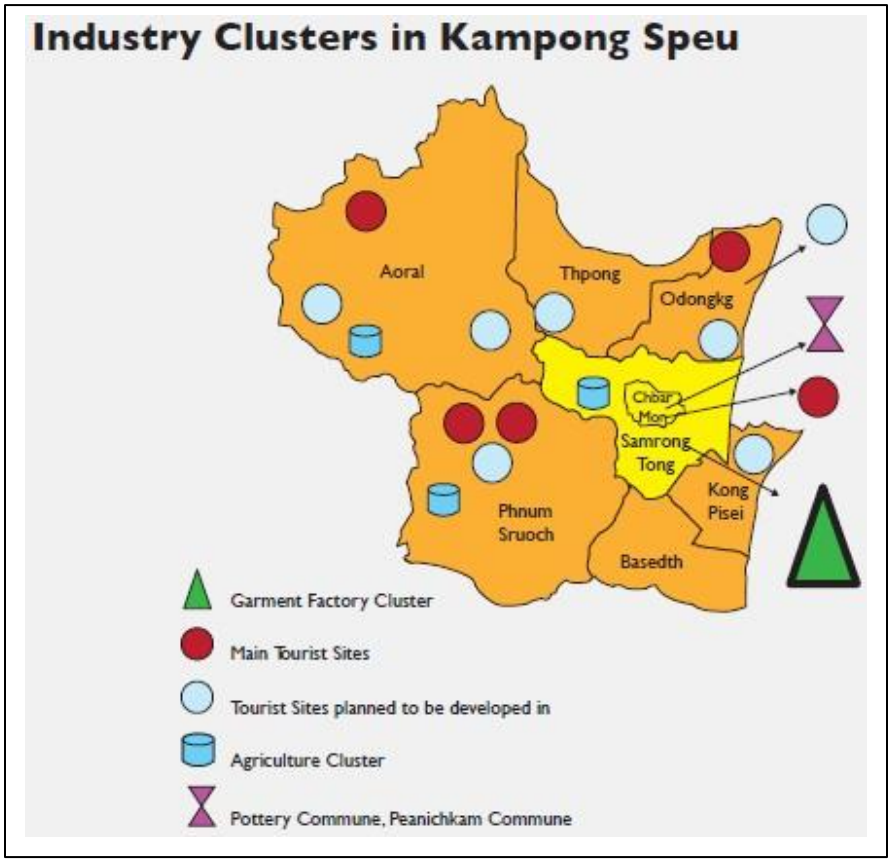
3.2.4 Investment plan of the province

Kampong Speu is home to 16 factories, around 10 of them producing garments, with more under construction. Total factory employment in the province was around 38,000. The province

believes there is potential for 20,000 more. Beside the support to tourism, the provincial government will focus on the following activities (*EMC, 2008: p 7*):

- Continued efforts to attract garment manufacturers to the province to take advantage of existing infrastructure developed by its garment clusters and access to key markets/export points.
- Attracting new investment in agriculture through improved irrigation and new investment to increase production.
- Increased skill training and infrastructure development in key areas.
- Assist businesses in finding export markets for their produce.

