# Mekong Cross-Boundary Impacts: Ecological Changes and Communities' Livelihoods A Case Study in Kraom, Kaoh Snaeng, and Tonsang Villages, Stung Treng Province

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**Abstract**

The research focused on the cross-boundary impacts of ecological changes on the livelihood of communities in three villages in Stung Treng province, Cambodia. The research objectives were to analyze river ecological changes and their drivers, and to explore the impacts of these changes on the livelihood of the communities.

The research was conducted in Kraom, Kaoh Snaeng, and Tonsang villages. The study found that there have been significant changes in the environment of these villages. The fishery resources have declined between 2019 and 2022 due to factors such as population growth, illegal fishing, loss of flooded forests, and the presence of hydropower dams. The extent of flooded forests has also significantly decreased, negatively impacting fish populations and the overall ecosystem. Water level fluctuations have become irregular since 2018, with lower water levels during the rainy season compared to previous years. Riverbank landslides have been a concern, posing threats to safety and livelihoods. Excessive algae growth in the rivers has also been observed.

The research findings indicate a decline in income from fish catch in all three villages, with varying levels of stability. Expenses for food have also varied. Migration patterns have been observed, with individuals seeking better opportunities elsewhere due to the decline in fish stocks. Crop damages have been attributed to irregular flooding and fluctuating water levels, leading to a decrease in crop cultivation. Changes in water quality, including the presence of lime and algae, have impacted the well-being of the residents.

Overall, the research highlights the need for interventions and support to address the economic challenges faced by the communities, mitigate the loss of equipment and housing, and improve water quality.

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Thanks also to Oxfam for providing capacity building on FPAR (Feminist Participatory Action Research) for MVi staff. This training has allowed us to apply the knowledge gained to support community researchers in conducting this research.

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**Lists of Research Technical Team and Researchers**

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2. KRY Solany, Program Manager, Member
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Community Researchers

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| 4. Ms. Pon Chanthyda | 5. Ms. Mar Chantha | 6. Ms. Por Somnang |
| 7. Ms. Khon Somche | 8. Mr. Sai Bournleerng | 9. Ms. Chheng Sokhea |
| 10. Mr. Lai Chanthon | 11. Ms. Mourn Chanthor | 12. Ms. Kha Sros |
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**Tables of Contents**

Contents

## Lists of Tables, Figures and Photo

### List of Tables



### Lists of Figures



### Lists of Photos

## Abbreviation

| | |
|---|---|
| CGIAR | : Consultative Group for International Agricultural Research. |
| CRC | : Community Researcher Committee |
| DFID | : Department for International Development |
| FPAR | : Feminist Participatory Action Research |
| GLBT | : Gay, Lesbian, Bisexual, and Transgender |
| MC | : Mekong Connection |
| PWD | : People with Disability |

# CHAPTER 1: INTRODUCTION

## 1.1. Background

The development along the Mekong River, particularly in Cambodia, has experienced substantial growth. Currently, there are a total of 755 dams in the region. Among these, 537 have already been completed, while 152 are still in the planning or proposed stage. Furthermore, 52 dams are currently under construction, while 14 have been canceled or suspended. These dams serve different purposes, with 392 being hydropower projects, 337 for irrigation, and 26 categorized as other types of dams (CGIAR, 2015).

While some officials may perceive hydropower dams as a means of economic development, many local experts and NGOs have acknowledged the negative impacts associated with these projects. These include a decline in fishing stocks and the exacerbation of socio-economic issues (Asia and the Pacific Policy Society, 2022).

Despite experts conducting research on the ecosystems and livelihoods impacted by these dams, there has been a dearth of studies conducted by local communities to investigate the cross-border effects of these projects. This is noteworthy considering that local communities have been facing issues stemming from the Mekong Development. Therefore, it is essential to conduct studies that integrate local knowledge to comprehend their unique circumstances and empower them to engage in negotiations with decision-makers and policymakers. This will enable them to address their needs and effectively respond to the findings of studies on local planning for sustainable community development.

## 1.2. Research Objectives

The objective of this study is to investigate the transboundary impact of the Don Sahong Dam on fisheries resources, ecosystems, and community livelihoods in three villages, downstream of Don Sahong hydropower dam. The specific objectives are

- To analyze river ecological changes (fishery resource, flooded forests, land slide and water fluctuation) and its drivers in three villages of Kraom, Kaoh Snaeng and Tonsang villages.

- To explore the impacts of ecological changes on the livelihood of communities in three villages of Kraom, Kaoh Snaeng and Tonsang villages.

### 1.3. Research Scopes

This study employed qualitative analysis and incorporated the knowledge of the local community. It was conducted over a period of six and a half months, from January 1st, 2023, to July 15th, 2023. The study specifically focused on various aspects of the communities, including fishery resources, the overall ecosystem, and livelihoods. The research framework utilized some components of three approaches: the Communities' Livelihood Approach, the Fishery Resource Approach, and the Ecosystem Approach. It is worth noting that there was a lack of scientific knowledge available for this research.

