

Thesis report

Master thesis presented for graduation of the international master " Agronomy and Agrifood Sciences diploma"

Speciality : Système Agricoles et Agroalimentaires Durables au Sud (SAADS)

Option : Ressources, Systèmes Agricoles et Développement (RESAD)

Livelihood Diagnosis And Analysis On Land Use And Land Governance In Floodplains Area In Kandal Province, Cambodia



by **Srey Pich Sinh**

Date of defense: 2022

Host organization: UMR 183 Gestion de l'Eau, Acteurs, Usages (183 G-Eau)-IRD

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Date of defense: 2022

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RESUME

La dynamique des terres et des systèmes agricoles dans la province de Kandal n'est pas bien étudiée dans les sous-zones de la vaste plaine d'inondation située entre les fleuves Bassac et Mékong. Cette étude examine les dispositions et les droits d'accès à la terre (tant légaux qu'informels) et leur évolution au cours des deux dernières décennies, alors que la végétation naturelle inondée se transformait progressivement en parcelles agricoles. Ainsi, l'approche du diagnostic agraire a été appliquée pour identifier les différents modèles d'accès aux terres et zones inondées. Cette étude a également cherché à déterminer qui est habilité à fournir cet accès afin de caractériser les différents systèmes agricoles de la zone et d'établir des liens éventuels entre ces systèmes et des trajectoires foncières distinctes. Des entretiens approfondis avec des informateurs clés ont été menés afin de mieux connaître l'histoire de la zone d'étude. Ensuite des enquêtes socioéconomiques ont été menées avec 49 agriculteurs pour élaborer une typologie des systèmes agricoles de la région.

Nous avons identifié six systèmes agricoles distincts: une petite agriculture diversifiée (<2 ha); les agriculteurs de taille moyenne (2-5 ha) avec revenu complémentaire; les ménages diversificateurs de taille moyenne (2-5 ha); les agriculteurs intensifs de taille moyenne (2-5 ha); une grande agriculture avec environ 10 ha; et l'agriculture comme activité secondaire sur moins de 2 hectares. D'après les résultats, les ménages possédant de petites terres (<2 ha) et des activités diversifiées ont des difficultés à survivre. En général, ces ménages essaient de subvenir à leurs besoins en pratiquant la pêche, l'élevage, ou en vendant leur main d'œuvre dans le secteur agricole ou dans un autre domaine. De plus, 1 des 6 types d'exploitations agricoles (représentant en tout 22% des ménages interviewés) ne permettent pas de dériver l'équivalent du revenu minimum au Cambodge. Certains agriculteurs qui intensifient leurs cultures parviennent toutefois à augmenter leur rentabilité, améliorant ainsi le bien-être économique de leur famille. À ce résultat favorable s'ajoutent d'importantes préoccupations en matière d'environnement et de biodiversité, car ces exploitations nécessitent un volume élevé d'intrants tels que des pesticides et des herbicides. En conséquence, la dégradation des sols et la contamination de l'eau continuent de s'aggraver. Dans l'ensemble, cela a un impact négatif sur la pêche et la santé humaine puisque les villages dépendent de l'eau pour leur usage quotidien.

Mots clés :

Cambodge, utilisation des terres, gouvernance foncière, plaine inondable, végétation naturelle, régime foncier.

ABSTRACT

Land tenure dynamics and agricultural systems in Kandal province have not been studied in detail, specifically in the sub-area of the broad floodplain between the Bassac and Mekong rivers. This study examines the modalities and rights of access to land (both legal and unofficial) and their evolution over the last two decades as flooded natural vegetation gradually transformed into agricultural plots. An agrarian diagnosis approach was applied to identify the different modalities of access to land and flooded areas. This study further investigated who has the right to ensure this access in order to characterize the various agricultural production systems in the area and to establish possible links between these systems and distinct land trajectories. In-depth key informant interviews with individuals were done in order to know the history of the case study area, notably in terms of land access. Then socioeconomic surveys were conducted with 49 farmers in four villages to elaborate a typology of the agricultural production systems.

We identified six existing agricultural production system: small size diversified agriculture (<2 ha); medium size farms (2 to 5 ha) with extra (non agricultural) revenues; medium-size diversifiers (2 to 5 ha); medium-size intensive farmers (2 to 5 ha); large-size farms of about 10 ha; and agriculture as a secondary activity on less than 2 ha. As additional findings, the small size diversifiers (<2 ha) are struggling to survive. Typically, they attempt to earn a living by fishing, raising cattle, or selling their wage labor force in the agricultural sector or in other areas. Further, 1 out of the 6 agricultural production systems identified (corresponding to 22% of the interviewed households) generate less than the minimum wage salary. Some farmers intensifying their cultivation are able to have a better profitability, thereby improving their family's economic and well-being. Along with this favorable outcome, there are major environmental and biodiversity concerns, as these farms require a high volume of inputs such as pesticides and herbicides. As a result, land degradation and water contamination continue to worsen. In aggregate, it has a negative impact on fisheries and human health, as villages rely on water for everyday use.

Keywords:

Cambodia, land use, land governance, floodplain, natural vegetation, land tenure.

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Finally, I want to express my heartfelt gratitude to my family and closest friends for everything.

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FOREWORD

The following work was conducted in the context of the COSTEA2 project implemented by the joint research unit “Water Management, Actors, Territories” (UMR G-EAU). The overall objective of this study is to understand the history of land access, assess current land tenure arrangements and to identify agricultural production systems and characterize their profitability.

By conducting an agrarian diagnosis in the province of Kandal in Cambodia, the missions and objectives of the internship are to conduct an analysis of the modalities and rights (formal and informal) of land access and their evolution over the last two decades.

Four months of fieldwork were done in the Koh Thom and Leuk Dake districts in Kandal province. The primary research area was in Chroy Snou village, with sub-areas in Chheu Khmao, Phum Thmey, and Boeung Kroam.

GLOSSARY

Agrarian system	: An agrarian system is “the state of the farming sector of a society at a given point in its history, along with the way it functions and the conditions for it to be sustainable. The concept of a farming system includes: the way the ecosystems are put to use and the way they are sustained; the social relations which govern the forms of production and exchanges, and which have contributed to the set-up and development of this agrarian system; the economic and social conditions, and especially the system of relative prices, which fix the conditions for the greater or lesser integration of the local farming system into the world market.” (Cochet, 2005; Mazoyer & Roudart, 1997).
Boeung	: Khmer term for lowlands within the prek system.
Chamkar	: Khmer term for uplands within the prek system.
Krom Samaki Fishing lot	: Khmer term for group solidarity : Private fishing concession obtained through auction (diamantled in 2012)
Prek	: Khmer term for earthen canals connecting the river (Mekong or Bassac) to lowland.
Samras	: Khmer term for brush park
Stoeung	: Khmer term for stream

ACRONYMS AND UNITS

AFD	: French Development Agency
COSTEA	: Comité Scientifique et Technique pour l'Eau Agricole
CA	: Capita
ECOLAND	: Ecosystems Services and Land use Research Center
IRD	: French National Research Institute for Sustainable Development
FCi	: Fishery Community
HH	: Household
KR	: Khmer Rouge
LMUPC	: Land Management Urban Planning and Construction
MLMUPC	: Ministry of Land Management Urban Planning and Construction
MRC	: Mekong River Commission
PDoWRAM	: Provincial Department of Water Resources and Meteorology
UMR G-EAU	: Unit G-EAU (Water management, stakeholders, uses)

EQUIVALENCE OF UNITS AND CURRENCY

1 hectare (ha) = 7 kongs

1 are (A) = 0,01ha

1 dollar (USD) = 4100 riels

100 riel (KHR) = 565 Vietnamese dong (VND)

1 dollar (USD)= 22849.525 Vietnamese dong (VDN)

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INTRODUCTION

Cambodia's primary agricultural sector is concentrated in rural areas, particularly between the Bassac and Mekong River in Kandal province. During the flooding season, the ecology, natural vegetation, flooded forest, and biodiversity that farmers and fishers rely on for their livelihoods were all present (Mak, 2015). Additionally, Kandal province has a large floodplain area that allows floodwater to transport essential nutrients and new land during the dry season, enabling farmers to increase the productivity of their primary cropping systems, such as recession rice, dry season rice, maize, vegetables, and fruit trees (Sokhem and Sunada, 2006).

Land use and property in floodplain regions of Mekong River remain constrained and uncertain owing to the natural vegetation cover and the fact that the majority of farmers are fearful of the flooding season, climate change, and their cultivating season, which lasts just 4 or 5 months. Farmers in certain places wish to enhance their agricultural productivity, but due to the prolonged dry season, they still rely on rainfall and canal systems to irrigate their farms (Kruijssen et al., 2018).

Since the early 2000s, the government's strategy has aimed to improve farmer's livelihoods and encourage them to expand their farming systems. To achieve this policy, local governments played a critical role in promoting policies such as expanding cultivable land and renovating irrigation systems through communal foundations financed by the government and other organizations such as the World Vision Funds and AFD (Kawarazuka and Béné, 2010; Vilain et al., 2016).

Private fishing lots were eliminated in 2012, altering and increasing agricultural land. Following land clearance, numerous areas were converted to cultivable land through the development of agricultural infrastructures, most notably irrigation systems (Stołyhwoa & Sikorski, 2005 and Sokhem and Sunada, 2006; CNV, 2012).

In some rice areas, irrigation development has resulted in the conversion of a single annual rice crop to two annual rice crops. However, in other areas, agricultural land has deteriorated to the point where crop farming is no longer viable. As a result, farmers leave these lands to fallow or rent them to other farmers. Agricultural land has been converted to other uses in accordance with social and economic growth. This type of land might be used for hydropower projects, industrial zones, residential areas, or transportation. Farmers abandon farming in response to rising land prices, opting instead to sell their wage labor force and immigration. Additionally, land-use change has a transboundary effect on land security while also having a direct influence on other critical socio-economic sectors such as fisheries and biodiversity, which including flooded forests and natural vegetation (MRC, 2016).

Kandal province is undergoing significant transformation. Forests that have been flooded are now home to small-scale fishing. Over the last two decades, it has developed into an area of intensive farming. According to the internship's requirements, we seek to understand the context of agriculture and the economic sustainability of farming systems in Chroy Snou Village, the primary research region and three sub-area of Chheu Khmao village; Phum Thmey village and Boeung kroam villag.

The following work was conducted in the context of the COSTEA2 project implemented by the joint research unit “Water Management, Actors, Territories” (UMR G-EAU). The overall objective of this study is to understand the history of land access, assess current land tenure arrangements and to identify agricultural production systems and characterize their profitability.

Thus, the specific aims are to address and resolve the following:

- To gain a better understanding of the study area's land use history.
- To comprehend how land tenure and property rights are organized.
- To ascertain the agricultural production system and its associated activities.
- To investigate the household revenues.

Five hypotheses are formulated in order to address the study questions:

Hypothesis 1: Cultivation in the study area began around the year 2000.

Hypothesis 2: There is a diversity of modalities in access to land; in some places access has been formalized and in others not.

Hypothesis 3: The way that farmers have accessed the land; affected on their land use decision.

Hypothesis 4: Smallholder farmers increase their productivities by cultivating on all their land that they have and by increasing the use of chemical inputs. They also clear natural vegetation for new land; rent more land. Its resulted in the loss of natural vegetation. Contrarily, the large landowners don't expand their land anymore.

Hypothesis 5: A significant part of the land that has been reclaimed is used in an extensive rather than intensive way (land is a more an asset than a production factor).

1 THE STUDY AREA

1.1. Localization of the study area and topography

The kingdom of Cambodia is in the southern portion of the Indochina peninsula in Southeast Asia. Cambodia covers 181,035 square kilometers and is bordered by Thailand to the Northwest, Laos to the Northeast, and Vietnam to The East. On the fourth and open side, Cambodia faces the Gulf of Thailand. Topographically, the country resembles a shallow volcano. Forming the rim, two mountain ranges -Cardamon and Elephant- follow the Thai border. In the Northeast, the land rises to a plateau up to the borders with Laos and Vietnam. These mountains and plateau are mostly forested. Inside the rim is a lowland area connecting the Tonle Sap Great lake plain with the Mekong alluvial plain. Both the Tonle Sap and Mekong Rivers join in Phnom Penh, the capital city.

Cambodia is a mostly agricultural country and agriculture is in perpetual change (Diepart, 2015). Two main types of cropping systems can be identified in Cambodia: the inundated rice-based, and chamkar-based (non-rice) systems. This internship takes place in the floodplain of the Cambodian Upper Mekong delta where inundated rice systems are common.

Inundated rice-based systems are adapted to the specific agro-ecological conditions of the lowland plain and are influenced by the seasonal flood (and recession) of flood water coming from the Mekong River. The receding rice varieties are cultivated in the dry season when the floodwater recedes.

The study region lies in the Kandal province of Cambodia. It is bounded on three sides by the Bassac; River (Hau River in Vietnam) to the west, the Mekong River (Tien River in Vietnam) on the east side, and a wide stretch of vegetation covered to the north and the Vietnam border in the South. Drainage canals and small reservoirs dug by the Khmer Rouge administration (in the late 1970s) sustain a single rice-growing season in the center part of the zone, which runs from December through March. Vegetables and fruit trees can advantageously be grown along the edge of the river. An increase in agriculture and a change to two rice growing seasons can be achieved thanks in part to the renovation of transversal waterways (dubbed Preks) that take water from the Bassac and the Mekong, while fishing continues to be a significant industry after the flood from November to February (Aires et al., 2020).

The internship focused on a sub-area of the large floodplain located between the Bassac and the Mekong. The areas known as “Lot 9” “Lot 10” and “Lot 11” are former fishing lot. They cover both rice fields and natural vegetation. In circle in figure 1, the “protected area” of Lot 9, which is supposed to be protected by the Fishery community established in Chroy Snou in 2012 after a private fishing concession that exploited “Lot 9” was dismantled.

One of the study's aims will be to determine whether land dynamics (history of access and use) differ in these sub-areas, which include Chheu Khmao village, Phum Thmey village, and Boeung Kroam village.

Figure 1: Map of the study area between Bassac River and Mekong River. (Annex 3)

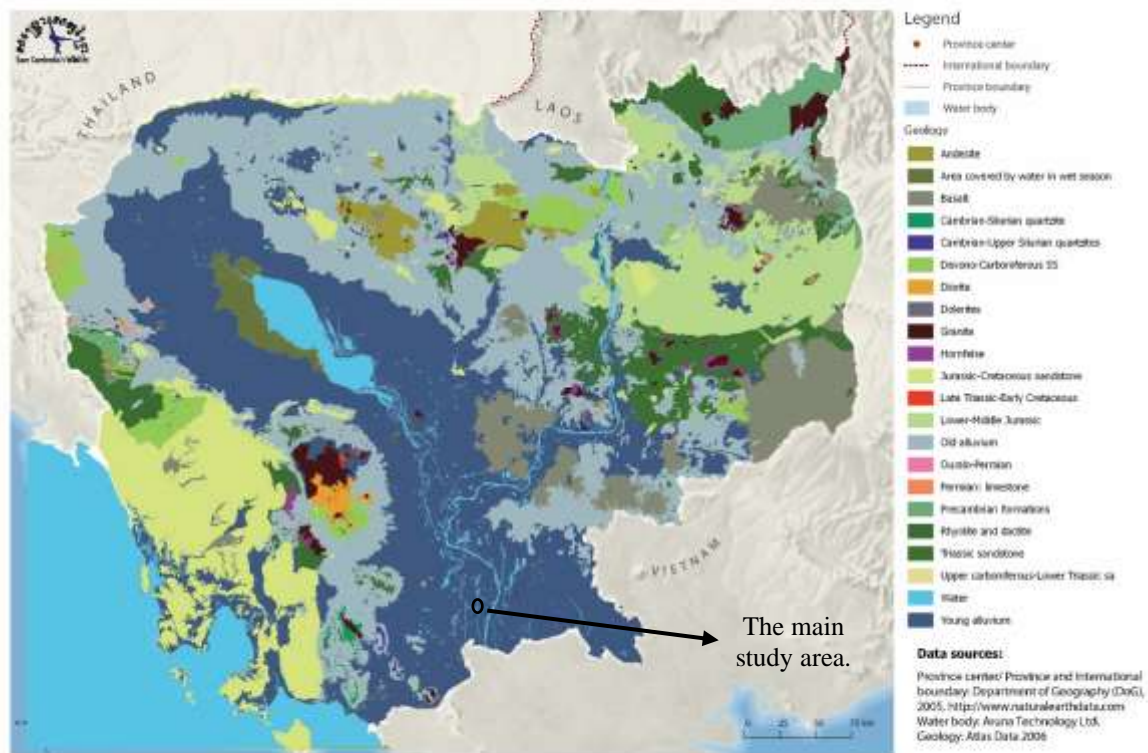


1.2. The physical environment

1.2.1. Geology

A soil map (1:250,000) of most of Cambodia based on the FAO World Soils Map (1998) and Soil resources map for the lower Mekong Basin (MRC, 2002) is shown in Figure 2. The soils in the case study area are recent alluvial (Figure 2).

Figure 2: Generalized geology map of Cambodia, source: opendevelopmentcambodia.net



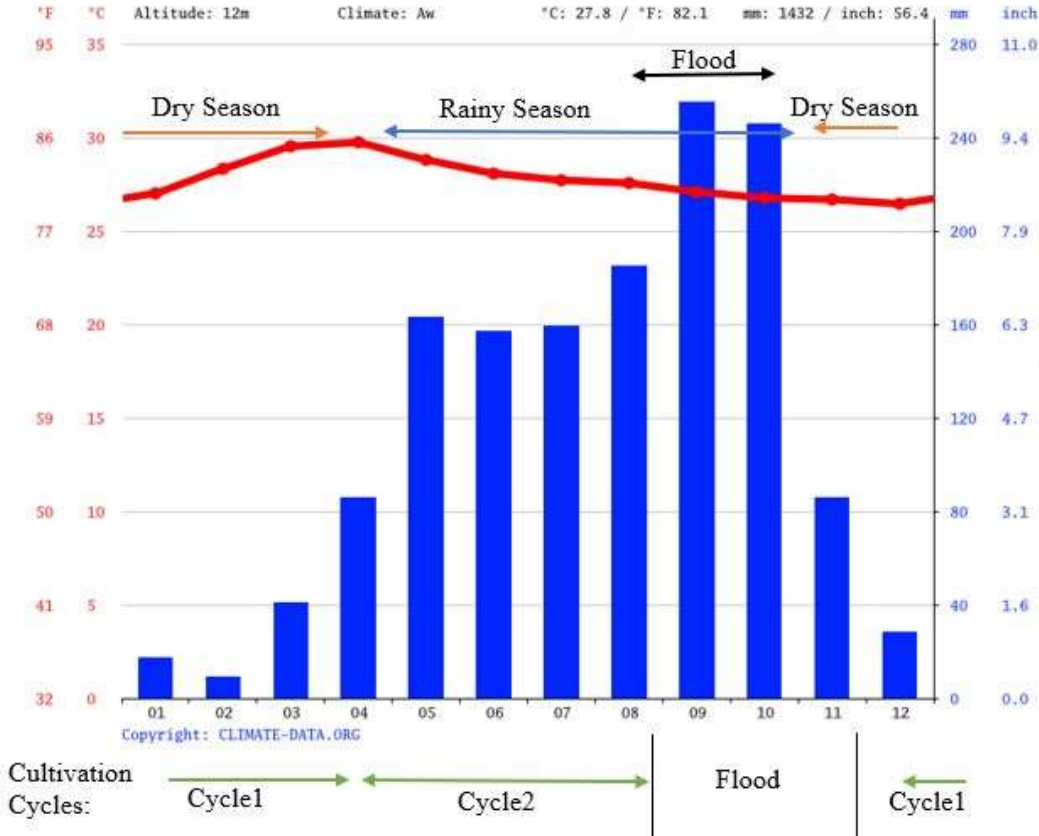
1.2.2. Climate and cropping systems

In Cambodia, there are two distinct seasons. The rainy season runs from May to October due to the southwest monsoon, and the dry season runs from November through April due to the northwest monsoon. When the rain begins in July and August, the great flood usually arrives in September and October. The average annual rainfall is 1200–1432 mm, while the average annual temperature is 27–33 °C (Figure 3).