Figure 22. Industrial cluster in Kampong Spoeu province

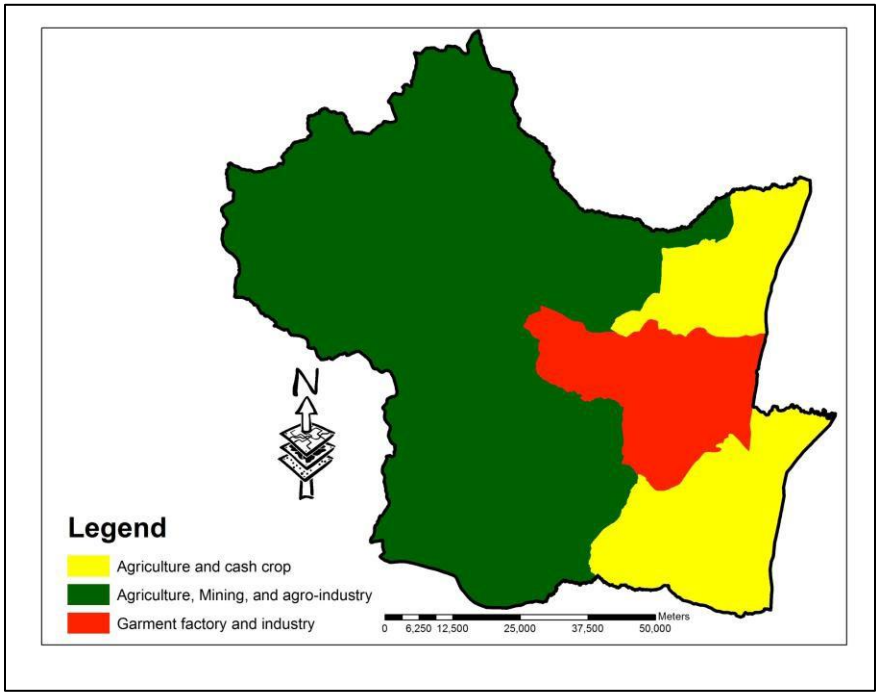


Source: Emerging Markets Consulting (EMC).2008: p 6

Samrong Tong district and Chba Morn City are highly potential for garment factory, small and medium scale industrial, craft, and other business. Most part of Aural, Phnom Srouch, and Thpong districts cover by forest. These district are suitable for agriculture, mining, agro-

industry, and livestock industry. For Kong Pisey, Odong, and Borseth district are suitable for palm juice collection (*Kampong Spoeu. 2011: p 7 & Kampong Spoeu. 2013: p 6*).

Figure 23. An overview of land suitability in Kampong Spoeu Province



Source: *Kampong Spoeu. 2011: p 7*

3.3 Main stakeholders

There are different stakeholders in managing natural resources in Prek Thnot Watershed of Kampong Spoeu province. These stakeholders include the followings:

- Forestry administration which one institution under Ministry of Agriculture Forestry and Fishery. This administration involve mainly with the management of production forest.
- General directorate of agriculture is under MAFF with the main role in managing crop and agricultural land.
- Economic Land Concession (ELC) secretariat which is under Ministry of Agriculture Forestry and Fisheries involve with the management of ELC in Cambodia.
- MOWRAM is one ministry involve mainly with water resources management including reservoir, development and construction of irrigation system.
- Ministry of Environment involves mainly on protection forest, national park, and wildlife sanctuary in Prek Thnot watershed, especially in the upstream.
- Ministry of Land Management Urban Planning and Construction involve mainly with planning of land in the whole country as well as Kampong Spoeu province

- Ministry of Mine and Energy involves with the management of mine and energy as well as identification of area for mining and energy development such as hydropower damp.
- Local authorities which is under Ministry of Interior involves mainly the management of local planning
- NGOs involves with local livelihood and also conservation of natural resources.

3.4 Disasters, Disaster Risk Reduction Management Plan of the Province

3.4.1 Potential Risk and Vulnerable Areas

Kampong Speou province faces quite often with drought and also flood and storm. Droughts are considered periods of abnormal dry weather that causes serious hydrological imbalance in the area. Drought is the most prominent hazard for agriculture sector in Kampong Speu province. Severe drought conditions occurred in 1987, 1999, and 2000. There are four main characteristics of drought affecting agricultural sector in Kampong Spoeu province (Provincial Department of Agriculture. 2013: p 6):

- Unpredictable delays in rainfall in the early wet season
- Unpredictable variations in wet season rainfall in term of amount and duration across different areas
- Early ending of rains during the wet season
- Common occurrence of drought spells of up to three weeks or more during the wet season, which can damage or destroy crops without irrigation

Floods do not regularly pose devastating impacts on agriculture in Kampong Spoeu province. Major floods occurred in province in 1994; the last flood of 2010 affected several districts, including Chbar Morn, Phnom Sruoch, Thporng, and Baseth (Provincial Department of Agriculture. 2013: p 6 &7). In general, floods in Kampong Speu are flash floods which occur due to heavy rainfall in upstream areas, with water flowing into streams and tributaries of the Tonle Sap. As a result, areas along Prek Thnoat River are among the most prone areas to this type of floods, which include Krong Chbar Morn, Samrong Torng, Aural, and Phnom Sruoch districts.