### 1.4. Research Significance

The findings of this study hold great significance for decision-makers, policy-makers, Civil Society Organizations (CSOs), and local communities. These findings can be utilized to influence decision-makers and policy-makers in the development of more effective policies that benefit the communities residing in the Mekong basin, particularly those along the Mekong River affected by the Don Sahong hydropower dam. Furthermore, the study findings can contribute to the recovery of issues faced by these communities.

Sub-national authorities can also make use of the study findings to develop plans that are responsive to the needs of the communities. Civil Society Organizations (CSOs) and local communities themselves can employ the study findings to design and implement interventions that effectively address the challenges faced by these communities. Overall, the findings of this study have the potential to drive positive change and facilitate the resolution of issues impacting the communities.

### 1.5. Research Approaches and Framework

#### 1.5.1. Research Approaches

In this study, three approaches were applied to conceptualize the research: the Communities' Livelihood Approach, the Fishery Resource Approach, and the Ecosystem Approach.

The Communities' Livelihood Approach focuses on understanding the means by which communities secure the necessities of life. It encompasses the capabilities, assets, and activities required for sustainable livelihoods. A sustainable livelihood is one that can withstand and recover from stress and shocks, maintain or enhance its capabilities and assets, provide sustainable opportunities for future generations, and contribute net

benefits to other livelihoods at the local and global levels in the long and short term (DFID, 1999). The framework of livelihood assets includes:

- Human Assets: The skills and abilities of individuals within a community.
- Natural Assets: The landscape, air, water, wind, soil, and biodiversity of plants and animals.
- Financial Assets: Money or other investments that can be used for wealth accumulation.
- Physical Assets: Man-made physical infrastructure, such as housing, factories, schools, roads, power systems, water and sewer systems, and communication infrastructure.
- Social Assets: Networks, organizations, and institutions that exist among and within groups and communities (The University of Memphis, nd).

The Fishery Resource Approach considers the myriad biological, chemical, and physical attributes of fishery resources. These resources include plankton, fish, mammal species, as well as factors like salinity, oxygen concentration, sediment type, oil and gas reserves, currents, and space. These attributes can be further differentiated by quantity, quality, and relational attributes (Edwards, 2005).

According to the Fishery Law (2006), fishery resources encompass freshwater and marine organisms, both living and non-living, such as fish, mollusks, amphibians, insects, reptiles, mammals, and other invertebrates. It also includes fertilized organisms in water, plankton, seaweed, seagrass, coral reefs, and submerged forests, including mangroves.

An ecosystem refers to a geographic area where plants, animals, and other organisms, along with weather and landscape, interact to create a functioning system of life. Ecosystems comprise both biotic (living) and abiotic (non-living) components. Biotic factors include plants, animals, and other organisms, while abiotic factors encompass elements like soil, water, air, and climate (National Geographic, nd).

### 1.5.2. Research Conceptual Framework

The literature review above enabled researchers to conceptualize the research as below

The conceptual framework for this research aims to identify and understand the drivers and ecological changes related to the impacts of hydropower dams on the surrounding

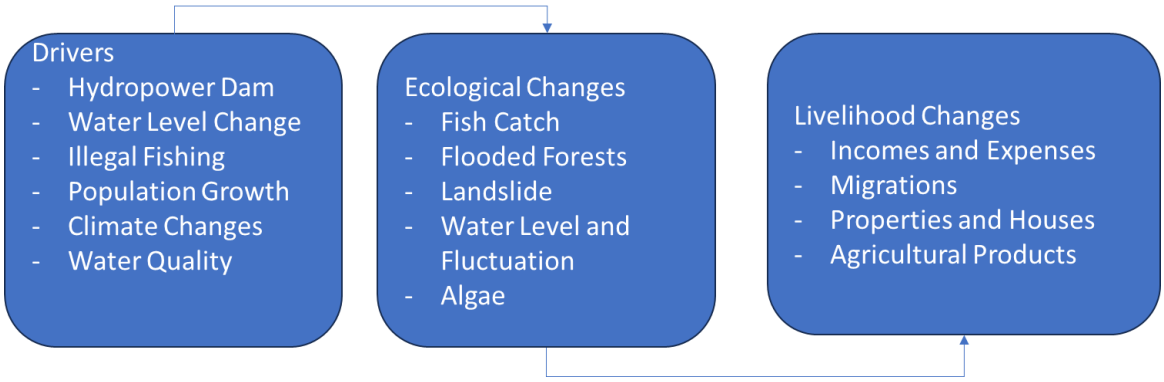
environment. The framework consists of two main components: drivers and ecological changes.

The drivers of the impacts include factors such as the presence of hydropower dams, changes in water levels, illegal fishing activities, population growth in the area, climate changes, and water quality. These drivers play a significant role in shaping the ecological changes that occur in the surrounding environment.

The ecological changes that are influenced by these drivers include changes in fish catch, the impact on flooded forests, occurrences of landslides, fluctuations in water levels, change in algae, and changes in livelihoods. These ecological changes have direct and indirect effects on the local communities and the environment.