Cropping systems in Cambodia revolve around three seasons: April to July for the early wet season, July to October for the main wet season, and November to March for the dry season (Nesbitt, 1997). However, farming can only take place twice a year in Kandal province. In the research area, where maize was the primary crop, farmers was planted by hand in the same manner as they had done with recession rice. Harvesting begins around the middle of March or

the beginning of April. Crops for the dry season can only be planted in areas with adequate water storage and irrigation.

Figure 3: Climate of Kandal province and cultivation cycles (Source: climatedata.org, model based on data collected from 1982 to 2012).



2 METHODOLOGY: Agricultural Diagnosis

2.1. Landscape analysis and historical development of land use and agriculture: key informant interviews and focus group discussion to gather data about the history of land use dynamics.

An agricultural system is defined as "the state of a society's farming sector at a particular time in its history, as well as the manner in which it functions and the parameters necessary for it to remain sustainable." The concept of a "farming system" encompasses the following: the way ecosystems are utilized and sustained; the social relations that regulate output and exchanges and have played a role in the establishment and improvement of this agrarian system; the socio-economic status, most notably the system of price level, that establishes the criteria for the local farming system's greater or lesser position in the international market." (Cochet, 2005; Mazoyer & Roudart, 1997; Barral et al., 2011)

We began this study by reviewing the bibliography produced under earlier research undertaken by the DOUBT and COSTEA projects in Kandal province, which focused on general

knowledge of the study area, land tenure, and state sub-decrees governing land management and land rights in Cambodia. This stage also contributed to the preparation of questionnaires (Annex 1) for key informant and farmer interviews, which were conducted utilizing the qualitative and quantitative interviews with the help of my supervisor, Dr. Jean-Philippe Venot.

The second stage began in May and June 2021 with field observations and in-depth interviews with key informants, followed by individual and focus group discussions. The major informants for the interviews were the village leaders and deputy heads of four villages, as well as the commune chiefs of four communes. The study area comprised four villages and communes: Chroy Snou village, which is located within Prek Chreey commune in Koh Thom district; Boeung Kroam village, which is situated in Khpob Ateav commune in Leuk Dake district; Phum Thmey village, which is located in Leuk Dake commune in Koh Thom district; and Chheu Khmao village, which is positioned inside Chheu Khmao commune, in Koh Thom district. Other major informants include the district administration, the LMUPC, the FAs of Koh Thom and Leuk Dake districts, the Kandal Provincial Fisheries Department, and intermediaries who purchased land surrounding the communities. The questionnaires inquire about the research area's history, the background of land access and use, the major changes and their impact on the study region, as well as the existence and roles of institutions. Key informants were interviewed to discover the various modes of access to land and flooded areas, including who has the authority to secure this access.

2.2. Characterization and economic analysis of production systems: Farmers interview

The agricultural system notion is largely applicable to farm holdings, the fundamental unit of production that is typically family-oriented. This level of research is critical because farms serve as the backbone of the rural community, organizing methods of production and crisscrossing the value chain. Farm holdings are the fundamental relationships that bind villages together, engendering cooperation, paradoxes, and confrontation. Additionally, this unit of thinking is critical since it is here that the field researcher establishes the initial "contact" by interviewing farmers (Cochet, 2012). Although the concept can be applied to the individual enterprise level, to help understand how the family farm functions thus enabling the formulation of personalized advice, this "individualized" approach is insufficient for comprehending dynamics at a regional scale. This is why it is more efficient to apply the production system concept to a group of farms with the same resources (same amount of surface area, same level of mechanization, same size of labor force) in similar socio-economic contexts, with a similar crop maximum, a group of farms that can be represented by the same model (Dufumier, 1995; Cochet and Devienne, 2006). In a typology of farm holdings based on this concept, each type of farm can be represented and corresponds to a model of one particular production system (Barral et al., 2011).

Farmers were interviewed between July 8th and July 28th, 2021 in four villages of the four communes in two districts, beginning with the main study area in Chroy Snou village of Prek Chreey commune, Koh Thom district, and moving on to sub-areas such as Boeung Kroam village, Phum Thmey village, and Chheu Khmao village. I used the interview guide for farmers' specialized questionnaires (Annex 2), which are divided into two sections: presentation of the household and its surroundings, and general household economics (agricultural activities, other

key economic information, fishery activities, livestock activities, and water sale activities). I questioned 49 households in four villages. I collected data quantitatively using three sampling strategies: random sampling, snowball sampling, and categorizing respondents into four groups: sole fishermen (or people who are mostly fishermen and those with land less than 1 hectare), people with land between 1 and 3 hectares who also fish for self-consumption and small scale sale, people with land between 5 and 10 hectares, and finally those with land greater than 10 hectares.

Table 1: Number of farmer interviews in four villages.

Villages	Chroy Snou	Chheu Khmao	Phum Thmey	Boeung Kroam
Number of interviews	15	14	6	14

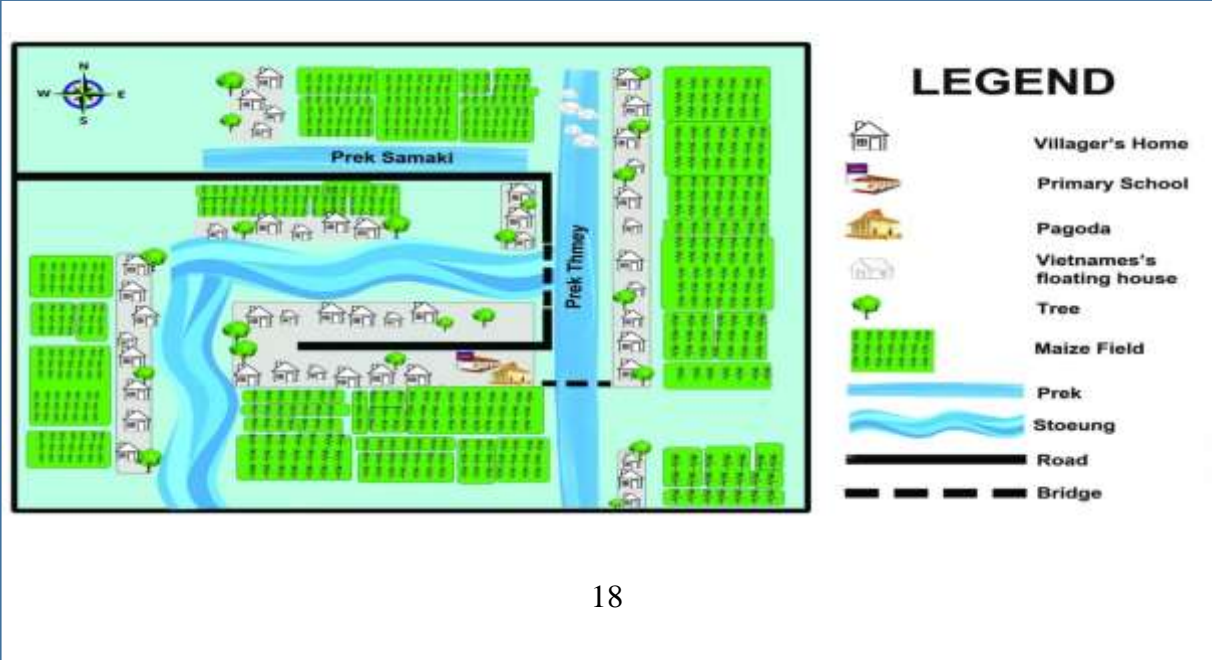
Socio-agro-economic surveys aim to characterize the different agricultural production systems in the area and link these systems to different “land trajectory”. Analysis of farming system will include an analysis of the multiple activities of agricultural households: agriculture, breeding, fishing, non-agricultural activities and pay attention to level of indebtedness. An analysis of key economic indicators (gross product, intermediate consumption, income and value added per hectare by type of crop, income per worker, etc.) is done. The socio-agro-economic analysis was very simple by using excel for analysis of Gross product (GP), Intermediary consumption costs (IC), Gross added value (GAV), Net added value (NAV) and Agricultural income (AI) (Annex 2)

3 RESULTS

3.1. History of the Case Study Area

Key informant interviews are the primary source of knowledge regarding the history of the case study area; therefore, the interview questions focused exclusively on the village's history and the history of access to and use of land in the main study and sub-study areas.

Figure 4: Agrarian system of Chroy Snou village between 2000s and 2021



3.1.1. Chroy Snou village

The village of Chroy Snou is located far from other villages (figure1). There are now 161 Cambodian and 34 Vietnamese families living in the area. The village was formed prior to the French colonial period. At the time, in the north of *Stoeung* Chroy Snou, there were approximately 100 families and one pagoda. The area was a thriving fishing community with frequent trade between communities that are now located in modern-day Cambodia and Vietnam.

The village was destroyed by fire during the Khmer Isarak period (1945–1953). After Cambodia gained independence, the village relocated the pagoda to the south side of the *Stoeung* (stream). There were around 200 Cambodian families before the Khmer Rouge and approximately 300 Vietnamese as well as Khmer-Vietnamese families during the Sangkum Reas Niyum (Popular Socialist Community) period from 1955 to 1970.

Chroy Snou village was abandoned during the Khmer Rouge times, and residents were forced to relocate to Khna Tangyou village to the south of the case study area, near the Vietnamese border, while Vietnamese and Khmer-Vietnamese families went to Vietnam. The residents of Chroy Snou were compelled to dig canals to obtain water from Steung Chroy Snou and plant rice.

In 1980, after the Khmer Rouge Period, 80 percent of the original villagers returned to Chroy Snou village, while 20 percent chose to remain along the Bassac and Mekong Rivers located in Prek Chreey, or Chheu Khmao villages. After returning to Chroy Snou between 1982 and 1992, the majority of the villagers worked as fisherman, grew mung beans, and black beans from December to March in small plots near their homes and along the Steung River's banks, where their parents had done the same before them. They sold their products to Vietnamese villagers who came to sell rice and buy fish. At the time, the entirety of the area was covered by flooded forest and located within a private fishing lot, limiting the villagers' capacity to increase their farming.

There were no solidarity groups (named in Khmer, Krom Samaki) in Chroy Snou. In 1987, the authorities of Chroy Snou village and Prek Chreey commune began allocating land to Cambodian locals who were volunteering, but Vietnamese families were unable to obtain land at the time. Only 30 families (about a third of all households at the time) requested it and were granted land in the south of the village, between the two streams (*Stoeungs*). Each Cambodian family received a strip of land around 50 meters wide and 500 meters long. In 1989, authorities in Chroy Snou village allotted land between the Western stream (*Stoeung*) and Canal 14, which had been dug during the Khmer Rouge period. This time, 70 families received strips of land measuring 35 meters wide by approximately 200 meters long. Farmers began manually clearing land and natural vegetation and then burning them during the dry season.

From 1991 to 1995, apart from fishing time between December and March, locals started growing soybeans (instead of mung beans) since it was more expensive, but there was no expansion of cultivated land. After 1995, villagers switched to red maize because Vietnamese traders offered greater prices upper land farmers got higher yields than low-lying land farmers due to acid-sulfate soils. Villagers in Chroy Snou did not use tractors since they planted

gradually after the floods. They only needed water-resistant seeds. On the other hand, farmers utilized tractors in the Boeung Kroam settlement at that time.

Beginning in the late 1990s, with the assistance of border police guards, some residents of Chroy Snou village imported machinery to clear land and dig or renovate canals in the area west of the village in order to increase the cultivated area during the dry season near canal 13. Between July and November, when fish reproduce, the Fishery Administration prohibits them from clearing land. The owner of the fishing lot let them farm during the dry season away from the stream (*Stoeung*) and also prohibited them from using pesticides. At the time, few farmers expanded their cultivating areas, as many still relied on fishing as their primary source of income. During the dry season, many Vietnamese families residing in villages, those from surrounding villages, and also those coming from Vietnam rented land from Cambodian farmers for farming. These individuals have exceptional abilities and were able to cultivate crops in low-lying areas with acid-sulfate soil, which was challenging for Cambodian farmers. Vietnamese farmers typically rent land for cultivation for a period of one to several years. Cambodian farmers reclaimed their property and began cultivating it themselves after several years of renting it.

In 2012, the prime minister announced the closure of fishing lots numbers 9, 10, and 11, allowing fishermen to fish anywhere they pleased. Additionally, the government established a Fisheries Community (FCi) on each former lot to ensure compliance with fishery regulations and to protect areas with a greater percentage of flooded vegetation to protect fish. However, the Fishing Community and even the Fishery Department are powerless to manage people due to a lack of personnel and financial resources. Following the decision, a large number of individuals have rushed to the area for fishing, some using illegal equipment (like electric shocks or putting *samras* (the brush park) systems in the *Stoeung* (stream)).

Apart from fishing, people cleared land by hand or with agricultural gear without seeking permission from authorities (normally, authorization should be sought from PDOWRAM to dig a canal and from the Fishery administration for clearing land). They did so in old fishing lot 9 which is located in the "protected area". Villagers were uncontrollable by local authorities. Wealthier households from the four communes, including Prek Chreey, Chheu Khmao, Leuk Deke, and Khpob Ateav, cleared more land than less wealthy families because they could afford to acquire or rent machines. In recent decades, most villagers can crop twice a year (December to March, and April to mid-July in the dry season), as there have been no major floods. From 2012 to 2017, Vietnamese farmers who know how to cultivate on acid-sulfate soils rented land for one year or more. However, land rental by foreigners in border zones will be prohibited after 2017.

The Prek Samaki excavation project by the Ministry of Public Work and Transportation and/or commune development fund projects (excavation of canals numbers 11,12,13,14, and 15), all contribute to the extension of farming. Fishing is declining because there is no more natural vegetation. At the same time, it is difficult to travel by boat due to illegal equipment planted in the Steung (*Samras* or Brush park), and sometimes there are conflicts between Khmer, Cham, and Vietnamese fishermen with the military and administration. The rising use of pesticides also causes environmental and health issues. Despite this, most people believe the entire area will be cultivated soon due to the high demand for land from businessmen and locals from surrounding places.

Until 2014/15, the village authorities only delivered land use history letters (which are official document certifying that a given person has been using a specific piece of land) when farmers requested them to obtain a loan. In 2016, people began selling their land to middlemen or chiefs of companies who came to invest in Chreey Thom commune (a small village on the west of the Bassac bordering Vietnam with a special economic zone status). At that time, the price of land ranged from 1,000 USD to 3,000 USD per hectare. Small farmers generally sell their cleared land properties to build houses or other things. The medium-sized farmers kept their land, as the price of land climbed to 25,000–35, 000 USD per hectare, they wanted to sell that land. However, the village chief of Chroy Snou asked the commune chief twice to register the village land, but the LMUPC of Koh Thom district did not respond. Since all the land in Chroy Snou village was public state land, the LMUPC district office notified the local authorities that they couldn't deliver any land history letters until 2020. However, some buyers managed to get their land registered by officials in the district and later through the “one window service” (this is the system put in place to centralize all administrative request) at the provincial hall. They pay taxes, but were unable to get a land title. Land with a land use history letter is more expensive than land without it. People are afraid of losing their land back to the state as they lack paperwork, which is why they are selling it. Later in 2021, district LMUPC permitted local authorities to sign land history letters except in the protected area of Lot 9 (with a size of 807 hectares).

In general, farmers and local authorities we interviewed stated that economic conditions have improved as cultivable land has grown, and many people have sold cleared land property and used the money to build new homes. Cambodian farmers have improved farming skills through learning from the Vietnamese farmers with whom they rented land. And at last, some conflicts are happening between villagers from different villages over the land clearing. Neighbors from Khbop Ateav commune staged a demonstration against Chroy Snou villagers, accusing them of utilizing land outside their commune's borders. This prompted the provincial hall (provincial government) to intervene and foster dialogue, as well as to relocate the border of Chroy Snou for 400 meters more to the east.

3.1.2. Chheu Khmao village

Chheu Khmao village (Figure 1) is in Chheu Khmao commune, Koh Thom district, Kandal province in the west of the case study area, on the banks of the Bassac river. There are about 230 families and 1300 villagers in the village.

Before the Khmer Rouge period, villagers cultivated maize near the village, along the banks of the Bassac river and only 1 time per year. During the Khmer Rouge period (1975-1979), villagers and people from other places were forced to dig the Karbai Kon and Rumlech reservoirs to store water and irrigate the area in the east of the village. They also dug canals from West to East and North to South, by clearing the forest and natural vegetation in the area.

After the Khmer rouge period, people cultivated maize in their *Chamkar* (closes to the *prek*) field as well as rice, once a year between November to March, on both side of the *Prek* that drew water from the Bassac (called *Prek Kandal*). From 1979 to 1981, they followed the Krom Samaki system and cultivated in the same groups that had been formed under the Khmer rouge because individual families lacked labor force and there was no agricultural equipment for land preparation or harvesting. The rule was that, after harvest, each person who helped during cultivation and harvesting received 1 ton of rice. There was not enough production for family

consumption so villagers had to work elsewhere, fish and some cultivated maize on an individual basis.

In 1981, the local authorities allocated *Chamkar* land and each person (kids included) received an area of 1 meter (East-West) by 300 meters (North South) on one side of Prek Kandal. Land on both side of the prek was allocated. Rice land was also allocated: each person received a plot of 15meters (East-West) x 550m (North South) on the south side of canal 21. In 1984, the authorities allocated land for a second time and each person received a plot of 0.5 meters x 300 meter along Prek Kandal further to the east than had been allocated before. In 1985, as the population increased, the local authorities took back 200 meters of Chamkar land along Prek Kandal - to create new housings. In the same time, villagers started clearing the natural vegetation and the forest to cultivate along the Prek Samaki canal until 2km from Chroy Snou village where they stopped clearing because there was too much water to cultivate.

After they cleared the natural vegetation and forest, they cultivated rice in the recession season (November-March) but their yield was low because they lacked water for irrigation before harvesting. Therefore, between 1987 and 1993, the villagers collected labor force every year to excavate Prek Samaki canal, which villagers had dug to bring water from *Stoeung* (stream) Chroy Snou before 1970. Starting in 1993 and until 2000, each year, the local authorities rented a mini excavator from Vietnam to renovate the canal Prek Samaki and villagers had to pay 150 000 riels per hectare. Starting in the 2000s, as the reservoirs kept less water for shorter time, villagers in Chheu Khmao village cleared the natural vegetation in Rumlech reservoir (north side of the road) and Krabai Kon reservoir (south side of road to Chroy Snou village) for cultivation without asking for authorization from the local authorities.