Kampong Spoeu is partially protected against strong winds by the surrounding mountains and forests. Large scale hurricanes do not reach the province usually. However, localized strong winds occur often associated with heavy rains causing flash floods and inundating crops. Damages by strong winds have been observed on farmer houses and community buildings. However, major destructions of fruit trees or crops have not yet been reported. (*Provincial Department of Agriculture. 2013: p 7*).

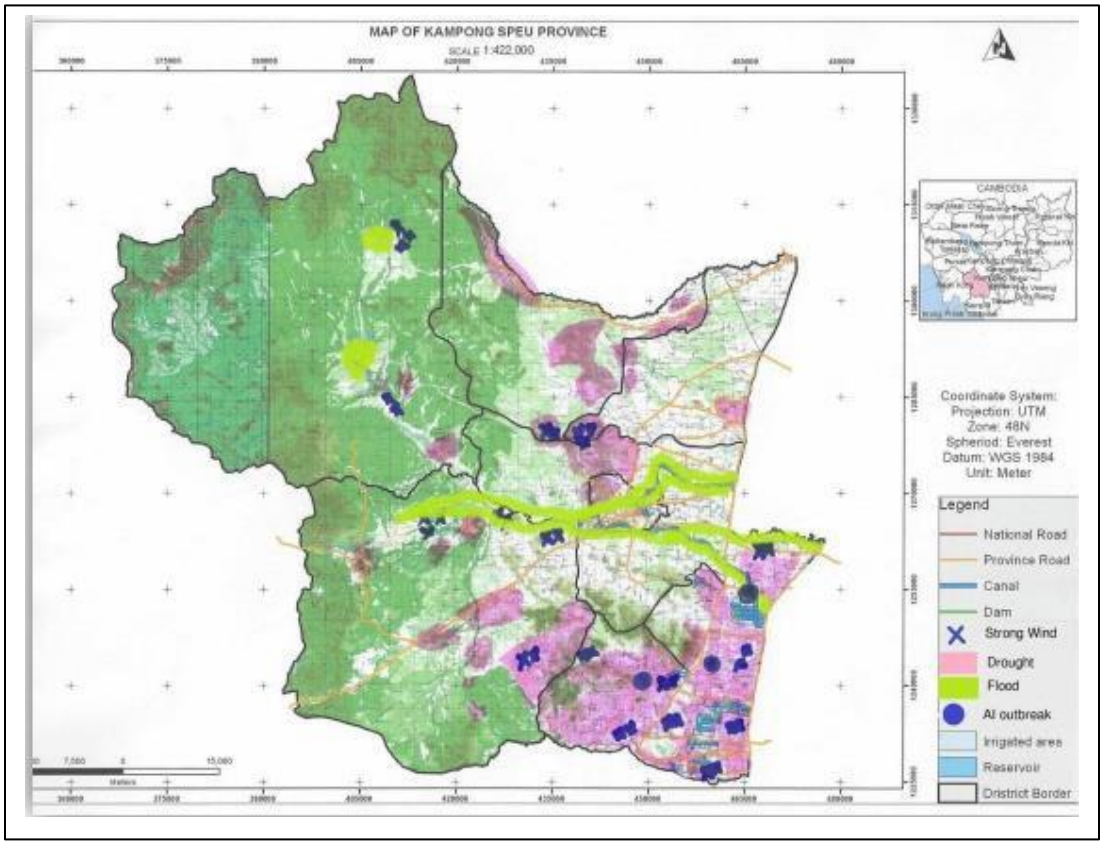
It was recorded in the provincial data base in 2011 that the majority of disaster risk in Kampong Spoeu province was drought which affected 539 families accounted to 1,478 people in 2011

while storm affected 17 families accounted to 55 people (*Kampong Spoeu data base.2011. (V_2011_K(2)).* There was no family recorded from flood in 2011.