The indirect effects include changes in livelihoods, such as variations in incomes and expenses, migrations of people from affected areas, impacts on properties and houses, and changes in agricultural products. These changes in livelihoods have a significant impact on the socio-economic aspects of the affected communities.

Figure 1: Research Framework

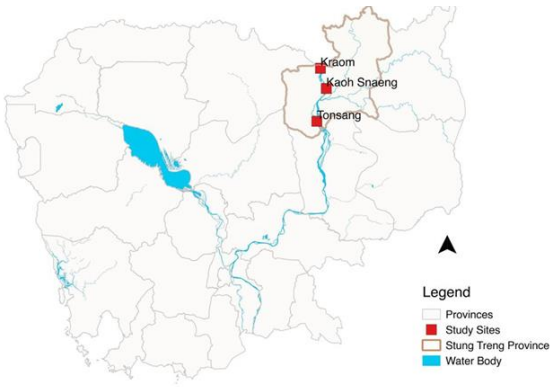


## CHAPTER 2: RESEARCH METHODOLOGY

### 2.1. Research Sites

The study was conducted in three target villages: Kraom village, Pras Romkel commune, Borey O'Svay district, Kaoh Snaeng village, Kaoh Snaeng commune, Borey O'Svay district, Tonsang village, Siem Bok commune, Siem Bok district, Stung Treng province. The location of these villages is shown in the map below. Tonsang village is located south of the town of Stung Treng province along the Mekong River, approximately 50 km from the town.

Map 1: Research Site




### 2.2 Steps of Research

The research process comprised six steps: community researchers' selection, research tool development and capacity building, data collection and validation, data analysis, research reporting, and dissemination of research findings.

*Step 1: Community researchers' selection*

In each target village, three local youth and women's groups were formed with 16 Community Researcher Committee (CRC), 11 of whom were females. The CRC members were selected through meetings that involved community members and local authorities.

*Step 2: Research tool development and capacity building*

The research tools, including the Community-Based Research Protocol on Transboundary Impacts: Fishery Resources, Ecosystem, and Communities' Livelihood, were collaboratively developed with the CRC members. A two-day meeting was held, involving MVi staff and CRC members.

*Step 3: Data collection and validation*

Community researchers collected field data through activities such as resource mapping, group discussions, and capturing photos of resources. To ensure data accuracy, validation

meetings were conducted with community researchers, community members, and local authorities.

*Step 4: Data analysis*

The data collected by 13 community researchers (eight females, one GLBT, and one PWD) from the three target areas were analyzed. The analysis focused on ecological changes and their impacts on communities' livelihoods, including fish catch, flooded forests, riverbank slides, water fluctuation, algae, income and expenditure, migration, and food (My Village, 2023).

*Step 5: Research reporting*

The research report was drafted by community researchers with technical support from MVi staff. The format of the report was agreed upon by the community researchers. The analyzed data was explained and interpreted in the research findings report.

*Step 6: Dissemination of research findings*

The research findings were disseminated to 159 individuals (107 females, 49 youths, 2 people with disabilities, and 1 GLBT) including community members and stakeholders. Village meetings were organized, involving community members, fishery officials, environment officials, and Department of Agriculture officials (My Village, 2023).

# CHAPTER 3: RESEARCH FINDINGS

The chapter 3 focuses on the ecological changes in the fishery sector, specifically examining various aspects of fish resources and its drivers of ecological changes. Under the category of fish resources, the document delves into the subcategories of fish catch and fish species. Additionally, other ecological changes such as the impact of flooded forests, water fluctuation, riverbank landslides, and algae are also explored. The second part of the document shifts its focus to the impacts of these river ecological changes on the livelihood of the surrounding communities. This includes analyzing the effects on income and expenses, migration patterns, loss of equipment and houses, damages to agricultural products and crops, as well as the water consumption and health impacts on the community.

## 3.1. Fishery Ecological Change

This part focuses on the changes in fishery resources, flooded forests, water level fluctuations, riverbank slides, and algae.

### 3.1.1. Change Fish Resources

The following tables present data on fish catch in three different villages - Kraom Village, Kaoh Snaeng Village, and Tongsang Village - for the years 2019 and 2022. Each table categorizes the fish catch by the type of fishing gear used in each village. These tables offer insights into the fish catch trends and the fishing gear preferences in each village over the specified years.

**a. Fish Catch**

a.1. Kraom Village

Table 1 presents data on fish catch (in kilograms) in Kraom Village for the years 2019 and 2022, categorized by fish gear used. The fish gear mentioned in the table are Gillnets and Castnets. In 2019, fishers using Gillnets were able to catch between 10 to 11 kilograms of fish. This catch was obtained by fishers who used five sets of gillnets for one night, with each night lasting for 13 hours. In 2022, the fish catch using Gillnets decreased significantly to only 2 to 3 kilograms.