Nowadays, villagers cultivate mango trees rather than maize and have dug wells in their *Chamkar* as there is low water availability in Prek Kandal.

Starting about 10 years ago, after the prime minister announced the dismantlement of the private fishing lots, some families started clearing the natural vegetation in the area of lot 9 and lot 10 by machettes and fire – families have cleared 3 to 10 hectares. The smaller farmers sold the land they cleared (investing in fishing or nonagricultural activities) to their neighbors who already had more land and capital and could invest more in agriculture.

In 2013, H.E. Mr.Sun Chantol, Minister for Public Works and Transport donated money to renovate the road along canal Prek Samaki and excavate it to bring water from Stoeung Chroy Snou. After that, villagers started cultivating rice two times per year (broadcasting in November/December and then in February/March) very intensively. In 2016, some areas of the canal were broken and there was siltation, and there was less water in canal prek Samaki. Since then, local authorities borrow pumping machines from PDOWRAM to bring water from canal Prek Samaki to smaller canals. As they lack water, villagers in Chroy Takeo, Kbal Koh, Chheu Kmao, Toul Svay and Chong Koh Village who also depend on canal Prek Samaki started digging wells because they wanted to continue cultivating two times per year even though cultivation in the dry season is challenging given high price of input, and the need for petrol for pumping. This year, the local authorities borrowed on excavator from PDOWRAM to renovate the canal number 11 because this canal also very importance for irrigation.

Land certification has not yet been done by MLMUPC in Chheu Khmo village.

3.1.3. Phum Thmey village

Phum Thmey village (Figure 1) was created in 2013 in the north of Chroy Snou village. It is in Leuk Dake commune, Koh Thom district, Kandal province. This village was separated from Prek Angdoug village because of population increase. The village area covers part of the former fishing lot 8 and 9 nearby. In the village there are 642 villagers (355 of female). Since 2018, a lot of women villagers go to work in the shoe's factory in Preak Sdei commune, Koh Thom district. Villagers of Phum Thmey access land in the former fishing lot number 9 (around 50 hectares close to the settlements and around 150 hectares in the Boeung).

After the Khmer Rouge period, villagers were organized in Samaki groups and then local authorities allocated 1 ha of land to each family, behind their house. As the area was located in fishing lot 9, they only cultivated along the *Stoeung* Ta Prom, connected to *Stoeung* Chroy Snou, and they also depended on Prek Ajah Ti from Bassac for irrigation.

Until 2015, most villagers were fishermen. They also did aquaculture of Sutchi catfish and Snakehead fish and raised pigs for selling to Vietnam. Until 2000, many of the transactions were done using gold. Villagers for which fishing was not a major activity rented land from their neighbor for cultivating rice (they paid 700 kilograms to the landowner for one hectares). They got yield from 3 tons to 4 tons per hectare. In the 2000s, villagers started using pesticides, pumping machines and small hand tractors for cultivation as well as rice thresher machine so they increased their yield to 4 or 5 tons per hectare during the recession season. At the time, there were a lot of Vietnamese people who rented land for cultivation during the dry season (starting in March) from the villagers (but with the authorization of lot owner) so they dug a 2200 meters canal connected to Prek Ajah Ti. In 2021, the local authorities renovated this canal, using the commune fund development of Leuk Dake commune. Farmers sold their crop production and fish in Vietnam or to middlemen coming from Vietnam to buy their products.

In 2012, when the fishing lot was dismantled, villagers manually extended their land (with machettes, fire, herbicides) until the border of Chroy Snou village and many families cleared between 5 and 10 hectares in 2 to 5 years. They did not cultivate all their land due to a lack of water and investment requirement. In 2015, 70% of the villagers stopped doing aquaculture and raising the pigs because the fish they feed almost died due to water quality decrease and a disease that affected many pig farms. In 2018, most of the women in the village went to work in garment factories and Casino in Prek Sdei commune (on the other bank of the Bassac).

In 2019 and 2020, land transactions increase. Many villagers who had rented the land they cleared sold it to build houses, purchase motorbike or reimburse loans and pay for health care. The villagers with more money manage to buy the land. Villagers who still cultivate can do two seasons from December to February and from April to July or August.

Villagers do not have the land title. They only have land history letters.

3.1.4. Boeung Kroam village

Boeung Kroam village (Figure 1) is in Khpob Ateav commune, Leuk Dake district, Kandal province. Boeung Kroam village is located east of Chroy Snou village, on the banks of the

Mekong river.

Since 1957, Samdach Norodom Sihanouk encouraged Cambodian villagers who live in Koh Thom district to move to live in Leuk Dake district. At the time, in Boeung Kroam village, as everywhere in the communes bordering the Mekong, there was almost 80% of Vietnamese and 20% Cambodian people.

During the Khmer Rouge period (1975-1979), there were villagers who came from Phnom Penh and other provinces and other communes in Leuk Dake district to work in the field in Boeung Kroam village. As was the case in Chheu Khmao village, the Khmer rouge divided people in 4 groups. Married people in working age had to cultivate rice and maize. People above 18 years old and single had to dug the reservoir and canals of the irrigation system; if they did not have any education, they were members of mobile units that controlled the other people working in the field. People between 15 and 17 years could be members of the mobile units or work in jobs that were not too hard such as collecting fertilizer. There was a last group of old and sick people who looked after babies or were engaged in non-physical works.

After the Khmer Rouge period, most people stayed in Boeung Kroam village and did not go back to their hometown. Nowadays, there are 486 families and 1847 villagers (292 among them –mostly women have migrated to work in other provinces such as in Phnom Penh, Sihanouk province and Svay Rieng province). Villagers mostly cultivate maize two times per year (from December to August); last year (2020) many farmers cut the mango trees they had planted in the last ten years because the price of mangos decreased a lot and is less profitable than that of maize.

From 1979 to 1981, villagers used the land as part of the Samaki group system (Solidarity group), sharing the harvest after cultivation on collective land. They cultivated maize and rice only one time per year from December to March. There were 10 families per group and each group had 4 cows for preparing the fields. Each group cultivated 100 meters of width on the side of the preks and unlimited length (towards the south or the north). In this period, the villagers did not have money and transactions were done in kind or using gold.

In 1982, the government under the control of the Vietnamese army and Soviet communist introduced money and allowed the commune hall to allocate Chamkar on both side of Prek Jonh and on the north side of canal 20, which is the southern limit of Boeung Kroam village. At the time there were more than 100 families, and each person (including kids) received a plot of 1meter x 300 meters. They cultivated maize on the land close to *the Prek* and rice further away. They had to clear the natural vegetation before cultivating and they focus on the *Chamkar* land. After farmers harvested, they had to sell their maize or rice products to the government with the price 2.5 riels per kilogram but middlemen also came to buy their crop production with the price 5 riels/kg. The government enforced strict rules and if they knew farmers sold their production to middlemen, the local authorities seized all the yield of farmers and middlemen. Until 1983, local authorities still allocated land to new comers, following the same rules.

In 1984 to 1986, the government introduced free market and the local authorities allocated rice land to villagers. Each family could get an additional plot of 15 meters x 400 meters along the

Preks. To get, the land each family had to renovate the Prek Touk, Prek Jonh, Prek Dang K'dor and canal 20 (which are in the village area). In 1986 to 1987, all men aged from 18 to 30 years in Leuk Dake district were forced to join the military to fight against the Khmer Rouge at Samload in Battambang province at the border of Thailand – at the time agriculture was not so dynamic and some families did not get land because they did not have the labor force. Farmers cultivated maize, mung bean, soy bean and rice and sold their harvest to Vietnamese middlemen. Cambodian farmers started to rent machinery from Vietnam for preparing and increasing the size of the land they cultivated. They learned from Vietnam farmers and started using pesticides and chemical fertilizer.

From 1986 onwards, the local authorities provided land history letters to all villagers in Boeung Kroam village (in Koh Thom district this was not done). Between then and the 2000s, villagers extended the land they cultivated, buying second hand tractors imported from Japan. World vision, an international NGO, implemented a program to build agricultural skills and it renovated the preks and the roads, which was good for farmer to transport their harvest and middlemen came to buy their crop product very easily.

In 2010, villagers started growing mango trees in their *Chamkar*. Some farmers rented the mango trees to Vietnamese farmers with the price 430 USD per 100 mango trees because they did not want to take care the mango trees and did not have the technical skills to use hormones to stimulate the mango trees to produce in another season. Normally mango trees produce in December/January but using hormones they can also produce in May/June and September/October. As they planted fruit trees such as mango, jack fruit, coconut and banana in their *Chamkar*, they started cultivated maize instead of rice in their low lying fields.

Between 2012 and 2014, villagers in Boeung Kroam village cleared the natural vegetation in the former fishing lot 9 and families cleared between 2 and 8 hectares. At the time, the local authorities requested the province governor to allocate land to villagers but he did not agree and he said the former fishing lot 9 was a protected area and land cannot be allocated. But the villagers still went to clear the natural vegetation. In 2021, when MLMUPC came to the village for official land registration, part of the land in the former fishing lot was demarcated and allocated. Only land in the protected area of the former fishing lot and close to Steung Chroy Snou was not allocated (but the protected area is not yet officially demarcated).

Villagers still continue cultivating in the area that has not been allocated and middlemen still buy land. They use their connections with MLMUPC of district or in the province to know where they can buy so that they can get land certificates. They can also buy land in areas where they will not get land certificate but at lower price (1000 to 2000 USD/ha). Some manage to get certificates and others do not. The fact that some farmers cultivate and that some people have land use certificates means it is difficult for the fishery administration to officially register the land as a “protected area”. Villagers of Boeung Kroam village, Khpob Ateav commune and Sandar commune had conflict with Chroy Snou villagers because they said the latter cleared the land in their commune. The administration of Koh Thom district, Leuk Dake district and the local authorities facilitated discussion between villagers so they accepted to do a new map of Chroy Snou village, with the border of the village 400 meters the east side of Stoeung Chroy Snou (while before the limit of the village was the *Stoeung*).

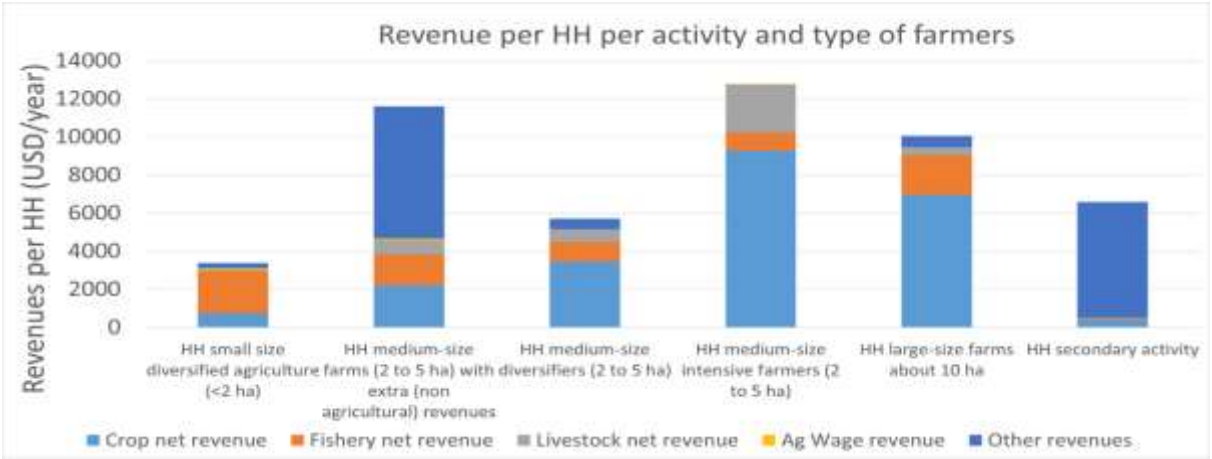
In recent years, 2020 and 2021, villagers of Boeung Kroam village started cultivating recession rice and early wet season (broadcasting in May) because the flood arrived late (in September instead of July).

3.2. Characterization of agricultural production systems

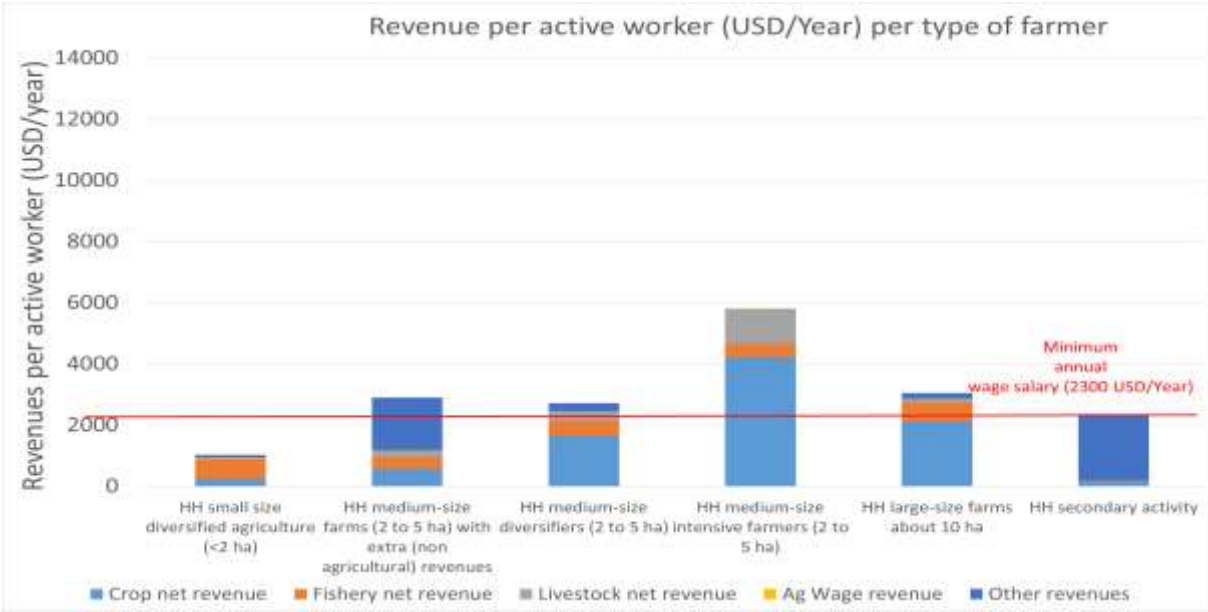
Multiple approaches were used to characterize agricultural production systems in our research. To begin, we examine a range of agricultural household activities, including cultivation, aquaculture, fishing, and other non-agricultural activities. Second, we determine the level of debt. Finally, and importantly, we looked at key economic indicators such as gross product, intermediate consumption, income, and value-added per hectare by crop type, as well as income per worker.

Upon assessment, we classified agricultural production systems into six categories (graphs 1 and 2) such as small size diversified agriculture (<2 ha); medium size farms (2 to 5 ha) with extra (non agricultural) revenues; medium-size diversifiers (2 to 5 ha); medium-sized intensive farmers (2 to 5 ha); large-size farms of about 10 ha; and secondary activity. The first category includes households with a small plot of land (less than 2 ha) that rely on a variety of income-generating activities to survive. Due to their small land size, this group is reliant on both agricultural and non-agricultural activities. The second category is medium size agriculture that have land holdings of between 2 and 5 ha and derive a great portion of their income from non-agricultural activities. The third class is made diversifiers households with moderate landholdings (2 to 5 ha). This set of households earned the majority of their earnings from agricultural activities, and their total revenue was almost comparable to that of households with large land areas of around 10 ha. The fourth category are medium-sized intensive farmers, who own between 2 and 5 ha of land. This type of household is primarily reliant on agricultural income. The fifth category includes households with more than 10 ha of land that earned less money from agricultural activities due to high input costs and a shortage of labor. As a result, they are unable to cultivate their land in a timely manner in relation to the size of their land. Finally, the sixth category is household for which agriculture is a secondary activity; they earn the majority of their income from sources other than agriculture.

Graph 1: Revenues per HH per activity and types of farmers (USD/Year)



Graph 2: Revenues per HH per active worker (USD/Year) per type of farmers



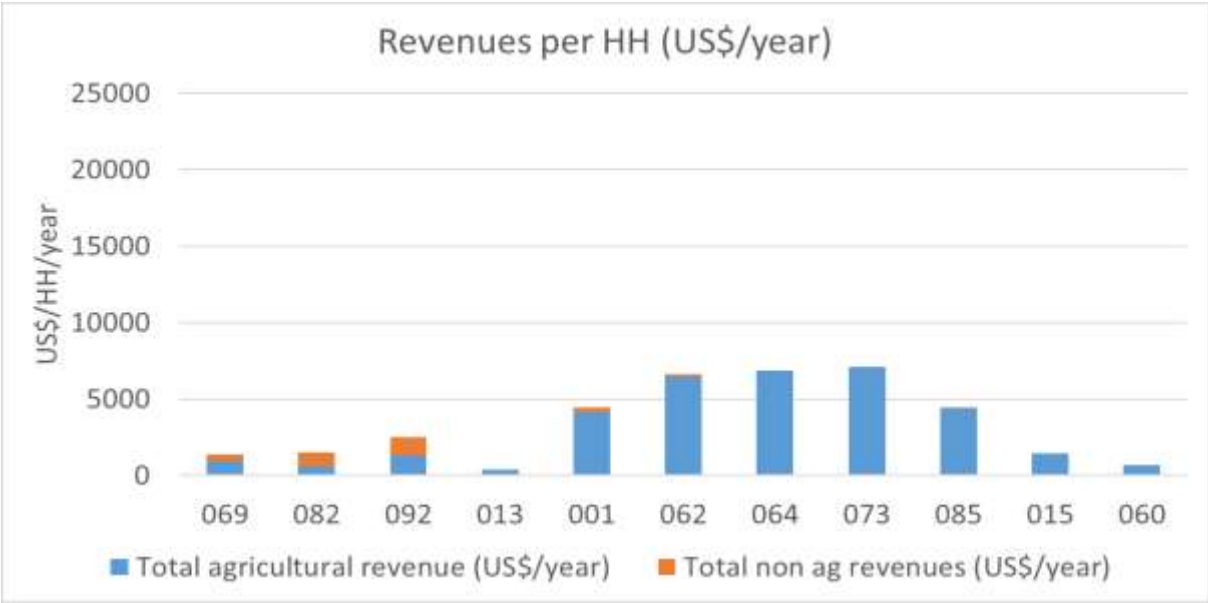
3.2.1 HH small size diversified agriculture (<2ha)¹

These households own less than 2 hectares. Those with the smallest land size rent their land out to other farmers (2 out of 6 HH). One household (Number 82) does not have any land and exclusively depend on livestock, fisheries and wage labor. These are mostly middle age couples who live with one of their children and whose families have been living in the area for a long time. Most of these households are living in Chheu Khmao village, Chheu Khmao commune, Koh Thom district where land has been allocated since a long time.