It was reported that from 2009 to 2013, there were 16,358 ha affected by drought and the losses/damage was 865 ha. The 2013 was the major disaster in which 2,239 ha of agricultural crop, especially paddy rice were affected. Major floods occurred in province in 1994 and the last flood of 2010 affected 1,766 ha of paddy field, of which 277 hectares were completely destroyed (*Provincial Department of Agriculture. 2013: p 6*).

Most of disaster risk in Kampong Spoeu province occurred mainly in the downstream where the majority of agriculture activities have been implemented. Flash flood occurred mainly along the downstream of Prek Thnot Watershed while drought occurred in all districts within Kampong Spoeu province (Figure 24).

Figure 24. Risk prone area in Kampong Spoeu province



Source: Provincial Department of Agriculture. *2013: p 5*.

3.4.2 Risk Reduction Plan of the Province

In general, the Kampong Spoeu province has included disaster risk management strategy into its 5-year development plan for 2011-2015. This plan was mentioned only key point for coping with disaster and risk. These key points include the followings (*Kampong Spoeu. 2011: p 73)*:

- Reserving medicine, budget, and tools
- Repairing path for emergency transfer
- Repairing canal and setting drainage system
- Identify safety place
- Repairing river bank
- Warning system
- Preparing equipment and tool for emergency
- Pumping machine and gasoline
- Rice seed
- Restoring canal and reservoir
- Safety in the disaster area
- Information sharing
- Group establishment for disaster risk protection

Since the majority of population in Kampong Spoeu province is farmer, disaster risk protection for agricultural sector is very important. The Provincial Department of Agriculture in Kampong Spoeu province developed Plan of Action on Disaster Risk Reduction in Agriculture in 2013. This plan of action was developed and covered the period from 2014 to 2018. The main goal of this plan of action is to enhance capacities and resilience of farmers and communities to threats and disasters affecting agriculture and rural livelihoods (*Provincial Department of Agriculture. 2013: p 11*). This plan of action described in general for disaster risk reduction by focusing on 5 main priority actions and one cross cutting issues as followings (*Provincial Department of Agriculture. 2013: p 35*):

- Strengthen institutional and technical capacities and enhance coordination mechanisms for disaster risk reduction and climate change adaptation in agriculture:
    - Strengthen institutional mechanisms for effective coordination between line agencies and other stakeholders at provincial level for implementing DRR and CCA
    - Strengthen technical capacities of PDA, and DOA for effective implementation of DRR and CCA
- Promote and enhance early warning systems for pro-active disaster risk reduction and climate change adaptation:
    - Promote and support the exchange of data for climate services and EWSs in agriculture among relevant departments and stakeholders

- Promote the development of agriculture specific climate information and EW information products, adapted to the needs of agriculture
- Improve the communication channels for information outreach to farmers and agriculture dependent communities

- Enhance knowledge management and innovation in support of disaster risk reduction and climate change adaptation in agriculture:
  - Enhance and/or link DRR/CCA related databases to better inform planning and decision-making
  - Enhance knowledge base and promote innovation for DRR and CCA in agriculture including through good practice documentation and dissemination
  - Awareness raising and communication for DRR and CCA in agriculture
- Reduce vulnerabilities through improved technical options in agriculture and the promotion of Community-Based Disaster Risk Reduction and Climate Change Adaptation processes:
  - Promote integrated farming systems and crop diversification to build resilience of agriculture communities to disaster impacts
  - Improve animal production at all levels
  - Promote sustainable water management and conservation practices on farmer fields
  - Promote risk sharing and risk transfer mechanisms
  - Reduce adverse impacts of chemical fertilizers and pesticides in agriculture at provincial and local level
- Strengthen effective preparedness and response capacities and integrate disaster risk reduction and climate change adaptation into agriculture response interventions:
  - Enhance capacities of PDA to conduct regular contingency planning and integration regarding ongoing planning and activities
  - Improve effectiveness of emergency response actions and post-disaster recovery in agriculture and embed DRR interventions within recovery and rehabilitation measures
- Cross cutting issue:
  - Capacity development
  - Partnership
  - Gender equity

3.4.3 Development plan

The 5-year development plan (2015-2019) of Kampong Spoeu Province was develop the plan cover all sectors in the province. This development plan mentioned the strategies in managing environment, natural resources and land use in Kampong Spoeu province.