Fishers using Castnets in 2019 were able to catch between 5 to 6 kilograms of fish. This catch was obtained by fishers who used one set of cast net for a duration of 3 hours. However, in 2022, the fish catch using Castnets decreased even further to only 0.5 to 1 kilogram. Based on the data provided, it is evident that there has been a decline in fish catch in Kraom Village between 2019 and 2022 for both Gillnets and Castnets.

Table 1: Fish Catch (kg) in Kraom Village

| Fish Gear | Fish Catch (Kg) | | Description |
|---|---|---|---|
| | 2019 | 2022 | |
| Gillnets | 10 to 11 | 2 to 3 | Fishers who have used 5 sets of gillnets for one night (13 hours) |
| Castnets | 5 to 6 | 0.5 to 1 | Fishers used one set of cast net for 3 hours |

a.2. Kaoh Snaeng Village

Table 2 provides information on fish catch (in kilograms) in Kaoh Snaeng Village for the years 2019 and 2022, categorized by fish gear used. The fish gear mentioned in the table are Gillnets, Hook Longline, Cast nets, and Fish Traps (Lob).

*Photo 1: Fish Catch in Kaoh Snaeng Village*

In 2019, fishers using Gillnets were able to catch between 5 to 10 kilograms of fish. This catch was obtained by fishers who operated 10 sets of gillnets, each measuring 20 meters, for a duration of 13 hours. In 2022, the fish catch using Gillnets decreased slightly to 2 to 5 kilograms.

Fishers using Hook Longline in 2019 were able to catch between 4 to 5 kilograms of fish. This catch was obtained by fishers who operated 100 hooks per line for a duration of 13 hours. In 2022, the fish catch using Hook Longline decreased to 1 to 2 kilograms.

Similarly, fishers using Cast nets in 2019 were able to catch between 8 to 10 kilograms of fish. This catch was obtained by fishers who operated a cast net with a mesh size of 2.5 centimeters for a duration of three hours. However, in 2022, the fish catch using Cast nets decreased significantly to only 1 to 2 kilograms.

Lastly, fishers using Fish Traps (Lob) in 2019 were able to catch between 3 to 4 kilograms of fish. This catch was obtained by fishers who operated five traps. However, in 2022, the fish catch using Fish Traps (Lob) decreased to 0 to 1 kilogram.

Table 2: Fish Catch (Kg) in Kaoh Snaeng Village

| Fish Gear | Fish Catch (kg) | | Remarks |
|---|---|---|---|
| | 2019 | 2022 | |
| Gillnets | 5 to 10 | 2 to 5 | Fishers who have operated 10 sets, 20 meters of each gillnet, for 13 hours |
| Hook Longline | 4 to 5 | 1 to 2 | Fishers who have operated 100 hooks per line, operation of 13 hours |
| Cast nets | 8 to 10 | 1 to 2 | Fishers who have operated cast net with 2.5-centimeter mesh, operation with three hours |
| Fish Traps (Lob) | 3 to 4 | 0 to 1 | Fishers who have operated 5 traps operated |

a.3. Tonsang Village

Table 3 presents data on fish catch (in kilograms) in Tongsang Village for the years 2019 and 2022, categorized by fish gear used. The fish gear mentioned in the table are Gillnets, Fish Trap (Lob), Fish Trap (Chan), Hook Longline, Say Yoeun, Fish Trap (Trou), and Cast Nets.

In 2019, fishers using Gillnets were able to catch between 5 to 6 kilograms of fish. This catch was obtained by using five sets of gillnets with a mesh size of 6-7 centimeters, and the operation lasted from 6 AM to 6 PM. In 2022, the fish catch using Gillnets decreased significantly to only 0.5 to 1 kilogram.

Fishers using Fish Trap (Lob) in 2019 were able to catch between 4 to 5 kilograms of fish. This catch was obtained by operating three sets of Fish Trap (Lob) for three nights. In 2022, the fish catch using Fish Trap (Lob) decreased slightly to 1 to 2 kilograms.

Similarly, fishers using Fish Trap (Chan) in 2019 were able to catch between 5 to 6 kilograms of fish. This catch was obtained by using two Fish Traps (Chan) for two nights. In 2022, the fish catch using Fish Trap (Chan) remained relatively stable at 1 to 2 kilograms.

Fishers using Hook Longline in 2019 were able to catch between 4 to 5 kilograms of fish. This catch was obtained using a hook longline with 100 hooks during the dry season. In 2022, the fish catch using Hook Longline decreased to only 0.5 to 1 kilogram.

The fish catch using Say Yoeun in 2019 ranged from 5 to 10 kilograms. This catch was obtained using one set of Say Yoeun. In 2022, the fish catch using Say Yoeun decreased to 1 to 2 kilograms.

Fishers using Fish Trap (Trou) in 2019 were able to catch between 7 to 10 kilograms of fish. This catch was obtained during the rainy season by operating Fish Trap (Trou). In 2022, the fish catch using Fish Trap (Trou) decreased to only 0.5 to 1 kilogram.