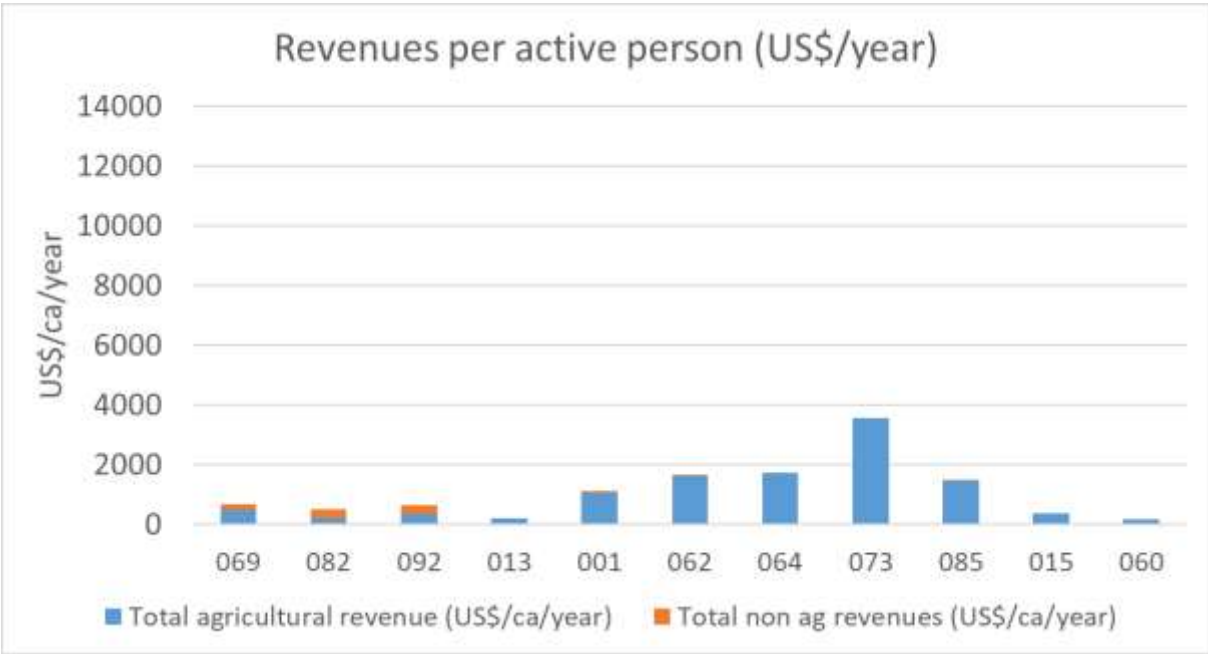
These household inherited small land from their parents (0.5 to 1 hectare) when they married (between the mid-1980s and mid 2020s). They said that because their parent had many children, they could only give small areas of land to each child. Some of them also had to sell part or all the land they inherited for health treatment of family members or for the study of their children. The oldest HH have also allocated some of their land to their children, further decreasing their land area. 8 out of 11 households did not have the land title certificate because the government did not yet draw official maps in their communes (Chheu Khmao and Prek Chrey commune in Koh Thom district).

¹ 11 interviews out of 49; HH Code number: 1;13;15;60;62;64;69;73,82;85;92

Graph 3: HH small size diversified agriculture (<2ha) revenues (US\$/HH/Year)



Graph 4: HH small size diversified agriculture (<2ha) revenues per active people (US\$/ca/Year)



Fishing activities (65% of total revenues). is the main source of revenue. HH are also involved in nonagricultural revenues (such as the remittance from the family, land rental, wage labor in the construction or garment sector) (8% of the total revenues) and agricultural wage labor (3% of the total income). Crop cultivation only represent 22% of the total net revenue. Total annual revenue per household is about 3390 USD/year (graph3) and total monthly revenue per active worker is 86 USD/ca/month (graph4), which means they earn less than half the Cambodian minimum salary which mean that they are very poor.

Figure 5: The house and livestock of one of our interviewees who is 55 years old and lives in Chheu Khmao village. He is landless since he sold his land 8 years ago for supporting his children's education and paying for the health treatment of his mother who was sick. Now his family depends on livestock, fisheries activities, agriculture wag labor and wag labor of garment (HH Number 82 in graphs 3 and 4).



3.2.2. HH medium size farms (2 to 5 ha) with extra (non agricultural) revenues²

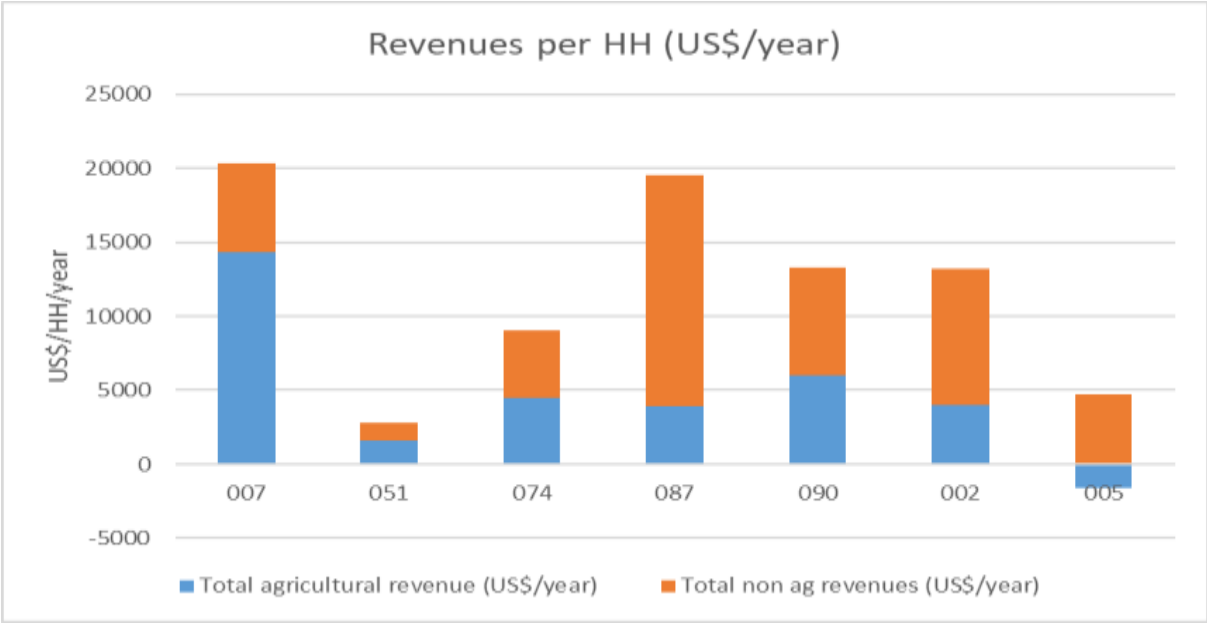
These households own between 1.5 to 5 hectares but they have started a transition outside of agriculture. Non-agricultural income (small business and remittances from family members working in factories in Koh Thom district or Leuk Dake district and Phnom Penh, as well as wage labor in the construction sector) is their main source of revenue though they still have significant crop cultivation, fisheries, and livestock activities and revenues.

These are mostly old couples whose families have been living in the area for a long time; they often live with the family of one or their married children who works with them. The average size of HH are 6 members, most of them are aged 18+ and working. Most of these households live in Chheu Khmao village and to a lesser extent in Boeung Kraom, Chroy Snou, and Phum Thmey villages.

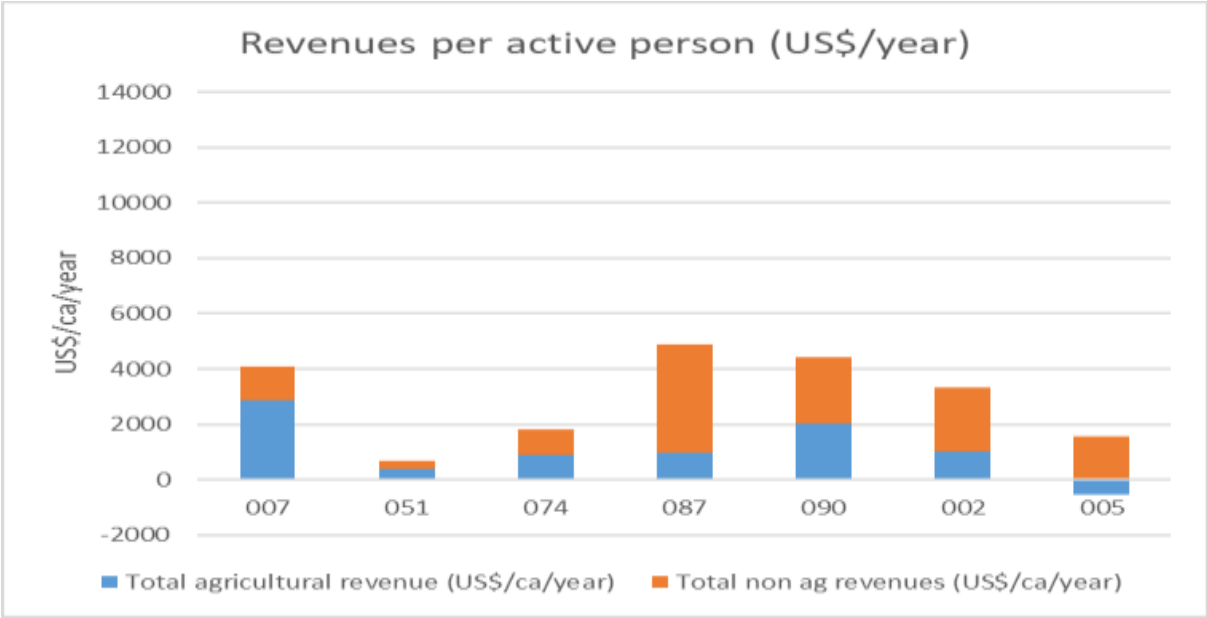
In the early 2000s, these are HH who managed to pay the Chheu Khmao commune chief at the time who had rented agricultural machinery from Vietnam to clear land in the boeung – farmers had to pay 700,000 riels per hectare to the commune chief (to rent the tractor for clearing the natural vegetation and preparing the land) or to clear the land by themselves. They managed to extend their cultivated area, clearing the natural vegetation close to the land that they had been allocated between canal 15 and canal 21. At the time, agricultural equipment was limited and road conditions were poor so some HH were not interested in cultivating in the boeung and sold the additional land they cleared to neighbors or relatives and re-invested this money in *Chamkar* cultivation or other activities.

² 7 interviews out of 49; HH Code number: 2;5;7;51;74;87;90

Graph 5: HH medium- size farms (2 to5 ha) with extra (non agricultural) revenues (US\$/HH/Year)



Graph 6: HH medium-size farms (2 to 5 ha) with extra (non agricultural) revenues per active people (US\$/ca/Year)



About 3 years ago, these HH started double cultivation of rice or maize (December-March/April and May to August) in the Boeung (low lying land) as canals in the area were dredged with support from the commune fund and PDOWRAM. However, they still regularly face water shortage in the second season, especially in Chheu Khmao and Phum Thmey villages due to a lack of irrigation water. Most farmers dug wells to irrigate their recession rice, just before harvest, and their dry season rice (investment of about 390 USD/well), especially in the south

of canal Prek Samaki (Figure 6; 7 and 8). They say the quality of the water is not good and pumping expensive so they prefer pumping in the canal that brings water from the Chroy Snou streams but the canal depth is low and water available is still a problem.

Figure 6: shortage of water of Canal Prek Samaki in dry season.



Figure7: Farmers dug well for irrigation because of lack of water.



Figure 8: The well for irrigation the rice field in Chheu Khmao village.



Non agricultural revenues (such as small business; wage labor of construction or garment; renting land; salary and remittance from members of family) are the main sources of revenue (60%). Crop cultivation account for 19% of the total income; livestock activities for 7% and fisheries activities for 14 %. Total annual revenue per household is about 11619 USD/year, the highest revenue of all type of HH. Monthly revenue per active worker is 242 USD/capita/month.

Most of these farmers do not have long term loans. They have light agriculture equipment (such as sprayer, pumping machine, corn planting machine, boat) and there are only two households who have second-hand tractors. They mostly rely on their own labor force for cultivation and rent machinery for preparing their land and harvesting. They use a lot of inputs for their rice and maize cultivation (purchased as advance from local input suppliers) which may lead some farmers to lose money (see HH 5 in graph 5 and 6). Overall intermediary cultivation costs are 547 USD/ha (60% of gross output) for rice and 578USD/ha (73% of gross output) for maize.

Figure 9: The household of one of our interviewees graph6: HH 087) who owns 1.3ha and is a very intensive farmer. Her family also has a small business serving as a middleman for mangoes and her son provides extra revenues as he works as a mechanics.



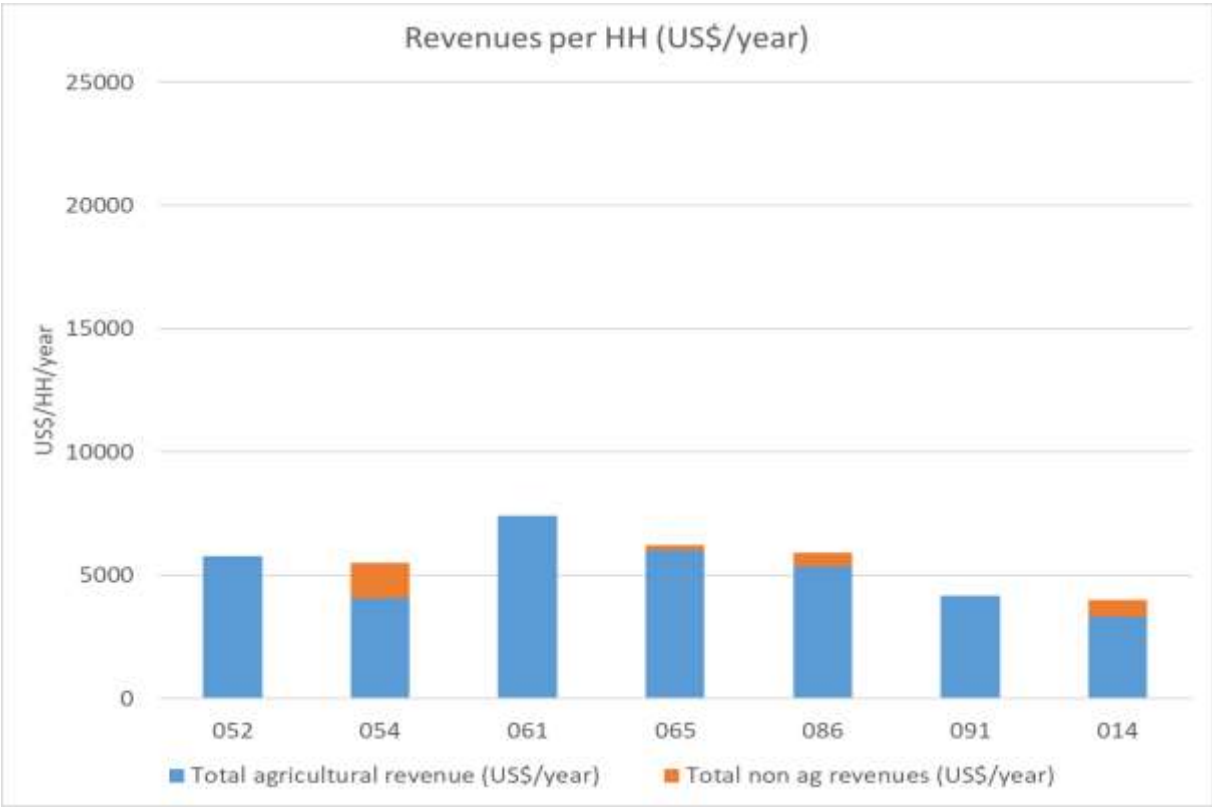
3.2.3. HH medium-size diversifiers (2 to 5 ha)³

These households cultivate between 2 and 5 hectares; they can rent part of it (0.7 to 3 hectares). These are mostly young couples with young kids whose families have been living in the area for a long time.

Most of these households live in Chroy Snou village. There is on average 5 members per HH. They mostly cultivate *boeung* (low lying land) with rice or maize, twice a year (December-March and May to August). They regularly face water shortage in the second season, especially in Chheu Khmao and Phum Thmey villages.

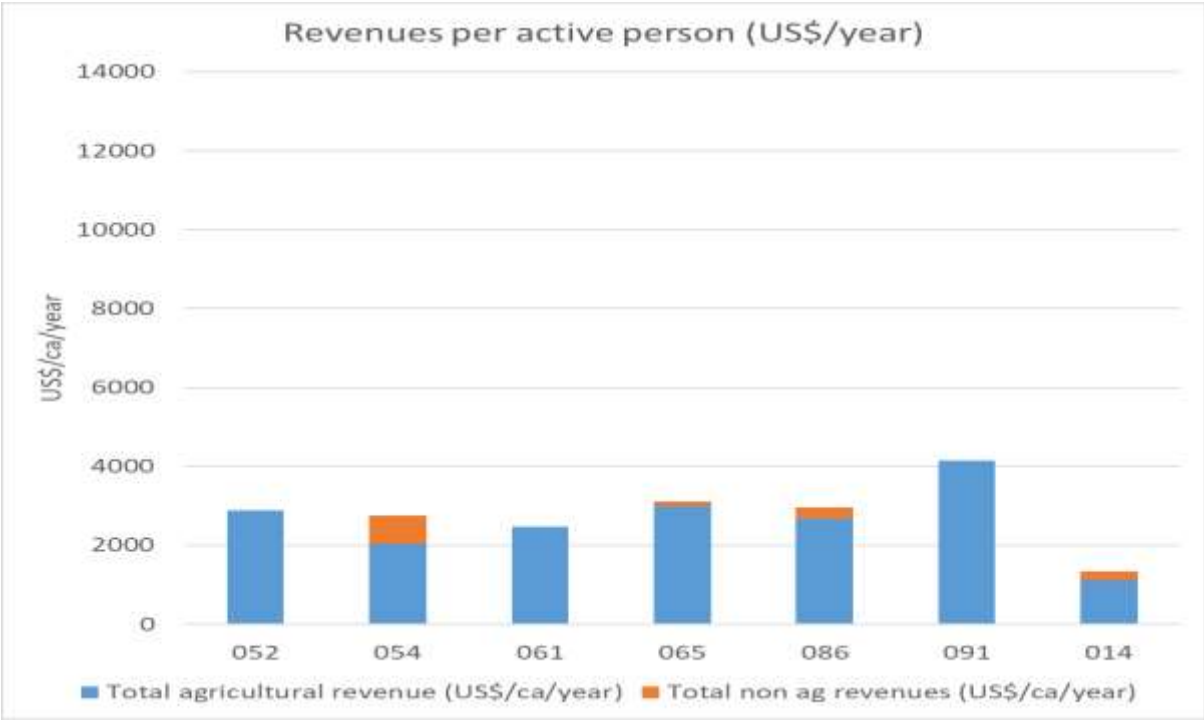
Their parents benefitted from land allocation (about 2 ha) by the local authorities in the 1980s and have a “notice letter” issued by the local authorities (village, commune chief or Mé Prek) for that land. They cleared small extents of natural vegetation mostly in the early 2000s (when the fishing lot was not dismantled and even if this was officially illegal) but most of them sold the land they cleared (in the mid-2010s) to middlemen to build new housing. The older couple distributed their land among their children after these got married and the latter can rent additional land.