Many points have been stressed out for land use strategy. These include the followings (*Kampong Spoeu, 2015: p 79*):

- Enhance land tenure, land market, land conflict resolution, and commune land use plan
- Dissemination of related existing laws and regulations
- Transferring public land to people for agricultural production and settlement
- Mine clearance
- Review and put necessary measure to increase effectiveness of public land

Strategy for managing natural resources and environment was also set out as followings: (*Kampong Spoeu, 2011: p 81 & 82*)

- Law enforcement
- Rehabilitate and develop irrigation system
- Extension
- Enhance and conserve natural resources through econ-tourism
- Biodiversity conservation, forest plantation, boundary demarcation, and encouraging private sector for private forest establishment in degraded forest area.
- Establishment of tree nursery

The new development plan of Kampong Spoeu province from 2015 to 2019 was also developed. This new plan identified the strategy for the development of land use, natural resources management, environment, disaster and risk, and climate change as followings (*Chen.2013. p 10*):

- Dissemination of related law and regulation such as forestry law, land law, protected area law, etc.
- Training on related subjects such harvesting technique
- Equip more bean
- Assess the EIA for all project
- Commune land use plan
- Land use plan
- Land registration
- Land conflict resolution
- Law enforcement

It is noted that the development plan and investment plan in Kampong Spoeu province described the general activities that the province intend to implement. Most of identified locations for the

development plan are in the provincial town such as road rehabilitation, drainage system, and light along the road side in provincial town.

IV. SUMMARY

Prek Thnot Watershed is one among critical watershed. Sustainable management of this watershed provide benefit not only people in the upstream in Kampong Spoeu province but also people in downstream of Phnom Penh capital and Kandal Province. Land use planning in the watershed would contribute to the sustainable natural resources management.

The main objective of this study aimed at characterizing bio-physical and socio economic condition of Prek Thnot watershed. Furthermore, the study tried to capture the existing land use and risk reduction plan within the watershed area.

In order to capture these data and information mentioned above, the study employed different methodologies which included household survey for collecting socio-economic information, key informant interview, field observation, and reviewing existing document and data base. Bio-physical data were mainly derived from existing data base from different organizations.

As results, bio-physical characteristics of the area have been characterized. These include elevation, slope, land use/land covers, soil types, soil fertility, geology, river system, biodiversity rainfall, and temperature. The highest elevation in the watershed is in the upstream, around 1700masl, which are located in the Northwest and Southwest while the Northeast and East are low elevation with gentle slope. Forest cover was the majority of land use in the watershed which accounted to 45% and it was followed by agriculture land which was accounted to 32%. Among forest different type of forest cover, the deciduous forest shared the biggest area compared with other three forest type, namely: every green forest, semi-evergreen forest, and other forests. Even the forest cover was the major land use in this watershed in 2010, the current forest cover seem to rapidly decrease due to the development activities during the last several years. Some of forest area had been converted or allocated to industrial crop through the economic land concession (ELC). Most of agriculture activities are located in the low land where the elevation and slop are gentle. There are 9 soil types in the watershed. Red-yellow podzols was the major soil type in the watershed which covered 23.7% of the total land area. It is followed by acid lithosols and planosols which accounted to 23% and 18%, respectively. The low fertility soil covered most part of the watershed which accounted to 66%. Geology of the watershed consisted of 20 type. Among those, the Pediment was the majority of geology type in the watershed which accounted to 47%.

The river system consisted of canal, river/stream, levee, and intermittent river/stream. The intermittent river/stream is the major river system in the watershed with the total length of

1,872 km. The density of river/stream was high in the upstream while the downstream was lower. The average rainfall in the area is between 800 and 2600mm. the majority of the rainfall in the area was 1200-1400mm. Most of the area which accounted to 96 % had the temperature higher than 16^{o}C. Phnom Aural formed important part of the watershed. Different bird species and non-bird species were reported in this watershed while the main tree species in this watershed are *Shorea obtusa, Shorea siamensis, Dipterocarpus obtusifolius, Dipterocarpus tuberculatus,* and *Pterocarpus macrocarpus.*