Lastly, fishers using Cast Nets in 2019 were able to catch between 10 to 20 kilograms of fish. This catch was obtained using one set of cast net with a mesh size of 2 centimeters for one night. In 2022, the fish catch using Cast Nets decreased to 2 to 3 kilograms.

Overall, there are mixed trends in fish catch in Tonsang Village between 2019 and 2022. Some fish gear, such as Gillnets and Hook Longline, experienced significant decreases in fish catch, while others, like Fish Trap (Lob) and Fish Trap (Chan), remained relatively stable.

Table 3: Fish Catch (Kg) in Tonsang Village

| **Fish gear** | **Fish Catch (Kg)** | | **Description** |
|---|---|---|---|
| | **2019** | **2022** | |
| Gillnets | 5 to 6 | 0.5 to 1 | The yields in 2019 and 2022 was caught with using five sets of gillnets with 6-7 cm mesh from 6 AM to 6 PM |
| Fish Trap (Lob) | 4 to 5 | 1 to 2 | The fish was caught with three sets of Fish Trap (Lob) which was operated three nights |
| Fish Trap (Chan) | 5 to 6 | 1 to 2 | Two Fish Traps (Chan) was used to catch the fish for two nights |
| Hook Longline | 4 to 5 | 0.5 to 1 | The fish was caught with hook longline with 100 hooks in dry season |
| Say Yoeun | 5 to 10 | 1 to 2 | One set of Say Yoeun was used |
| Fish Trap (Trou) | 7 to 10 | 0.5 to 1 | Troup was operated by rainy season |
| Cast Nets | 10 to 20 | 2 to 3 | One set of cast net (2 cm mesh) was operated one night |

Source: Discussion with Fishers in Tonsang Village, 2023

The decline in fish catch in the villages can be attributed to several key drivers. Population growth has led to increased fishing pressure and competition for fish resources in Kraom Village, resulting in a decline in fish catch. Illegal fishing activities, including the use of electric shock and overfishing, have also played a significant role in decreasing fish stocks. While reported cases of illegal fishing may have decreased in some villages, it is believed that illegal fishing still occurs and negatively impacts fish populations. The loss of flooded forests, which serve as crucial fish habitats and spawning grounds, has further contributed to the decline in fish catch. The reduction in flooded forest areas has likely affected the

availability of fish and their ability to reproduce. Additionally, the construction and operation of hydropower dams have disrupted natural water flow patterns, impeded fish migration, and altered fish habitat conditions. These combined factors have collectively led to the decline in fish catch in the respective villages.

**b. Fish Species**

There were three notices of community researchers in regarding to fish species: fish species[1] regularly caught and fish species[2] rarely caught in three target villages.

In Kraom village: The fish species caught regularly during dry season include Trey Riel, Trey Chorpin, Trey Chlang, Trey Chkok, Trey Po, Trey Arch Kok, Trey Kanhchos, Trey Kahe Loeng, Trey Choviet, Trey Kamphor, Trey Sraka Kdam, Trey Pra and Trey Kman. In rainy season, some fish species regularly caught by fishers include Trey Kya, Trey Proul, Trey Kes, Trey Chlang, Trey Krabei, Trey Sek, Trey Andeng, Trey Po, Trey Chorpin, Trey Kray and Trey Choviet. The fish species caught regularly in whole year include Chlang, Trey Chorpin, Trey Chrakeng, Trey Khman, Trey Chorviet, and Trey Po.

In Kaoh Snaeng village: The regularly caught fish species include Trey Riel, Trey Kaek, Trey Proul, Trey Ke, Trey Po, Trey Kya, Trey Kray, Trey Arch Kok, Trey Chorpin, Trey Chovit, Trey Khman, Trey Kes, Trey Chorkok Kda, Trey Pakak, Trey Chrokeng, Trey Chlang, Trey Khcao, Trey Damrei. The catch of the mentioned fish species was noticed in decline in comparison between 2019 to 2022. The fish species which were rarely caught include Trey PaSeE, Trey Pava, Trey Kol Reang, Trey Roes Chek, Trey Chlang Thmor, Trey Pra, Trey Ros, Trey Khsan, Trey Andat Chke. In 2019, one fish species, called Trey Ambong, disappeared in village while new fish species, called Trey Chen, presented in their village.

In Tonsang village, The fish species regularly caught include Trey Riel, Trey Ka Ek, Trey Ke, Trey Proul, Trey Kya Thmor, Trey Kray, Trey Arch Kok, Trey Chovit, Trey Khman, Trey Chokok, Trey Chrokeng, Trey Chlang, Trey Damrei, Trey Pa Pien, Trey Ka Ok, Trey Kantrap, Trey Chek Tom, Trey Proma, Trey Khchoeng, Trey Adndat Chke, Trey Kahe, Trey Chorpin, Trey Pra Kandor, Trey Kramom, Trey Kampot, Trey Krom, Trey Kanh Chrouk, Trey Tompouk Kroy, Trey Sraka Kdam, Trey Krabei, Trey Kros. The catches of mentioned fish have decreased. The fish

[1] The term “the fish species regularly caught” means that these fish species are usually or often caught by fishers

[2] The term “the fish species rarely caught” means that these few fish a season.

species were rarely caught including Trey PaSeE, Trey Pava, Trey Kes, Trey Pava Bak Mouk, Trey Phka Kor, Trey Sanday, Trey Po, Trey Khla, Trey Proma, Trey Pra, Trey Kya, Trey Pakok, Trey Linh, and Borng Kang.