Graph 7: HH medium-size diversifiers (2 to 5 ha) revenues (US\$/HH/Year)



³ 7 interviews out of 49; HH Code number: 14;52;54;61;65;86,91

Graph 8: HH medium-size diversifiers (2 to5 ha) revenues per active people (US\$/ca/Year)



Fisheries and crop cultivation are the two main sources of revenue (61% and 18% of the total income, respectively). Fishery is most important in Chroy Snou village and cultivation most important in the other villages. Some households also have livestock activities (12% of total revenues) and nonagricultural revenues (remittances from family; 10 %) (graph7). Total annual revenue per household is about 5707 USD/year(graph7) with little variation among HH, and total monthly revenue per active worker is 226USD/capita/month (graph8), which means they earn more than the minimum salary.

Most of these farmers do not have long term loans. They have light agriculture equipment (such as sprayer, pumping machine) and a few have bought second-hand tractors. They mostly rely on their own labor force for cultivation and rent machinery for preparing their land and harvesting. They use a lot of inputs for their rice and maize cultivation (purchased as advanced from local input suppliers). Overall intermediary cultivation costs are 506USD/ha (48% of gross output) for rice and 531USD/ha (53% of gross output) for maize. It is a rather intensive farming system.

Figure 10: The House and agricultural equipment (second hand tractor) of one household cultivating 5 hectares.



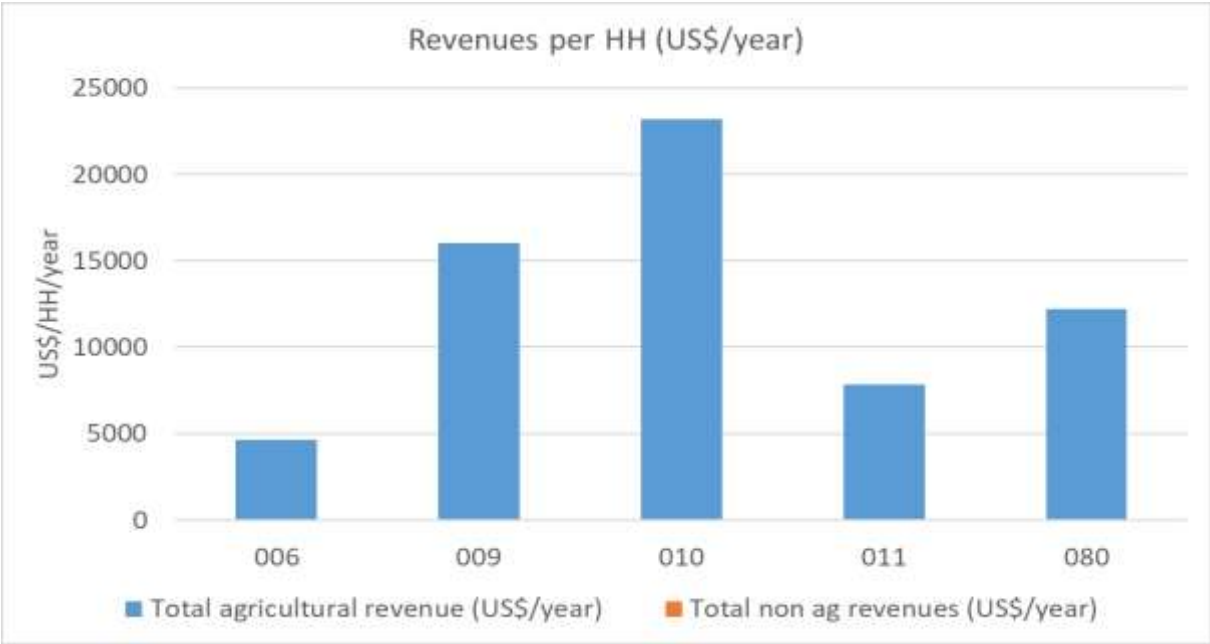
3.2.4. HH medium-size intensive farmers (2 to 5 ha)⁴

These households own between 2 and 5 hectares and they can also rent extra land (0.4 to 1 hectare). These are mostly young couples with young kids whose families have been living in the area for a long time. On average there are 5 members in the HH. Most of these households are living in Boeung Kroam village, Kphob Ateav commune, Leuk Dake district. They cultivate both *Chamkar* with mango, maize and vegetable such as winter melon, and *Boeung* (i) with rice or maize, twice a year (December-March/April and May to August). Most of these households depend on *preks* from the Mekong river to irrigate their fields. They have very intensive systems and are vulnerable to fluctuation in market prices (a recent drop in the price of mango due to the closing of the Vietnamese market where most mangoes are exported led some farmers to cut their mango tree to grow crops such as maize in their *Chamkar*).

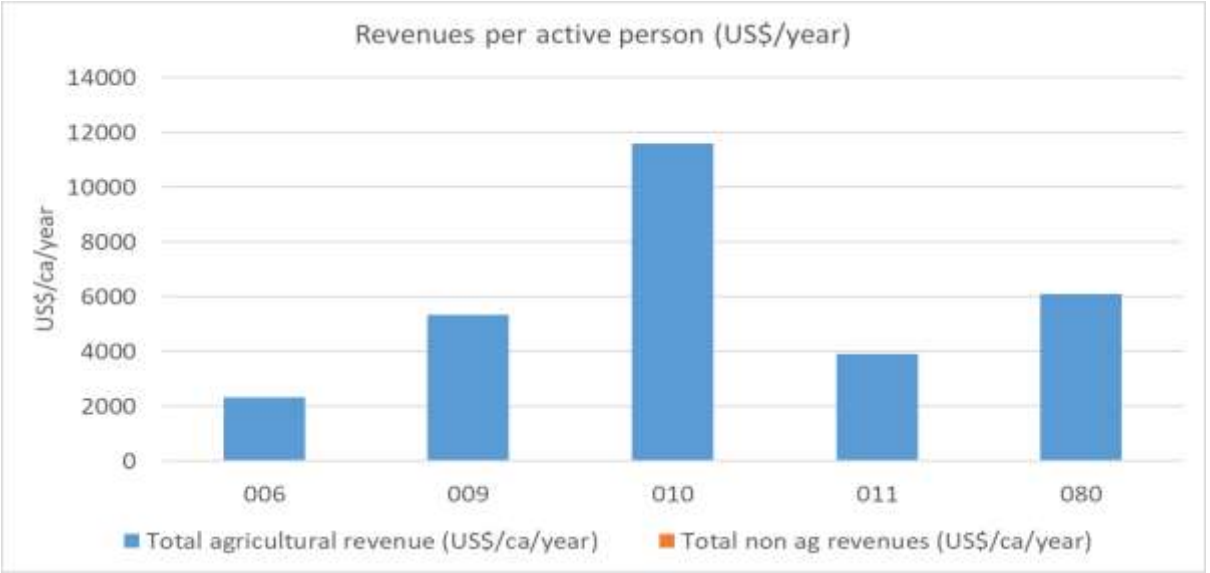
Between 2012 and 2014, villagers in Boeung Kroam village cleared the natural vegetation in the former fishing lot control (each family cleared about 3 to 4 hectares by manual labor – the local authorities did not authorize them to do it but could not stop them either). They needed more land because the population in the village had increased. In 2020, the government initiated formal land registration. Farmers who cultivated in the former fishing lot area could not register their land but continue to cultivate it even though the authorities indicated they do not have the right to do so.

⁴ 5 interviews out of 49; HH Code numbers: 6, 9,10,11,80

Graph 9: HH medium-size intensive farmers (2 to5 ha) revenues (US\$/HH/Year)



Graph 10: HH medium-size intensive farmers (2 to5 ha) revenues per active people (US\$/ca/Year)



Crop cultivation and livestock are the two main sources of revenue (73% and 20% of the total income, respectively). Some households also have fishing activities (7% of total revenues). Total annual revenue per household is about 12792 USD/year (graph9) and total monthly revenue per active worker is 485 USD/capita/month (graph10), which means they earn twice as much as the Cambodian minimum salary. One of the HH has a significantly highest revenue than others because of a more diverse and intensive farming system (including rice, maize and mango trees), but there is maybe also some problems in data collection.

They have light agriculture equipment (such as sprayer, pumping machine and tractor) and most farmers (3 out of 5 HH) have also contracted long term loans for buying large agricultural equipment and/or building new houses. They use a lot of inputs for their rice and maize cultivation (purchased through advance from local input suppliers). Overall intermediary cultivation costs are 405USD/ha (44% of gross output) for rice and 589USD/ha (30% of gross output) for maize. It is a very intensive farming system.

Figure 11: The household of one of our interviewees who owns 4.4 ha and a second hand tractor he uses for dry season rice cultivation in the Boeung.



3.2.5. HH large-size farms of about 10 ha⁵

These households own between 4.5 and 25 hectares and those who own large agricultural equipment rent extra land (4 to 7 hectares). These are middle age couples, some of them living with their married children, whose families have been living in the area for a long time. There are about 5 members per family. Most of these households live in Chroy Snou village, Prek Chreay commune, Koh Thom district.

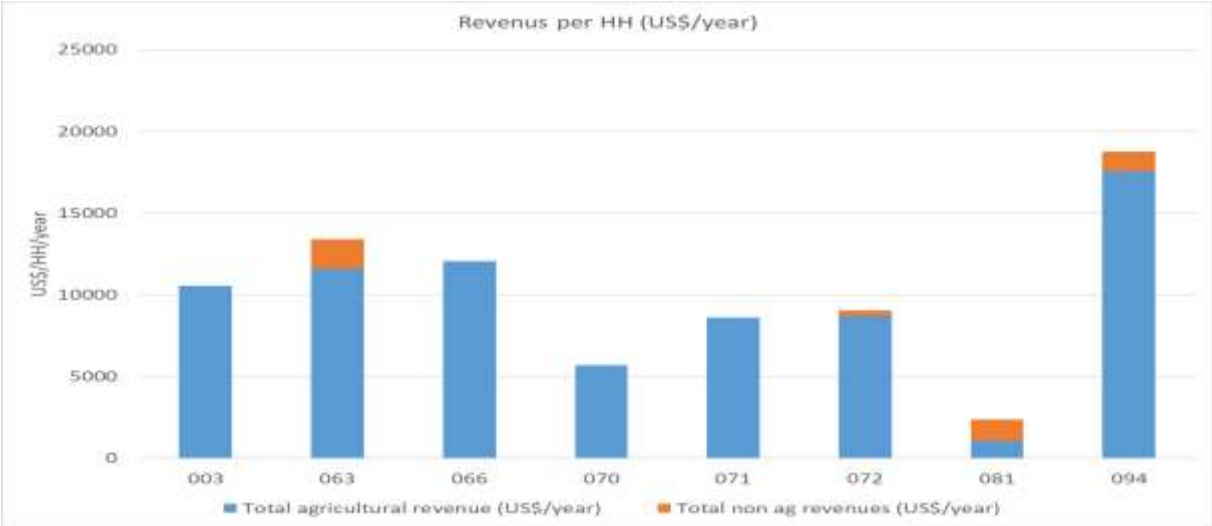
They cultivate Boeung (low lying land) with rice or maize, twice a year (December-March/April and May to August) in the area of the former fishing lots 9 and 10. Most of these households depend on the *Stoeung* (stream) located between the Mekong and Bassac rivers to irrigate their fields. They are using a lot of inputs but their system is rather extensive due lack of labour force. They have to hire agricultural laborers but wage labor is expensive because everyone is working at the same time. They are vulnerable to fluctuation in market prices as their village is far from the commune center as compared to Chheu Khmao and Boeung Kroam village and transporting their harvest by road is not easy. Some farmers sell their harvest to Vietnamese traders but at low price because they are bound by the “in-kind” input credit they contract from them. In these conditions, many of these HH do not cultivate all their land. They sometimes rent to Vietnamese farmers but this is less and less the case because the government is forbidding this in border areas like this one. Because they lack labour force to manage their field they can incur large losses (see HH 70, 81 who have little economic income even if large land areas).

Starting in the early 2000s, households in this group starting decreasing their fishing activities and cleared the natural vegetation by hand – hence the largest families with more labor forced

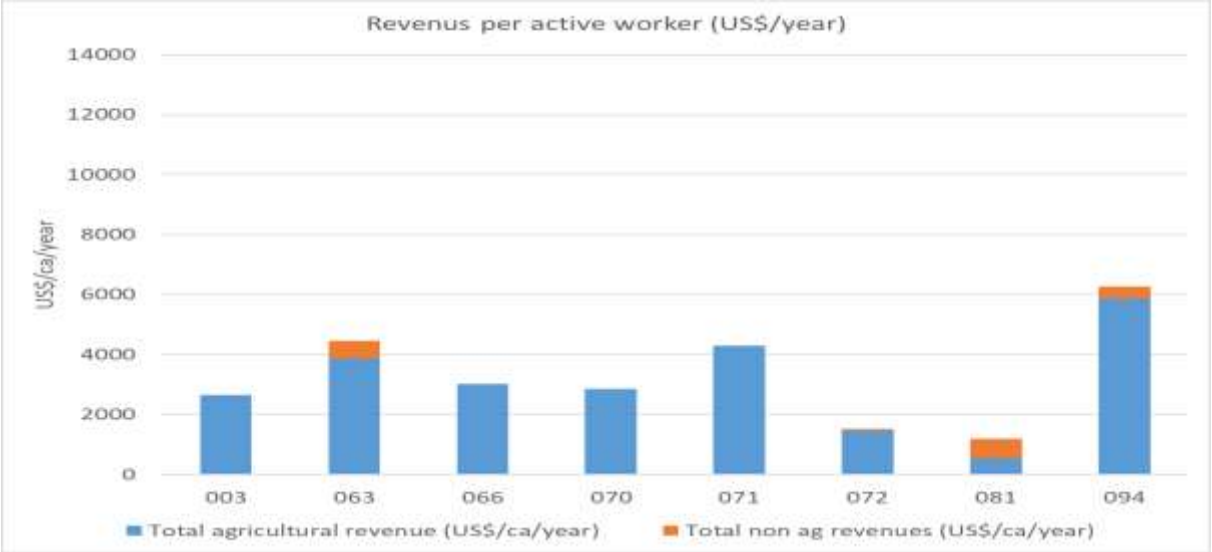
⁵ 8 interviews out of 49; HH Code number: 3;63;66;70;71;72;81;94

cleared more land (they could clear about 1 ha per year, and over time some HH cleared up to 25 ha sometimes). They did not necessarily cultivate all the land they cleared, but just put signposts indicating that the land was theirs, even if there was some natural vegetation on it. After 2011 and the announcement of Samdach Hun Sen to cancel the private fishing lots, they intensified land clearing and this led to conflicts between villagers from different villages (notably Chroy Snou and Boeung Kroam) because there was no regulation and villages borders were not respected. In 2019 to 2020, some of these households (3 out of 9 HH) sold some of the land they had cleared in the former fishing lot areas to middlemen to build new housings; they sold their land because they did not have land titles and were afraid that the state will take the land back, and middlemen put some pressure on them to sell too.

Graph 11: HH large-size farms about 10 ha revenues (US\$/HH/Year)



Graph 12: HH large-size farms about 10 ha revenues per active people (US\$/ca/Year)



Crop cultivation and fisheries are the two main sources of revenue (69% and 21% of the total income, respectively). Nonagricultural revenues (remittances from family) represent about 6%. Total annual revenue per household is about 10064 USD/year (graph11) and total monthly revenue per active worker is 254 USD/capita/month (graph12), which means they more than the Cambodian minimum salary. They do not have time to do other activities such as livestock or work as construction workers.

They have light agriculture equipment (such as sprayer, pumping machine, boat, hand tractor, brush cutter, harvesting machine and tractor) and some of them (3 out of 8 HH) have also contracted long term loans for buying large agricultural equipment such as harvesting machine and tractor. Overall intermediary cultivation costs are high due to input and/or land rental cost 512USD/ha (68% of gross output) for rice and 439USD/ha (28% of gross output) for maize. It is a system that is highly input intensive but labor extensive, for lack of time of HH members.

Figure 12: The house of one of our interviewees (HH63 in graph11 and graph12) in Chroy Snou village who owns 25 hectares of land east of stoeung Chroy Snou in lot 9.



3.2.6. HH agriculture as a secondary activity on less than 2 ha⁶

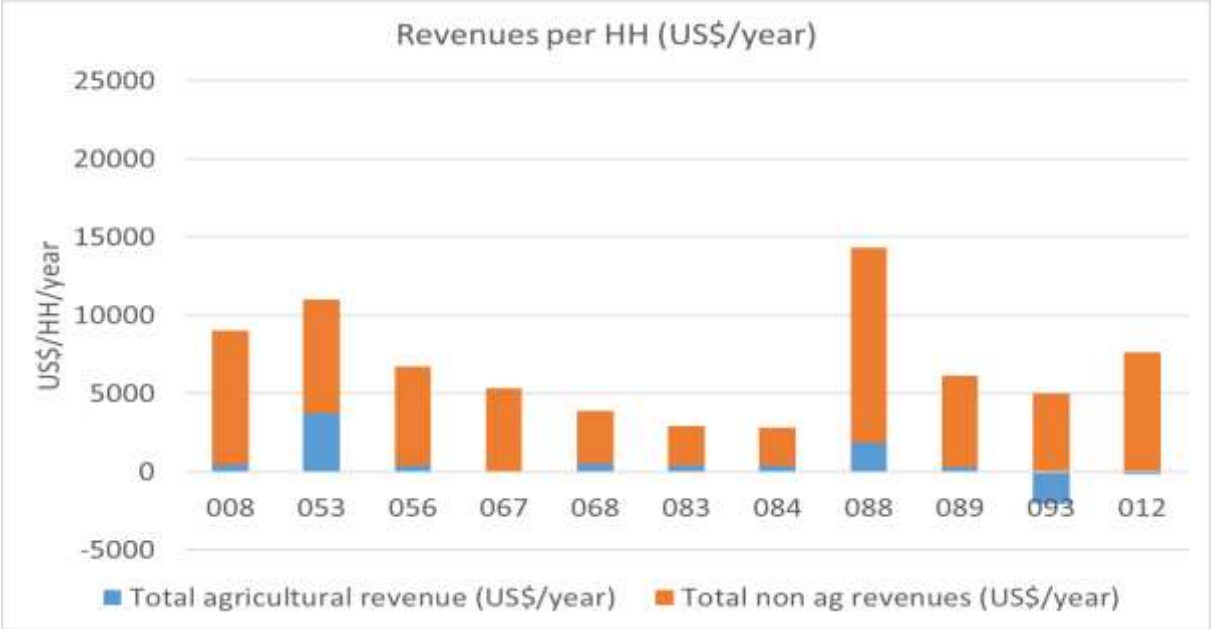
In general, these households (8 out of 11) own only a small area of land (less than 3 hectares) but there is a sub-group (3 out of 11ha) involved in land transactions who own large areas (more than 7 ha and up to 20 ha) that they sometimes rent to other farmers. Regardless of land size, these HH get most of their revenues from activities outside the agriculture sector: land transactions, small business, selling water, or salaried employment.