Kampong Spooeu province consisted of 151,391 families (14.8% were women headed household) or 765,302 people with the population growth rate at 2.0%. The majority of families which was accounted to 92.06% of the total families engaged in agriculture activities. The population was increased to 812,290 or 161,162 families in 2013 and the people involved in agriculture were decreased to only 67.61 % in 2013. The majority of the population are Khmer. However, it is noted that there are also Kuoy ethnic group who live in Aural district which is mostly in the middle or upper part of Prek Thnot Watershed. This ethnic group consisted of 137 families in 2010. Currently, these ethnic group are practicing livelihood activities like Khmer people. The population density of the province was estimated at 109 persons/km^2 in 2010. This population density was increased to 116 persons/km^2 in 2013. The upstream of Prek Thnot Watershed used to be a strong hole of Khmer Rough till 1997-1998 and there were no good road access to the these area. Therefore, the population density in the upstream area was low compared to downstream part of the watershed. The population density in the upstream was mostly less than 6 persons/km^2 while the downstream was much higher than the upstream, even up to 1,367 persons/km^2. This high density is located in Phnom Penh Capital City.

There is no specific study on poverty in the Prek Thnot Watershed, however, the poverty incidence in Kampong Spoeu Province, as a whole, was estimated at 21% which was lower than most of the province nearby. The poverty reduction has been achieved. However, the achievement rate was slow. Furthermore, like in some other places, Kampong Spoeu province was reported of land conflict and there were 1,173 cases of land conflict in 2010.

There are 6 main income sources, namely: forest, agriculture, fishery, other environmental income, livestock, and non-farm income. The average annual household income was estimated at 23 million Reil. The share from non-farm was around 60% of the total income and it was followed by agriculture which was accounted to 16% while the forest plays the third main role for income source which contributed 13% of the total income.

There is no specific development plan for Prek Thnot Watershed available during the study. However, the development plan for the whole province of Kampong Spoeu was developed. The plan categorized some districts that are located in the upstream as the area which are potential

for agriculture, mining and agro-industry while the district located in the Southeast of the downstream (Samrong Tong district) of the watershed is potential for garment factory and industry and the district in the Northeast of watershed is potential for agriculture and cash crop.

Kampong Spoeu province faces quite often with drought. Between 2009 to 2013, there were 16,358 ha of agricultural crop affected by drought and losses/damage was 865 ha. The 2013 was the major disaster in which 2,239 ha of agricultural crop was affected, especially paddy rice. Most of disaster risk in Prek Thnot Watershed occurred mainly in the downstream where the majority of agricultural activities have been implemented. Flash flood occurred mainly along the downstream of Prek Thnot river. Disaster risk management strategy has been considered and integrated in the 5 year development plan for 2015-2019. However, the plan mentioned only the key point that need to be taken into account. In addition, the Provincial Department of Agriculture in Kampong Spoeu developed a 5 year (2014-2018) plan of action for disaster risk reduction in agriculture sector. This plan of action focused on 5 main priority and 1 cross cutting issue for disaster risk reduction which include: i) strengthening institutional and technical capacities and enhance coordination mechanisms for disaster risk reduction and climate change adaptation in agriculture, ii) promote and enhance early waning systems for pro-active disaster risk reduction and climate change adaptation, iii) enhance knowledge management and innovation in support of disaster risk reduction and comiate change adaptation in agriculture, iv) reduce vulnerability through improved technical options in agriculture and the promotion of community based disaster risk reduction and climate change adaptation process, and v) strengthening effective preparedness and response capacities and integrate disaster risk reduction and climate change adaptation into agriculture response interventions.

Like other province, Kampong Spoeu developed 5 year development plan from 2015-2019. The plan take into account the strategies on land use, forest resources, natural resources and environment, and risk reduction and climate change. However, the plan stated in general not so focus on the specific site for the development.