### 3.1.2 Flooded Forest

**a. Flooded Forests in Kraom Village**

The data presented in Table 4 shows the trends in flooded forests in Kraom Village across three different locations: Kaoh Kor Kok, Kaoh Banteay, and Kon Roeusey. The table provides information on the areas of flooded forests in hectares and compares the changes in flooded forest areas between 2019 and 2023. The flooded forest include Rey, Tonlea, Rom Cheng, An Cheng, Reang, Romchek, Tros, and Rumdeng. Some flooded forests have been greatly reduced including Romcheng, Romdeng and Rey.

In all three locations, there has been a significant decrease in the extent of flooded forests, with a consistent 50% reduction across the board. Kaoh Kor Kok had an initial area of 1 hectare, but it decreased by 50% over the four-year period. Similarly, Kaoh Banteay started with an area of 0.21 hectares, and Kon Roeusey had an initial area of 0.5 hectares, both of which also experienced a 50% decrease in flooded forest areas.

Table 4: Flooded Forests in Kraom Village

| Location of Flooded Forests | Areas (hectares) | Comparison of Flood Forests in 2019 and 2023 |
|---|---|---|
| Kaoh Kor Kok | 1 | 50% of flooded forests decreased |
| Kaoh Banteay | 0.21 | 50% of flooded forests decreased |
| Kon Roeusey | 0.5 | 50% of flooded forests decreased |

b. Flooded Forests in Kaoh Snaeng Village

Table 5 presents the data on flooded forests in Kaoh Snaeng Village, including the locations and areas in hectares. The table also compares the changes in flooded forest areas between the years 2019 and 2023. The flooded forests in Kaoh Snaeng villages include Rey, Rom Chek, Rom Deng, Tros, Tonlea, Rom Cheng, Thmear,

*Photo 2: Flooded Forest Situation in Kaoh Snaeng Village*

Reang, Kroch Toek, Pring Toek,…etc. Some flooded forests have been greatly reduced including Romcheng, Romdeng and Rey.

In Kaoh Snaeng Village, the trends in flooded forests vary across different locations. Kaoh Samrong had an initial area of 1.5 hectares, with a 10% decrease in flooded forests in flooded forest areas over the four-year period. Kantouy Kaoh Han started with an area of 50 hectares, experiencing a 30% reduction in flooded forests in flooded forest areas. Kbal Kaoh Han had an initial area of 5 hectares, which decreased by 50%. Kan Tuy Kaoh Snaeng started with an area of 1 hectare, with a 40% decrease in flooded forests in flooded forest areas. Kbal Kaoh Snaeng had an initial area of 40 hectares, experiencing a 10% reduction, and Khang Lech Kaoh Snaeng started with an area of 10 hectares, also with a 10% decrease in flooded forests in flooded forest areas.

Photo 3: Flooded Forest Situation in Kaoh Han in Kaoh Snaeng Village

Similar to Kraom Village, the decline in flooded forests in Kaoh Snaeng Village has significant implications for fish populations and the overall ecosystem. Flooded forests provide crucial habitats for fish, serving as spawning grounds, shelter, and food sources. They also contribute to water quality regulation and the maintenance of ecological balance.

Table 5: Flooded Forests in Kaoh Snaeng Village

| Location of Flooded Forests | Areas (hectares) | Comparison of Flood Forests in 2019 and 2023 |
|---|---|---|
| Kaoh Samrong | 1.5 | 10% of flooded forests decreased |
| Kantouy Kaoh Han | 50 | 30% of flooded forests decreased |
| Kbal Kaoh Han | 5 | 50% of flooded forests decreased |
| Kan Tuy Kaoh Snaeng | 1 | 40% of flooded forests decreased |
| Kbal Kaoh Snaeng | 40 | 10% of flooded forests decreased |
| Khang Lech Kaoh Snaeng | 10 | 10% of flooded forests decreased |

c. Flooded Forests in Tonsang Village

Table 6 provides data on the flooded forests in Tonsang Village, specifically focusing on the location of Kaoh  Kon Sath. The table includes information on the area of flooded forests in hectares and compares the changes in flooded forest areas between the years 2019 and 2023. In Kaoh  Kon Sath, there was an initial area of 0.3 hectares of flooded forests. Over the four-year period, there was a 20% decrease in the extent of flooded forests in this location.

Some flooded forests consist of Rey, Reang, Treng, Rom Cheng, Tonlea, Rom Deng, Tros. Some flooded forests that have been greatly reduced in Tonsong village include Rom Deng, Rey, Rom Cheng and Tros.