Some HH also have institutional responsibilities in their village and related revenues (village chief, deputy village chief). These are mostly young couples who live with young children and whose families have been living in the area for a long time. Some of them (3 out of 11HH) may have migrated abroad (Thailand) in previous years and save money they then invested in their nonagricultural activity when coming back to the village. Most of these households are living in Chheu Khmao village, Chheu Khmao commune, Koh Thom district.

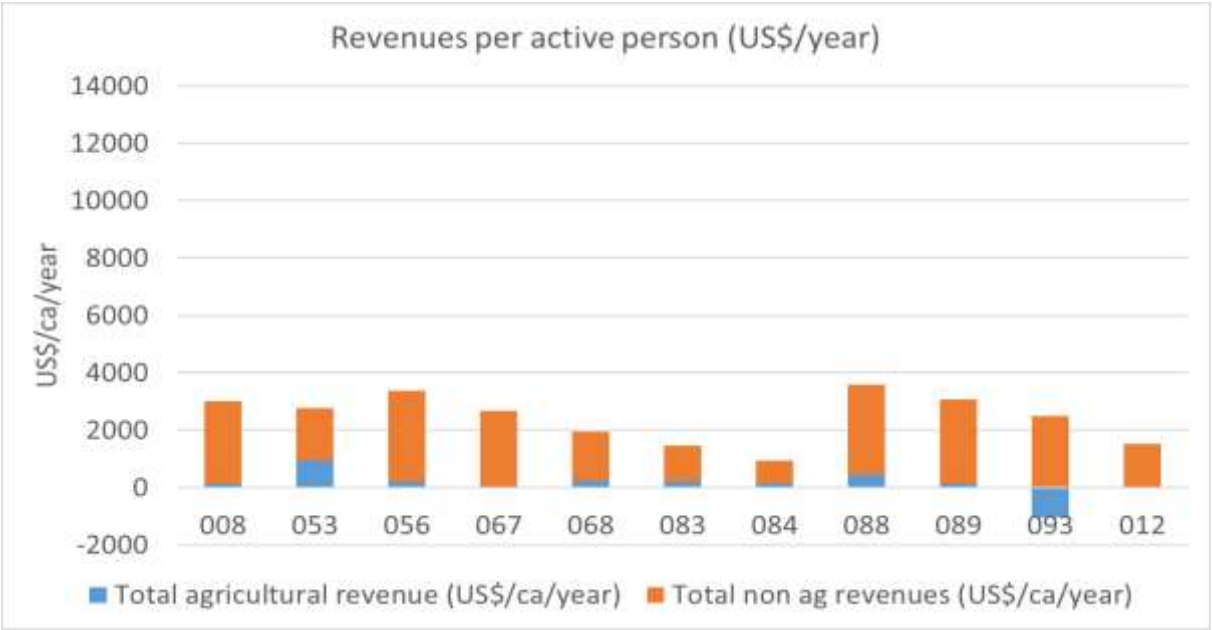
⁶ 11 interviews out of 49; HH code number: 8;12;53;56;67;68;83;84;88;89;93

Most of these HH received land from their parents in the early 1990s and 2000s when they got married. They mostly cultivate rice (recession rice, dry season rice and early season rice) but generate a low added value per hectare due to high input costs and little family labor involvement.

Graph 13: HH secondary activity revenues (US\$/HH/Year)



Graph 14: HH secondary activity revenues per active people (US\$/ca/Year)



Nonagricultural revenues (such as salary as –deputy- village chief or governmental employee, remittances from family, wage labor in the construction or garment sector, income from renting land) is the main source of revenue (92% of total revenues). HH are also involved in agricultural

crop cultivation (1% of the total income). Total annual revenue per household is about 6590 USD/year (graph13) and total monthly revenue per active worker is 196 USD/month/capita (graph14), which means they earn similar the Cambodian minimum salary which means that they are medium family.

Figure 13: The house of one of our interviewees who owns 20 hectares of land, east of canal Stoeung Chroy Snou. He rents his land to his nephew. The interviewee holds institutional responsibility in the village.



Figure 14: The house of one of our interviewees in Chheu Khmao village who owns 2 hectares of land, south of canal Prek Samaki. The family has a small dumper truck for transporting rice or maize.



DISCUSSION

In the case study area, and notably in the villages of Chheu Khmao, extension of cultivation accelerated in the early 2000s when farmers started rehabilitating and excavating the former KR canals. In Chroy Snou and Boeung Krom village, there was a second time when cultivation extended quickly, between 2012 and 2015 when the fishing lots were dismantled.

In some villages of the case study area (Boeung Krom), local authorities have delivered land history letters, certifying that farmers had cultivated their land for a long time (since before 2001) and the MLMUPC conducted official land registration in 2017 – including in the former fishing lots areas. In Chroy Snou village (as in the whole of Koh Thom district), however, it is different and no land registration was done – farmers only have land history letter for their house plots. The MLMUPC also did not deliver land title for the “protected area” in the middle of the case study area even if this protected area is not yet officially demarcated.

Almost all available land (apart in the protected area) has now been cleared but many households can not cultivate the entire land they cleared because of labor shortage and lack of money. They are also unsure the government will not take the land back from them as the land they cleared is public state land. As a consequence, they often sold land to middlemen who bought large areas of land after 2017/2018 when the government created a special economic zone not far from the case study areas. These bought the land (often for rich people in Phnom Penh) even if they can not yet obtain land title. Some farmers are now renting the land that they had cleared – after using the money they got from selling the land to build new houses, buy agricultural machinery or cover education or health expenses of their household.

Small farmers cleared the natural vegetation that existed in the area by hand or with agricultural machinery without seeking permission from authorities such as PDoWRAM or the Fishery Administration of MAFF even if the land they cleared was public state land. At the same time, the Ministry of Public Works and Transport funded the rehabilitation of roads and excavation of canals. Villagers can now cultivate twice a year (December to March, and April to mid-July in the dry season), also because flood extent has decreased. From 2012 to 2017, Vietnamese farmers who know how to cultivate on acid-sulfate soils rented land as some farmers did not have enough time and money to cultivate the full land they cleared. However, land rental by foreigners in border zones such as the case study area is prohibited after 2017.

In general, the interviewed farmers and local authorities stated that economic conditions have improved as cultivable land area has increased, and many people have sold part of the land they cleared to build new houses or invest to improve their livelihood conditions. Also, Cambodian farmers improved their agricultural skills thanks to the Vietnamese farmers to whom they rented land until 2017, but the clearing of the natural vegetation and increased use of pesticides has also led to a decrease in fishing activities, which has impacted the poorest.

CONCLUSION

However, the study shows a diversity of situations. There are 6 types of agricultural production systems in the study area. The small size diversifiers (category 1) who, over the last two decades, have not been able or willing to extend the area they cultivate are struggling to survive. Typically, they attempt to earn a living by fishing, raising cattle, or selling their wage labor

force in the agricultural sector but earn much less than the minimum Cambodian wage salary. A second type of HH has transitioned out of agriculture (category 6). They also cultivate small areas but they manage to derive the equivalent of the Cambodian minimum salary thanks to non agricultural activities (remittances from family members or wage salary from garment or construction companies). These two types of HH mostly live in villages located along the Mekong or Bassac river where land has been appropriated a long time ago. Then, there are 3 types of middle size farmers. These are households who had enough labor force and money to clear and keep some land over the last two decades. Households who cleared the land in the 2000s have sold some of it and invested the money outside of the agricultural sector (category 2) or in intensifying their agricultural systems (category 4). They mostly live in the villages located on the main river banks and derive revenues that are significantly higher than the Cambodian minimum wage salary. Households who have cleared the land later (and mostly living in Chroy Snou) (category 3) have not been able to intensify their system to derive a significant revenue and earn less than the minimum wage salary – also because they are more vulnerable to floods and low water availability in the dry season because they cultivate in the *boeung*. Finally, there is a last type of HH who own 10 hectares and more (category 5); these HH cleared the natural vegetation in the 2000s and later in mid 2010s after the lots were dismantled but they rarely cultivate the full area of the land they cleared and leave some parts fallow or rent land out to other farmers. They use a lot of inputs and sell the production at harvest at low price. For them, land is less a factor of production than a capital asset they have started to sell to middlemen.

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ANNEXES

Annexe 1- Interview guide key informants

Annexe 2- Farmers interview guide

Annexe 3- The figure 1 of map of the study area between Bassac River and Mekong River.

Annexe 4- The slides of presentation

Annexe 1 Interview guide key informants

In blue are questions specific to key informant interviews in the village of Chroy Snou. In black are questions for all key informants. You can use several questionnaires if you prefer. *[In italic and in brackets]*, I have identified hypothesis. If people do not answer the question, you can 'prompt them' with these hypotheses, checking if they are true or not. As we discussed, what we want to know is what has happened in the boeung **around** Chroy Snou village, which was **under a fishing lot** until 2012 and notably how farmers have managed to claim and access land. For sure, now, some villagers of Chroy Snou village cultivate in the area but it is also possible that people from **OTHER villages/communes** along the Bassac and Mekong river cleared the land and cultivate here. To know if this is the case, we need to interview chiefs of commune that have land in the boeung area close to Chroy Snou: Prek Chrey, Sandar, Khpob Ateav and ask them if villagers from their commune cultivate there (in the Boeung close to Chroy Snou) and if yes, we need to interview the corresponding village chiefs.

History of the Village

- When was the village created?
- Who created the village (e.g. before living in the village, where did they live)?
- Before there was a village here, did people come around here?
 - Who came ?
 - What did they do (what economic activity)? *[Hyp: Vietnamese fishing]*

History of access and use of land

The objective of this section is to identify if there have been different phases in the extension of cultivation and if there are different rules to govern land access and use depending on where the land is.

- In the village/commune, can you identify different types of land (Chamkar?Boeung)?
- Since when do people cultivate Chamkar?
- When was Chamkar land allocated? And by whom? *[Hyp: Krom Samaki in the 1980s]*
- At the time, did you have any rules regarding land allocation (for instance, a fixed number of hectares per household, a variable number of hectares depending on the size of the HH, etc.)?
- Who decided these rules ?
- Do people have land titles for their Chamkar land?
- Do they have other documents? Which one? Who gives these documents?
- In the area (only for Koh Thom district), there are a lot of canals:
 - When were they dug? *[Hyp: Khmer rouge]*
 - What happened after the Khmer rouge period? *[Hyp: people left]*
 - About when did people start using the canal for irrigation? *[Hyp: Early 2000s]*
 - Who was allowed to cultivate the land along the canals: was it everyone or people whose parents owned the land previously? How did people know who owned what ?

- Was land allocated following the same rules than for Chamkar? What was different/why?
- Do people have documents to ‘prove’ they can cultivate there? What documents ?
- Who delivers the documents if any? Is there a need to pay for it?
- In this area with the canals, did people need to clear the natural vegetation to cultivate?
 - If yes, did they do it by hand or by tractor?
 - Did they need/have an authorization to do it? Who gave it to them?
 - Did they have to pay something to clear the land? To whom?
 - Were there rules as to how much area people could clear (for instance, a fixed number of hectares per household, a variable number of hectares depending on the size of the HH)?
 - Who established these rules ?
 - Did some people clear more land than others? How come ?
- Do people of your village/commune cultivate land in the boeung, close to the Steung?
- Do they cultivate on the village side of the Steung only or on both sides?
- Are people from other villages/communes also cultivating in the boeung – Which one?
- Since when do people cultivate in the Boeung, close to the Steung?
- Can you identify a time (year) when more and more people started cultivating in the boeung, close to the Steung? [*Hyp: 2012/2013 when fishing lot was dismantled*]
 - When was that?
 - What happened then/What made it possible to start cultivating?
- Who is allowed to cultivate land in the boeung: is it everyone or people whose parents owned the land previously? How do people know who owns what?
- Do people have documents to ‘prove’ they can cultivate there? What documents ?
- Who delivers the documents if any? Is there a need to pay for it?
- In this area close to the Steung, did people need to clear the natural vegetation to cultivate?
 - If yes, did they do it by hand or by tractor?
 - Did they need/have an authorization to do it? Who gave it to them?
 - Did they have to pay something to clear the land? To whom?
 - Were there rules as to how much area people could clear (for instance, a fixed number of hectares per household, a variable number of hectares depending on the size of the HH)?
 - Who established these rules?
 - Did some people clear more land than others? How come ?
- In the areas where there was a need to clear the vegetation before cultivating, is it the same people who cleared and cultivated the land?
- Did people who cleared the land let others cultivate it?
 - Who cultivated and why? [*Hyp: Vietnamese*]
 - For how long ?

- What were the agreements between people who cleared and people who cultivated?
- How were yields just after cultivation [*Hyp: low because of acide sulphate soils*]
- Are there specific sub-areas in the boeung where it is forbidden to cultivate?
 - Where and why?
 - Who is in charge of making sure this rule is respected?
 - Is the rule respected and why?

Main changes and their impact

- What are the main economic activities in your village/commune?
- If you compare now and 10 years ago, what have been the main changes you observed?
 - How has land use changed in the last 20 years?
 - Is it good or bad and why?
 - What do you think are the impacts of these changes? m/
 - *Prompt: do you think it has an impact on fishery? Which one and why?*
 - *Prompt: what about pollution and health problems?*
 - Who do you think are the main responsible of these changes?
 - Do you think some people have been more negatively affected than others? Who and Why? [*if not mentioned, ask specifically what about the Cham?*]

Existence and Roles of Institutions

MAFF, Fishery administration, commune and district administration and Cfi Lot 9 all have an official role in terms of controlling/managing agricultural development and fishery in the area. The objective is to understand the relations between these organisations and what they do – which may be contradictory.

- As a village/commune chief/MAFF/FIAa agent,
 - What is your role concerning agricultural and fishing practices?
 - What do you do ?
 - What can you *NOT* do? And why ?
 - What challenges are you facing?
- Do you interact with the agriculture/fishery administration/village/commune representative?
 - About what ?
 - What are the main issues/difficulties you fac with them?
- Do you think the extension of the cultivated area should be stopped/reduced – and why?
- What are the difficulties to do so?

- Who is/should be responsible for this?

- Are you aware of the Community Fishery of Lot 9 (CFi Lot 9)?
 - What is its role?
 - Do they have a role to limit cultivation?
 - If yes, can they do it? Why?

- Are you aware of agricultural development project, for instance to excavate/dig the canals?
 - If yes, who is coordinating/implementing it?
 - What are the main reasons/purposes of these projects?
 - Do you think it is positive or negative – and why?

Annexe 2 Interview Guide Farmers

Date of interview
Name of interviewee Age Gender Contact
.....
Nationality and community
Residential area: Village Commune

Note: The open questions in the different sections are used to crosscheck the information that has been collected with key informant interviews. For each interviewee, you will write a short transcript (5 to 10 lines), presenting the main characteristics of the household (with answers from questions in the sub-section 'presentation of the household and the area'). This short transcript will also provide elements regarding what people tell you regarding the main changes that have affected the area (you can draw from answers provided to the qualitative questions in the sub-sections on agricultural and fishery activities).

Presentation of the Household and the area

- Since when does your family live in the area?
- Before, where did you live?
- Why did you come to the area?
- Are you living here for the full year or only part of the year - when?

- If part of the year, where do you go for the remaining of the year and why?
- If part of the year, do you consider the period that you spend here as being good for your livelihoods/household? Or is this a period of the year when things are more difficult? Why?

- How many members are there in your household?
- What are your main economic activities?
- How much land (hectares) do you cultivate? Do you own the land?

Plot Number	Type of plot (Chamkar/Boeung)	Since when do you cultivate it	Area (ha)	Tenure (owned or rented)

- Since you started living in the area, what have been the main changes you observed? Are they good or bad?
- What are the main consequences of these changes?
- Who is responsible for these changes and who has been most negatively affected?

Agricultural Activities

- If you cultivate in the boeung, are your fields in the area with the former KR canals or closer to the Steung?
- Did you have to clear vegetation before cultivating?
- How did you clear the vegetation – by hand or tractor? Or did you ask others to do it?
- After the vegetation was cleared, did you cultivate personally or did someone else do it?
 - If so, who, for how long and why?

- Who is allowed to cultivate land where you cultivate?
 - Is it everyone or people whose parents owned the land previously? How do people know who owns which land ?
- Were there rules as to how much area you could clear, or could you clear as much as you wanted?
- In case there were rules, who established those rules? Did they check if they were respected?

- Do you have documents to ‘prove’ you can cultivate there? What documents?
- Who delivers the documents if any? Is there a need to pay for it?

- Can you identify a time (what year?) when more and more people started cultivating in the boeung, close to the Steung?
 - When was that ?
 - What happened then/What made it possible to start cultivating there?

- Are there specific sub-areas in the boeung it is forbidden to cultivate?
 - Where and why?
 - Who is in charge of making sure this rule is respected?
 - Is the rule respected and why?

- Do you think the extension of the cultivated area should be stopped/reduced – and why?
- What are the difficulties to do so?
- Who is/should be responsible for this?

Table : Crop revenue
Crop/Season

Crop and cultivation season	Gross product			Production costs							
	Area (ha)	Yield (Kg/ha) The weight of one bag	Market price (riel/kg)	Fertilizer costs (USD/ha)	Pesticide costs (USD/ha)	Land preparation (Tractor or motor-tiller rental cost) (USD/ha)	Harvesting machine rental cost (USD/ha)	Pumping cost (USD/ha) (Own pumps and diesel to pump water)	Water cost (paid to private water seller) (USD/ha)	Wage labour paid (USD/ha)	Land rental cost (USD/ha)

Crop may include: recession and dry season rice, maize, chilies, etc..

Then ask these questions on constraints to production:

- Do you have easy access to water (to irrigate) in the dry season?
- How do you access water (to irrigate) in the dry season (own pump or purchase from a private water sellers)?

Other key economics information

Material owned	Value of material owned (USD)	Date of purchase of largest material owned
Remork		
Sprayer		
Powertiller		
Tractor		
Harvesting machine		
Motor Pumps		
Other:		

Term	Runnin g loan amount (USD)	Repaymen t period of loan (year)	Interest (%/year)	Purpose for loan (purchase of input, school or health, land purchase,etc..)	Source of loan (neighbour family members, micro credit institution, input seller,etc..)
Short					
Long					

Fishery Activities

- Have you observed any changes in flood patterns (flood coming later/earlier, the water staying longer/ leaving faster, the floods being larger/smaller)?
- How does this affect you? (4)
- Has fish catch in the flood plain decreased? (3)
 - If yes, is it a regular decrease over time (year after year) or is there a specific year after which fish catch decreased a lot?
 - What do you think is the cause of fish catch decrease?
- Has the type of fish you catch changed? How?
- Are there types of fish that you used to catch in the past, but you do not catch anymore?
 - Which one?
 - What happened to these fish/Why do you not catch them anymore?
- In general, what do you do with high value fish that you catch (consume/sell/depends)?

- What are the most productive fishing places in the area?
- Are you limited in the area and period when you can fish?
- Do you need to “pay” something for access or give fish to someone to be able to fish?
- Are there rules regarding the type of fishing system you can use?
- Who imposes these rules?
- Have you been ever stopped to fish? By whom and why?

- Are you aware of the Community Fishery of Lot 9 (CFi Lot 9)?
 - Are you a member?
 - What do you do? What do you get?
 - What is the role of the FC?
 - Do they have a role in limiting cultivation?
 - If yes, can they, do it?