V. CONCLUSION

Prek Thnot is one among critical watershed in which the upstream is located in Kamong Spoeu province. The highest elevation of the watershed is around 1700 masl which are located in the Northwest and Southwest while the Northeast and East are low elevation with gentle slope. Forest cover was the major land use in this watershed. However, some of these forest areas have been converted to industrial crop through economic land concession. Most of agriculture activities are located in the downstream with the gentle slope. There are 9 soil types in the

watershed. Red-yellow podzols was the major soil type in the watershed which covered 23.7% of the total land area. The majority of soil in the watershed are low soil fertility which covers 66% of the total watershed area. The parent material for soil formation in the watershed is mostly from pediment which accounted to accounted to 47%.

The river system consisted of canal, river/stream, levee, and intermittent river/stream. The intermittent river/stream form the main part of river system in the watershed with the total length of 1,872 km. The density of river/stream was high in the upstream while the downstream was low. Most of area was in the average rainfall of 1200-1400mm and the temperature higher than 16^{o}C. Since some forest area have been converted to other land uses, most of biodiversity in this Prek Thnot Watershed are focused mainly in Phnom Aural protected area.

The population density in the upstream area was low (6 person/km^2) compared to downstream (up to 1,367 person/km^2, especially the downstream nearby Phnom Penh) part of the watershed. The majority of population are Khmer. However, it is noted that there are 137 families of Kuoy ethnic group. But this ethnic group is now practicing livelihood activities the same as Khmer people. There is no specific total population in the watershed, however, the population in Kampong Spoeu province was increased from 765,302 to 812,290 people in 2013 and the people involved in agriculture were decreased to only 67.61 % in 2013.

The poverty incident in Kampong Spoeu province was 21% which is lower than most of the provinces nearby and this poverty reduction was achieved slowly. In addition to the poverty, Kampong Spoeu province was reported of land conflict and there were 1,173 cases of land conflict in 2010.

There are 6 main income sources for local people in Prek Thnot watershed. The average annual household income was estimated at 23 million Reil. The share from non-farm was around 60% of the total income which is the first main income source while it is follow by agriculture and forest which share the income of 16% and 13% to the total income, respectively.

There is no specific development plan for Prek Thnot Watershed available during the study. However, the 5 year development plan for the whole province of Kampong Spoeu was developed from 2015-2019. The plan categorized potential the area in the upstream for agriculture, mining and agro-industry while the area located in the Southeast of the downstream of the watershed is potential for garment factory and industry and the area in the Northeast of watershed is potential for agriculture and cash crop production. The plan ste the management strategies on land use, forest resources, natural resources and environment, and

risk reduction and climate change. However, the plan stated in general not so focus on the specific site for the development.

Draught is reported to be happened quite often in Kampong Spoeu. 2013 was the major disaster year in which 2,239 ha of agricultural crop was affected, especially paddy rice. Most of disaster risk in Prek Thnot Watershed occurred mainly in the downstream where the majority of agricultural activities have been implemented. Flash flood occurred mainly along the downstream of Prek Thnot River. Disaster risk management strategy has been considered and integrated in the 5 year development plan for 2015-2019. However, the plan mentioned the key points that need to be taken into account. In addition the 5 year development plan, the Provincial Department of Agriculture in Kampong Spoeu developed a 5 year (2014-2018) plan of action for disaster risk reduction in agriculture sector. This plan of action focused on 5 main priorities area and 1 cross cutting issue that need to be addressed.

The data and information for Prek Thnot Watershed have been documented in different document, especially bio-physical data. The primary data/information derived in this study is the socio-economic data. The data collected, consolidated, and derived from this study would be very helpful for land use planning in Prek Thnot Watershed in the future.

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ANNEX 1. Questionnaire for household survey

I. Control of information

1. Task	2. Date(s)	3. By who?
4. Interview		
5. Checking questionnaire		

II. Household information

1. Interviewee name	
2. Village name	
3. Commune name	
4. District name	
5. Sex	
6. Age	
7. Education	1.Can not read 2. Primary 3. Secondary 4.High school 5. University
8. Marital status	1. Single 2.Married 3. Widower 4. widow

III. Household income

3.1 Forest income in dry season

	1. Forest product	**2.Collected by whom?**	**3. Quantity collected**	**4.Unit**	**5.Own use (incl. gifts)**	**6. Sold (incl. barter)**	**7. Price per unit**	**8. Type of market**	**9. Gross value (3*7)**	**10. Potential costs (total)**	**11. Net income (11-12)**
1											
2											
3											