The decline in flooded forests in Tonsang Village, as in the previous villages, can have significant implications for fish populations and the overall ecosystem. Flooded forests provide important habitats for fish, including spawning grounds and shelter. They also contribute to the regulation of water quality and the maintenance of ecological balance.

*Table 6: Flooded Forests in Tonsang Village*

| Location of Flooded Forests | Areas (hectares) | Comparison of Flood Forests in 2019 and 2023 |
|---|---|---|
| Kaoh  Kon Sath | 0.3 | 20% of flooded forests decreased |

The research findings suggest that there are several factors contributing to the reduction of flooded forests. These factors include irregular fluctuations in the water regime, high water flow during the rainy season, and the presence of lime substance in water.

The irregular and nonseasonal water regime can cause flooded forests to be soaked in an unnatural way, leading to negative impacts on their health and survival. Additionally, the strong flow of water during the rainy season, which may be exacerbated by the presence of hydropower dams, has resulted in the collapse of some flooded forests. The altered water flow patterns can disrupt the natural balance and stability of these ecosystems.

Furthermore, the presence of lime in water has also been affected by the construction and operation of hydropower dams. Changes in water quality, including the presence of lime, can have detrimental effects on the vegetation and overall health of flooded forests.

It is important to address these factors and their impacts on flooded forests to ensure their conservation and sustainable management. Implementing measures to regulate water

regimes, minimize the negative effects of dam operations, and protect water quality can help mitigate the decline of flooded forest.

### 3.1.2. Water Level Fluctuation

The research findings indicate that the water fluctuations in the three target villages have become irregular since 2018. Specifically, during the rainy season, the water level was lower compared to previous years.

Table 7 presents the water fluctuation variability in three different villages: Kraom, Kaoh Snaeng, and Tonsang. The table provides information on the water level changes during the rainy season and the dry season between the years 2018 and 2022.

*Photo 4: Water Level Pole in Kraom Village*

In Kraom Village, there were instances of floods in certain parts of the village and some areas of rice fields during the rainy season. However, there were no floods in the village in either 2022 or 2023. The water level in 2022 was lower during the rainy season compared to 2018, with a difference of 1.70 meters. However, during the dry season, the water level in 2022 was higher than in 2018, with an increase of 1.10 meters. Similarly, in dry season, water running was stronger 2023 than 2019. It was observed that the irregular water fluctuation has occurred since the Don Sahong[3] hydropower dam construction and operation.

Similarly, in Kaoh Snaeng Village, the water used to experience seasonal fluctuations, with the water level rising between June and October and dropping from November to May. However, there have been noticeable changes in recent times. The water flow is not as strong as it used to be, and the fluctuations in water levels now occur every three days. In Kaoh Snaeng Village, the water level in 2022 was lower during the rainy season compared to 2018, with a difference of 1.44 meters. During the dry season, the water level in 2022 was higher than in 2018, with an increase of 1.10 meters.

[3] Kraom village is located at the downstream of Don Sahong hydropower dam about 5 kilometers

In Tonsang Village, water fluctuation has become irregular compared to the past three years. After the construction and operation of hydropower dams in Lao PDR, there have been noticeable changes in water fluctuations. Since increase in hydropower dams (Dong Sahong hydropower dam and Lower Sesan 2), the water level used to rise during the day and recede at night, with a height of approximately 30 centimeters. The irregular water fluctuations in height of around half meters have sometimes occurred within three days.

*Photo 5: Photo 5: Youth Activity in Water Fluctuation Reading in Tonsang Village*

The water level in 2022 was lower during both the rainy and dry seasons compared to 2018. The difference in the water level during the rainy season was 1.5 meters, while during the dry season, it was 1 meter.

*Table 7: Water Level and Fluctuation*

| Villages | Water Fluctuation Variability (2018 and 2022) | |
|---|---|---|
| | Rainy Season | Dry Season |
| Kraom | Lower in 2022 than 2018 with 1.70 meters | Higher in 2022 than 2018 with 1.10 meters |
| Kaoh Snaeng | Lower in 2022 than 2018 with 1.44 meters | Higher in 2022 than 2018 with 1.10 meters |
| Tonsang | Lower in 2022 than 2018 with 1.5 meters | Higher in 2022 than 2018 with 1 meter |

Source: Group Discussion, 2023

### 3.1.4 Riverbank Landslides

In 2019, Kraom village experienced several riverbank slides in different areas. Kandal Phoum had a slide measuring approximately 150 meters in length and 3-4 meters in width. Kbal Phoum had a smaller slide, about 30 meters long and 6-7 meters wide. Additionally, Kaoh Lon Island, which is around 250 meters long and 50 meters wide, had a significant slide affecting 30% of the island. It is worth noting that the occurrence of these riverbank slides

*Photo 6: Community Researcher Field Visits at Riverbank Slide in Kaoh Snaeng Village*

is believed to be closely related to the construction and operation of the Don Sahong project.