Detailed fishing activities description: Use the table in the excel file “detailed questionnaire fish practice” for this. One table will have to be filled for each interviewee and data entered in excel.

Costs related to fishing:

Use the excel file for data analysis (fishery revenue spreadsheet) and include questions related to orange colored columns, based on the format you prefer using for collecting data. You can use table format and/or open question as soon as you manage to collect all the data we need on the excel file.

Cost related to processing fish (USD/year)	Hired labor cost (USD/year)	Purchase of nets& other fishing gear (USD/year)	Repair and maintenance of nets/traps/equipment (USD/Year)	Repair and maintenance of boat (USD/Year)	Typical daily cost of fishing (petrol, bait,ice)

- Do you have fish cages of fish ponds? If yes, what kind of fish do you grow?
- Do you purchase the right to fish from bear systems?

	Number	Volume (m3) or size (m2)	Investment cost (USD)	Feed/antibiotic costs (USD)	Auction Costs (USD)	Production (Kg/year)	Quantity consumed (Kg)	Quantity given or bartered (Kg)	Quantity sold (kg)	Sales price (USD/kg)
Cage										
Pond										
Bear System										

To be filled if at least one answer to the two above questions is “YES

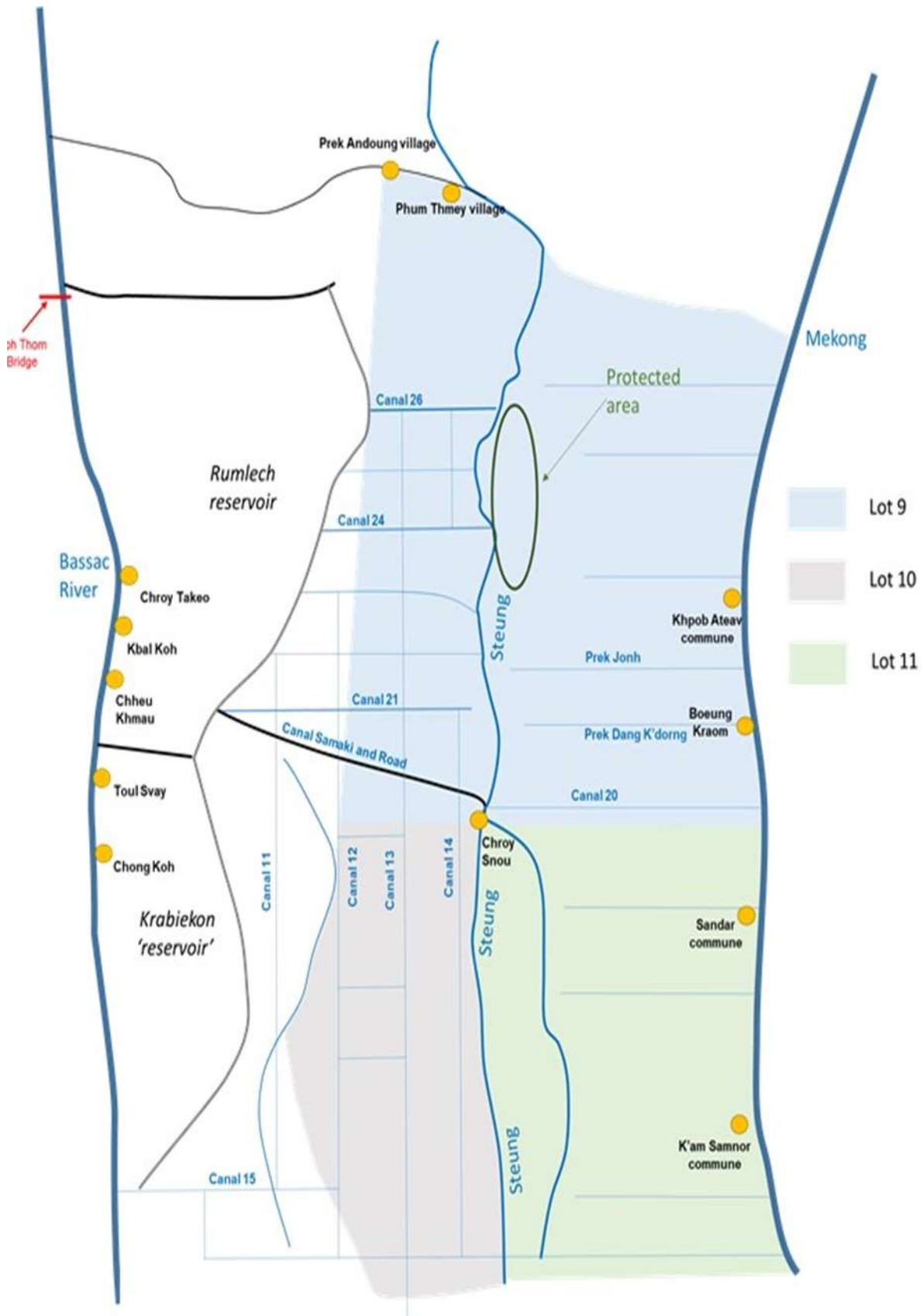
Livestock Activities

Types of livestock (Cows, buffaloes, chicken, ducks, pigs)	Number of heads/sizes of the herd	Types of production (eggs, meat, breeding)	Type of feed (green fodder, dry fodder, pasture, rice husk, paddy)	Price per head (USD)	Number of head sold per year	Sale of animal product (egg, milk) (USD/year)

Type	Value (USD/Year)
If the manure used in own fields, “value saved” by the owner	
If own crop products (rice straw fodder) used for feeding value saved by the owner	
Sale of manure to other if any	
Purchase of fodder/rice straw of husk if any	

Type	Value (USD/Year)
Payment for pasturing	
Payment you get to pasture in other people’s field	
Veterinary cost	
Antibiotic cost	

Annexe 3 The figure 1 of map of the study area between Bassac River and Mekong River.





agriculture • alimentation • environnement





Gestor de l'Eau, Acteurs, Impact



IRD Institut de Recherche pour le Développement





Srey Pich SINH-13/01/022

Livelihood Diagnosis And Analysis On Land Use And Land Governance In Floodplains Area In Kandal Province, Cambodia

Host organization	Thesis Report defense	Members of the Jury
UMR183 G-Eau-IRD	Master's Degree in Agricultural and Agrifood Systems in the South(SAADS)	Marie-Jeanne Valony, IRC-Montpellier SupAgro
Supervisor Jean-Philippe Venot	Speciality in Resources, Agricultural Systems and Development(RESAD)	Elisabeth RASSE-MERCAT, IRC-Montpellier SupAgro
Thesis director Marie-Jeanne Valony		Jean-Philippe VENOT, IRD/UMR G-EAU

Context > Methodology > Results > Conclusion > Perspectives > Limits

- Cambodia's primary agricultural sector is concentrated in rural areas, particularly between the Bassac and Mekong River in Kandal province.(Mak, 2015).
- Kandal province has a large floodplain area that allows floodwater to transport essential nutrients and new land during the dry season (Sokhem and Sunada, 2006).
- Ecological condition and land use tenure in floodplain regions of Mekong River remain constrained and uncertain (Kruijssen et al., 2018).
- Since the early 2000s, the government's strategy has aimed to improve farmer's livelihoods and encourage them to increase their productivities. (Kawarazuka and Béné, 2010; Vilain et al., 2016).
- Kandal province is undergoing significant transformation.



source : www.populationdata.net

The overall objective of this study:

To understand the history of land access, assess to land use and land management and to identify agricultural production system and farmer revenues.

The specific aims are to address and resolve the following:

- To gain a better understanding of the study area's land use history.
- To comprehend how land tenure and property rights are organized.
- To ascertain the agricultural production system and its associated activities.
- To investigate the household revenues.

Five hypotheses are formulated in order to address the study questions:

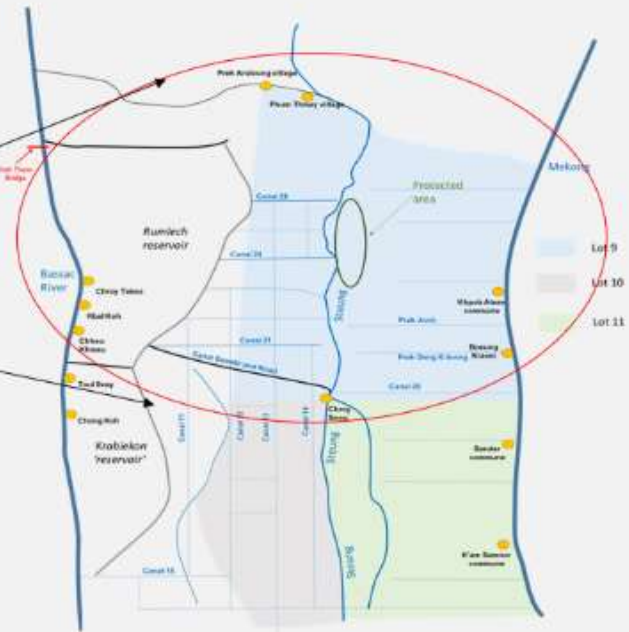
Hypothesis 1: Farmers started to cultivate in the study area around the year 2000.

Hypothesis 2: There is a diversity of modalities in access to land; in some places access has been formalized and in others not.

Hypothesis 3: The way that farmers have accessed the land, affect on their land use decision.

Hypothesis 4: Smallholder farmers increase their productivities by cultivating on all their land that they have and by increasing the use of chemical inputs. They also clear natural vegetation for new land, rent more land. Its resulted in the loss of natural vegetation. Contrarily, the large landowners don't expand their land anymore.

Hypothesis 5: A significant part of the land that has been reclaimed is used in an extensive rather than intensive way (land is a more an asset than a production factor).



The study area

➤ Localization of the study area and topography

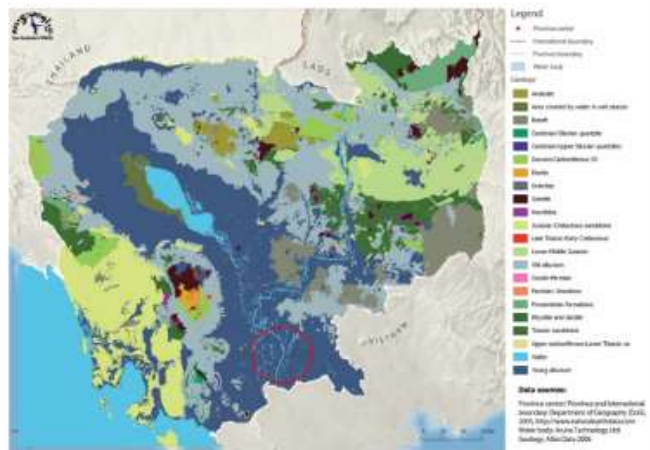
- Floodplain, Kanal province
- The Lot 9, which include Chroy Snou village, Chheu Khmao village, Phum Thmey village, and Boeung Kroam village.

➤ Soil type : alluvial (FAO,1998 and MRC,2002)

➤ Climate

- The rainy season : November to April
- The dry season : July to August
- The average annual rainfall : 1200 to 1432 mm, in driest month is February, with 9 mm.
- The average annual temperature : 27 to 33 °C

- Cropping system :
- Rice cultivation (twice a year).
- Maize
- Mango tree
- Sweet potato
- Mung Bean
- Vegetable

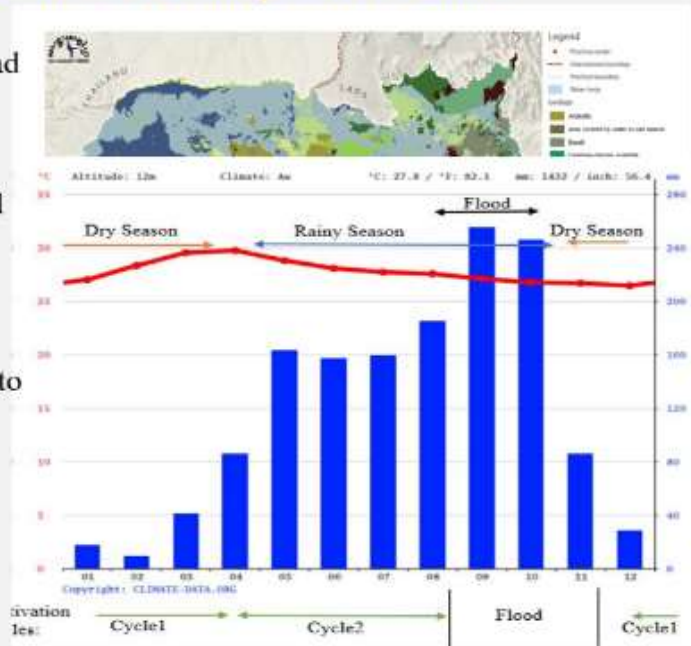


Generalized geology map of Cambodia, source: opendevlopmentcambodia.net

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➤ Climate

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 - Maize
 - Mango tree
 - Sweet potato
 - Mung Bean
 - Vegetable



Climate of Kandal province and cultivation cycles (Source: climatedata.org, model based on data collected from 1982 to 2012).

Agricultural Diagnosis :

- Landscape analysis
- Historical study : land use and agriculture with 15 key informant interviews and 2 FGD to gather data about the history of land use dynamics and land access.
- Characterization and economic analysis of production systems: Farmers interview (Then socioeconomic surveys were conducted with 49 farmers in four villages to elaborate a typology of the farming systems).

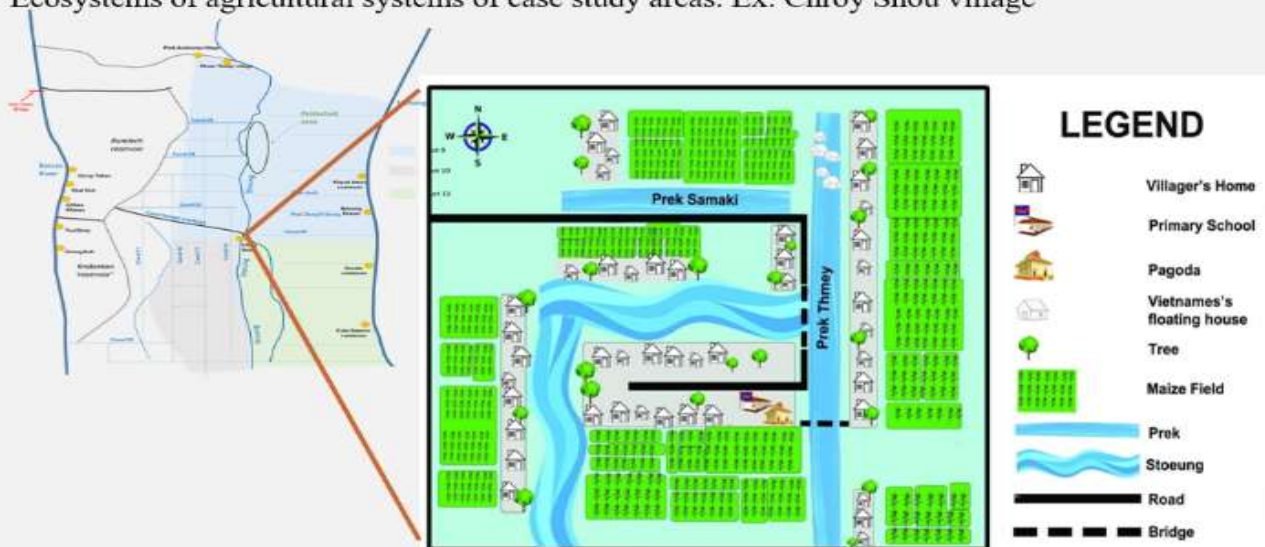
Villages	Chroy Snou	Chheu Khmao	Phum Thmey	Boeung Kroam
Number of interviews	15	14	6	14



HH types	Description
1	fishermen (fishermen own land <1 hectare)
2	1 to 3 hectares
3	5 to 10 hectares
4	>10 hectares.



Ecosystems of agricultural systems of case study areas. Ex: Chroy Snou village

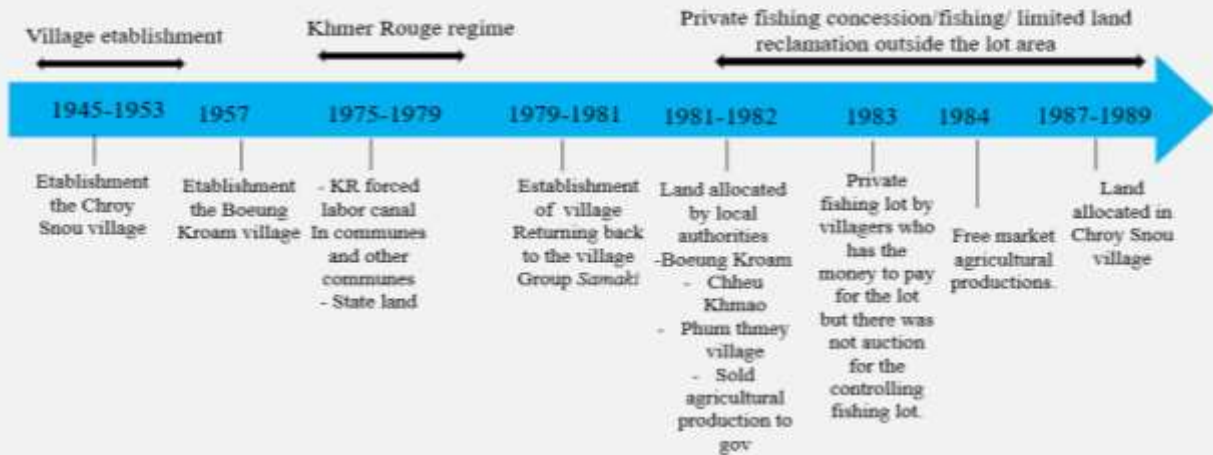


Agrarian system of Chroy Snou village between 2000s and 2021



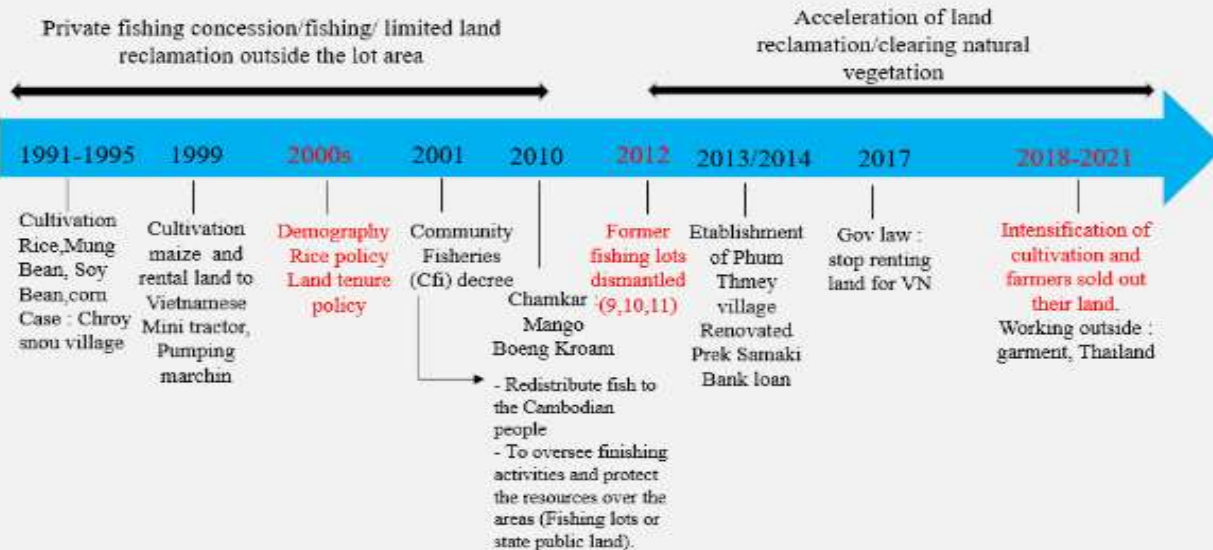
Context > Methodology > **Results** > Discussion > Perspectives > Limits > Conclusion

History of the case study area : Chroy Snou village, Chheu Khmao village, Phum Thmey village and Boeung Kroam village.