4											
5											

3.2 Forest income in rainy season

	1. Forest product	2.Collected by whom?	3. Quantity collected	4.Unit	5.Own use (incl. gifts)	6. Sold (incl. barter)	7. Price per unit	8. Type of market	9. Gross value (3*7)	10. Potential costs (total)	11. Net income (11-12)
1											
2											
3											
4											
5											

3.3 Fishing and aquaculture income in dry season (for water resources such as lake, stream…)

	1. product	2.Collected by whom?	3. Quantity collected	4.Unit	5.Own use (incl. gifts)	6. Sold (incl. barter)	7. Price per unit	8. Type of market	9. Gross value (3*7)	10. Potential costs (total)	11. Net income (11-12)
1											
2											
3											
4											

5											

3.4 Fishing and aquaculture income in rainy season (for water resources such as lake, stream…)

	1. product	**2.Collected by whom?**	**3. Quantity collected**	**4.Unit**	**5.Own use (incl. gifts)**	**6. Sold (incl. barter)**	**7. Price per unit**	**8. Type of market**	**9. Gross value (3*7)**	**10. Potential costs (total)**	**11. Net income (11-12)**
1											
2											
3											
4											
5											

3.5 Other environmental (such as firewood and meet from rice field) income in dry season

	1. product	**2.Collected by whom?**	**3. Quantity collected**	**4.Unit**	**5.Own use (incl. gifts)**	**6. Sold (incl. barter)**	**7. Price per unit**	**8. Type of market**	**9. Gross value (3*7)**	**10. Potential costs (total)**	**11. Net income (11-12)**
1											
2											
3											
4											
5											

3.6 Other environmental (such as firewood and meet from rice field) income in rainy season

	1. product	2.Collected by whom?	3. Quantity collected	4.Unit	5.Own use (incl. gifts)	6. Sold (incl. barter)	7. Price per unit	8. Type of market	9. Gross value (3*7)	10. Potential costs (total)	11. Net income (11-12)
1											
2											
3											
4											
5											

3.7 Agriculture income in dry and rainy seasons

1. Crops	2. Area of production (m^2)	3. Total production (5+6)	4. Unit (for production)	5.Own use (incl. gifts)	6. Sold (incl. barter)	7. Price per unit	8.Total value ((5+6)*7)	9. To stock (3-5-6)

3.8 Income from livestock

1. Livestock	2.Sold (incl. barter), live or slaught-ered	3.Slaught-ered for own use (or gift given)	4. Lost (theft, died...)	5. Bought or gift received	6. New from own stock	7. Price per adult animal	8. Total end value (8*9)

Cow							
Buffalos							
Goats							
Sheep							
Pigs							
Chicken/duck							
Others (……)							

3.9 Wage income

1. Household member	**2. Type of work**	**3. Daily wage rate**	**4. Total (expected) wage income (3*4)**	**5. Total wage income actually received**

3.10 Income from own business (per month)

	1. Business 1	2. Business 2	3. Business 3
1. What is your type of business?			
2. How many month per year			
3. Gross income (sales) per month			
Costs:			
4. Purchased inputs			
5. Own non-labour inputs (equivalent market value)			
6. Hired labour			
7. Transport and marketing cost			
8. Capital costs (repaire, maintenance, etc.)			
9. Other costs			
10. Net income (2 - items 3-8) per month			

IV. Development activities and risk

4.1 Are you aware of development activities in your community (Please cycle)? 1=Yes 2=No

4.2 if yes, please descript……
……
……
……

4.3 Is there any risk in the watershed area (Please cycle)? 1=Yes 2=No

4.4 if yes, please descript……
……
……

4.5 If yes, do you know any risk reduction strategy in your community? 1=Yes 2=No

4.6 if yes, please descript……
……
……

ANNEX 2. Guiding questions for KII/FGD

1. Is there any potential risk in your community?
2. What type of risk have you encountered in your community? How are they happened? How often are they? What are the destructions from those risks?
3. Is there any measure to address those risks?
4. Are you aware of any development activities in your area? If yes, what and where are they ?