Context > Methodology > **Results** > Conclusion > Perspectives > Limits

History of the case study area : Chroy Snou village, Chheu Khmao village, Phum Thmey village and Boeung Kroam village.



➤ Characterization of agricultural production system

➤ Set six categories of agricultural production system

- Small size diversified agriculture (<2 ha) or HH Small size DA (<2 ha)
- Medium size farms (2 to 5 ha) with extra (non agricultural) revenues or HH MS (2 to 5 ha) with extra
- Medium-size diversifiers (2 to 5 ha) Or HH MSD (2 to 5 ha)
- Medium-size intensive farmers (2 to 5 ha) or HH MSI (2 to 5 ha)
- Large-size farms of about 10 ha or HH LS of about 10 ha
- Secondary activity or HH SA

➔ Land size, labor, capital, types of activities

➔ Agricultural revenues : crop net revenue, fishery net revenue, livestock net revenue, agriculture wage net revenue.

➔ Non agricultural revenues: garment, construction, salary/remittance from member of family, immigration (Thailand, Korea..etc)

➔ Land title : hard land title, land letter history

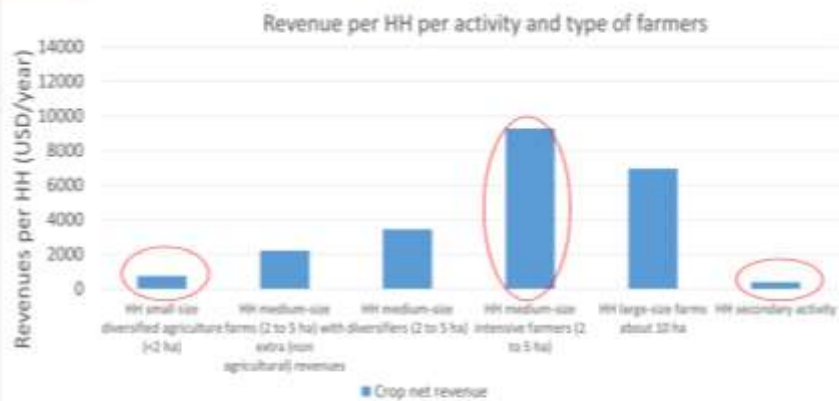


Crop net revenues :

HH Small size DA (<2 ha) :
Less revenues

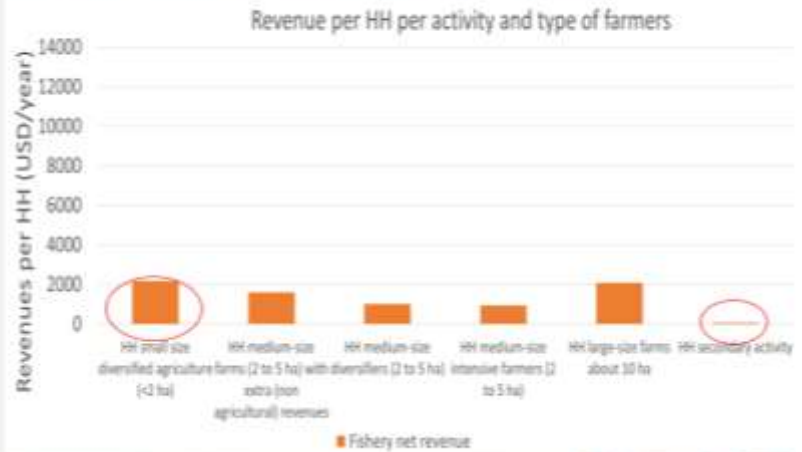
HH MSI (2 to 5 ha) : High
revenues

HH LS of about 10 ha:
medium revenues



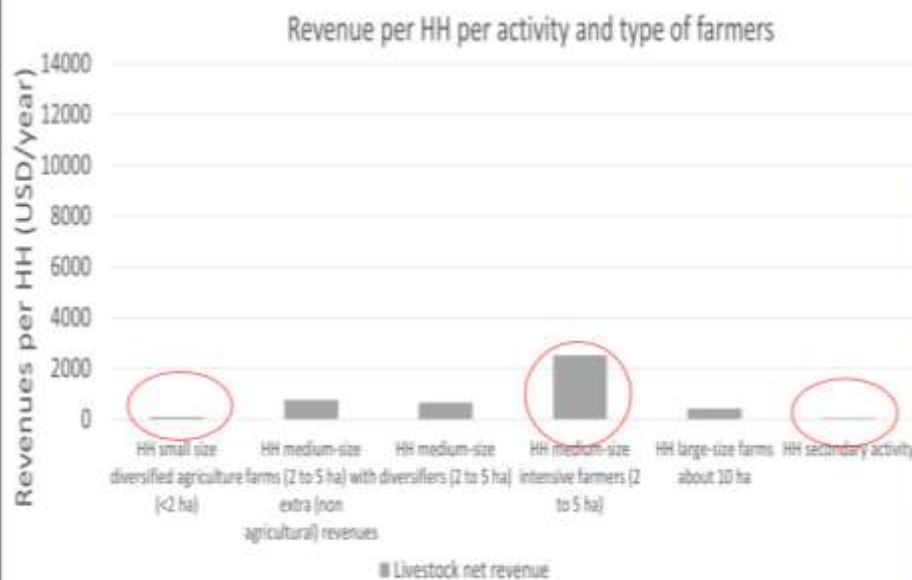
Fishery net revenues:

- HH SA : less revenues
- HH SMD (2 to 5 ha) : high revenues



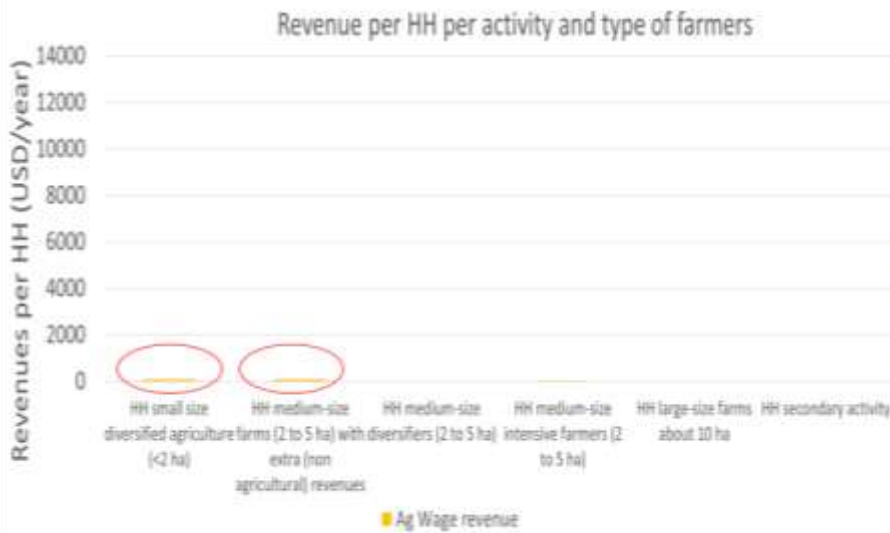
Livestock net revenues:

- HH SA and HH Small size DA (<2 ha) : less revenues
- HH SMI (2 to 5 ha) : high revenues



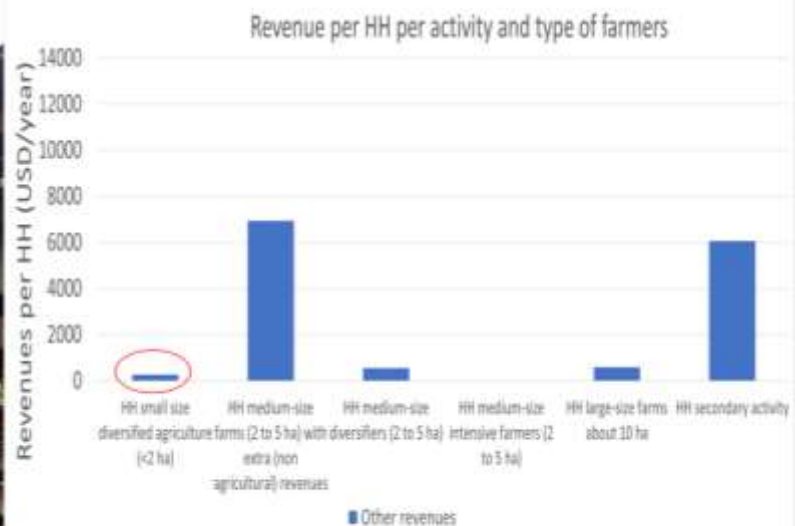
Ag wage net revenues :

Only HH small size DA (<2 ha) and HH MS (2 to 5 ha) + extra who benefited from agriculture wag revenues.

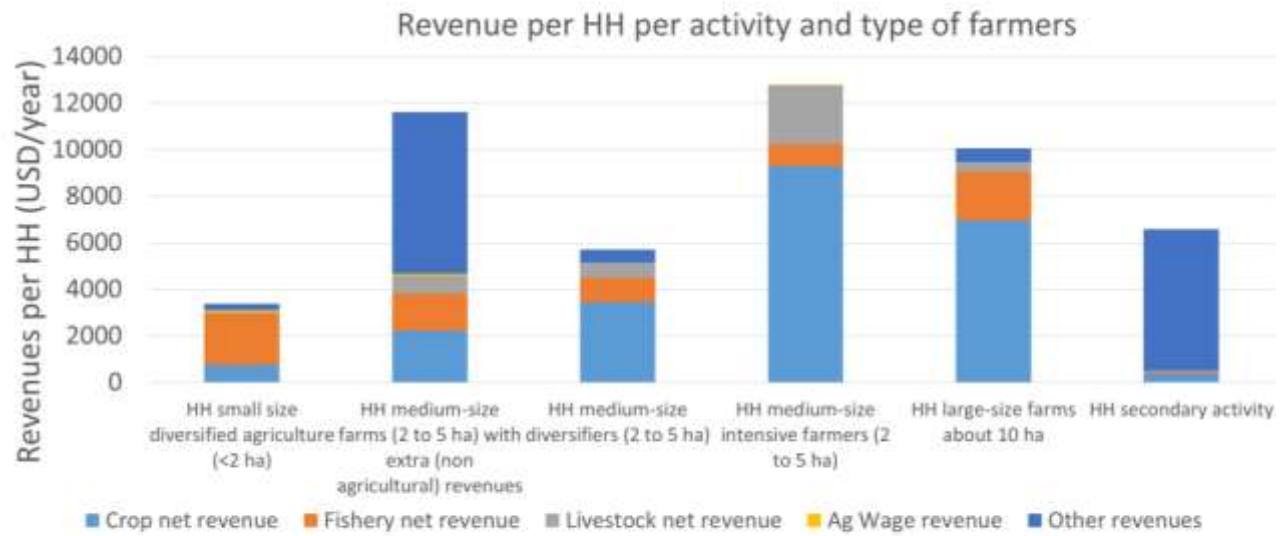


Other revenues/ Non Agricultural revenues:

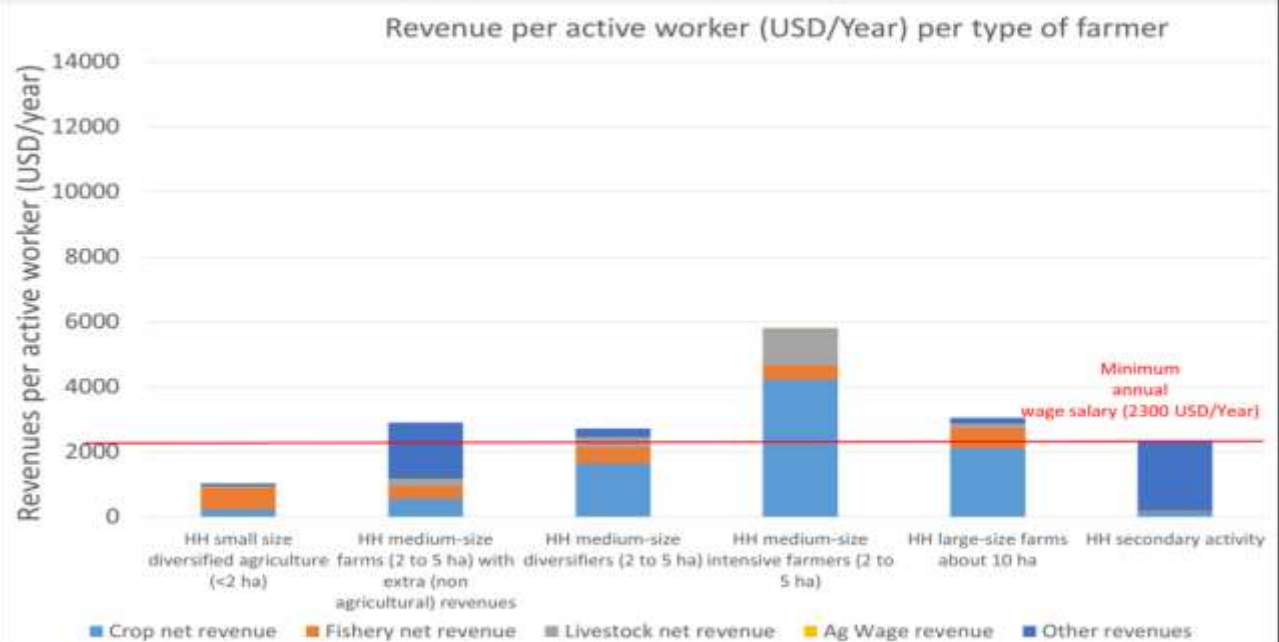
- HH SM (2 to 5 ha) + Extra (non agricultural) : high revenues
- HH SM DA (2 to 5 ha) : less revenues.



The HH revenues per year.



The HH Revenues per actives worker per year.



- The villages of Chheu Khmao, extension of cultivation 2000s. Chroy Snou and Boeung Krom village, there was a second time when cultivation extended quickly, between 2012 and 2015 when the fishing lots were dismantled.
- MLMUPC conducted official land registration in 2017 – including in the former fishing lots areas.
- Small farmers cleared the natural vegetation that existed in the area by hand or with agricultural machinery without seeking permission from authorities such as PDoWRAM or the Fishery Administration of MAFF even if the land they cleared was public state land. At the same time, the Ministry of Public Works and Transport funded the rehabilitation of roads and excavation of canals.
- Almost all available land (apart in the protected area) has now been cleared but many households can not cultivate the entire land they cleared because of labor shortage and lack of money.
- Economic conditions have improved as cultivable land area has increased, and many people have sold part of the land they cleared to build new houses or invest to improve their livelihood conditions. Also, Cambodian farmers improved their agricultural skills thanks to the Vietnamese farmers to whom they rented land until 2017, but the clearing of the natural vegetation and increased use of pesticides has also led to a decrease in fishing activities, which has impacted the poorest.

- Historical land use transformation from floodplain to agricultural land and sale ⇔
Impact factors on land use change are
 - ❖ Uncertainty of floodplain, Demography, Rice policy, land tenure policy, former fishing lots dismantled (9,10,11), Intensification of cultivation and farmers sold out their land
- The HH small size diversified agriculture (<2 ha) are struggling to survive
- 1 out of the 6 farming systems identified (corresponding to 22% of the interviewed households) generate less than the minimum wage salary.
- High volume of inputs such as pesticides and herbicides application cause to major environmental and biodiversity concerns, and land extension.
- Land degradation and water contamination continue to worsen cause to negative impact on fisheries and human health, as villages rely on water for everyday use.

→ Land title registration.



Security? Poverty?



- Covid 19, the difficulties with individual farmer interview.
- Short time for field work limitation because quarantine, Covid outbreak, authorization from authorities, its result the interview could be done by phone and less sampling.
- LMUPC of Koh Thom district did not collaborate with our research, its result missing understanding and clarifications on the process of land tenure.



RESUME

La dynamique des terres et des systèmes agricoles dans la province de Kandal n'est pas bien étudiée dans les sous-zones de la vaste plaine d'inondation située entre les fleuves Bassac et Mékong. Cette étude examine les dispositions et les droits d'accès à la terre (tant légaux qu'informels) et leur évolution au cours des deux dernières décennies, alors que la végétation naturelle inondée se transformait progressivement en parcelles agricoles. Ainsi, l'approche du diagnostic agraire a été appliquée pour identifier les différents modèles d'accès aux terres et zones inondées. Cette étude a également cherché à déterminer qui est habilité à fournir cet accès afin de caractériser les différents systèmes agricoles de la zone et d'établir des liens éventuels entre ces systèmes et des trajectoires foncières distinctes. Des entretiens approfondis avec des informateurs clés ont été menés afin de mieux connaître l'histoire de la zone d'étude. Ensuite des enquêtes socioéconomiques ont été menées avec 49 agriculteurs pour élaborer une typologie des systèmes agricoles de la région.

Nous avons identifié six systèmes agricoles distincts: une petite agriculture diversifiée (<2 ha); les agriculteurs de taille moyenne (2-5 ha) avec revenu complémentaire; les ménages diversificateurs de taille moyenne (2-5 ha); les agriculteurs intensifs de taille moyenne (2-5 ha); une grande agriculture avec environ 10 ha; et l'agriculture comme activité secondaire sur moins de 2 hectares. D'après les résultats, les ménages possédant de petites terres (<2 ha) et des activités diversifiées ont des difficultés à survivre. En général, ces ménages essaient de subvenir à leurs besoins en pratiquant la pêche, l'élevage, ou en vendant leur main d'œuvre dans le secteur agricole ou dans un autre domaine. De plus, 1 des 6 types d'exploitations agricoles (représentant en tout 22% des ménages interviewés) ne permettent pas de dériver l'équivalent du revenu minimum au Cambodge. Certains agriculteurs qui intensifient leurs cultures parviennent toutefois à augmenter leur rentabilité, améliorant ainsi le bien-être économique de leur famille. À ce résultat favorable s'ajoutent d'importantes préoccupations en matière d'environnement et de biodiversité, car ces exploitations nécessitent un volume élevé d'intrants tels que des pesticides et des herbicides. En conséquence, la dégradation des sols et la contamination de l'eau continuent de s'aggraver. Dans l'ensemble, cela a un impact négatif sur la pêche et la santé humaine puisque les villages dépendent de l'eau pour leur usage quotidien.

Mots clés

Cambodge, utilisation des terres, gouvernance foncière, plaine inondable, végétation naturelle, régime foncier.

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