The research findings on riverbank slides in Kaoh Snaeng Village reveal a concerning trend of multiple occurrences in various locations over the span of three years. Location 1, known as Kantuy Kaoh  Samrong, experienced a riverbank slide measuring approximately 100 meters in length and 20 meters in width from 2019 to 2022. Similarly, Location 2, named Khang Lech Kantuy Kaoh Han, witnessed a slide of about 200 meters in length and 30 meters in width during the same period. Location 3, Kantuy Kaoh Snaeng, also had a slide spanning approximately 100 meters in length and 20 meters in width. Lastly, Location 4, Kandal Kaoh Snaeng, encountered a slide measuring about 80 meters in length and 20 meters in width. These findings highlight the vulnerability of the riverbanks in Kaoh Snaeng Village, necessitating further analysis to understand the causes and impacts of these riverbank slides.

In Tonsong village, the island of Kaoh  Kon Sat has undergone a substantial reduction in size. Previously, it measured approximately 100 meters in length and 30 meters in width, but it has now diminished to around 50 meters in length and 15 meters in width. The initial bank collapse occurred in 2017, with subsequent collapses observed between 2021 and 2022. This ongoing trend of erosion and reduction in size raises concerns about the stability and long-term viability of Kaoh  Kon Sat.

### 3.1.5 Algae

The research findings indicate that the presence of algae in the three target villages has shown varying trends. Tonsang village has experienced an increase in algae since 2019, with a significant increase observed in 2021. Previously, algae was predominantly found on rocks in river, but now it is present all over the river in 2023.

*Photo 7: Algae Booming in Tonsang Village*

The increase in algae has disrupted the fishing activities of fishers, especially those using gillnet operations. The algae tends to adhere to the gillnets, making it difficult for the fishers

to catch fish. As a result, the fishers have to regularly remove the algae from their gillnets. In the past, the fishers have removed algae from their gillnets once a day. However, due to the significant increase in algae, the fishers now have to remove algae from their gillnets four times a day as of 2023. This increased frequency of algae removal highlights the impact of the algae growth on the efficiency and productivity of the fishing operations in the area.

On the other hand, in Kaoh Snaeng village, there has been a slight decrease in the presence of algae in the river since 2015, with a significant decline observed between 2019 and 2020. Previously, the river was heavily covered in algae, which made it challenging for fishers to catch fish. However, in recent years, there has been a noticeable reduction in the amount of algae present in the river. This decrease in algae has had a positive impact on the fishing conditions, making it easier for fishers to pursue their activities and improve their catch. Fishers had also concerned that the decline in algae have negatively impacts on fish stocks as the algae is important habitat for fish and also feed for some fish species.

The research findings indicate that several factors, including the presence of dams, lime, and sewage, contribute to the reduction of algae in Kraom village and Kaoh Snaeng village. These factors may lead to the decay of algae. However, the exact reason for the increase in algae in Tonsong village remains unknown to the fishermen, community members, and researchers involved in the study.

Overall, the research findings shed light on the variations in the occurrence of algae in the three selected villages. The decrease in moss in Kraom village, Kaoh Snaeng village can be attributed to various factors, while the increase in algae in Tonsong village warrants further investigation.

### 3.2. Impacts of River Ecological Changes on Community Livelihood

#### 3.2.1. Impacts on Income and Expenses

The analysis of incomes and expenses in the three research sites reveals important trends. In Kraom Village, there has been a consistent decline in income from fish sale over the years, with expenses for food gradually increasing. This indicates a challenging economic situation for the community. Similarly, in Kaoh Snaeng Village, although the income has remained relatively stable, the expenses for food have remained consistent. Tonsang Village stands

out with a pattern of seasonal income, which has also declined over time, while expenses for food have increased steadily.

In Kraom Village, the income from fish catch ranged from 40,000 to 50,000 Riel per day in 2019. However, over the years, this income gradually decreased, reaching 10,000 to 20,000 Riel per day in 2022. On the other hand, the expenses for food started at 10,000 to 15,000 Riel per day in 2019 and increased to 20,000 to 30,000 Riel per day in 2022. This data suggests a declining trend in fish sale income and a rise in food expenses, indicating a challenging economic situation for the community.

*Photo 8: Fishing Activity in Kaoh Snaeng Village*

In Kaoh Snaeng Village, the income from fish catch ranged from 30,000 to 50,000 Riel per day in 2019. This income remained relatively stable, with slight fluctuations, throughout the years. By 2022, the income decreased slightly to 10,000 to 30,000 Riel per day. Similarly, the expenses for food remained consistent, ranging from 10,000 to 15,000 Riel per day across the years. These figures suggest that while the income from fish sales did not show significant changes, the costs of food remained relatively constant for the villagers.

Tonsang Village reported income from fish catch per season instead of per day. In 2019, the income ranged from 1,000,000 to 2,000,000 Riel per season. However, this income steadily declined over the years, reaching 300,000 to 500,000 Riel per season in 2022. On the other hand, the expenses for food increased gradually from 5,000 to 7,000 Riel per day in 2019 to 13,000 to 15,000 Riel per day in 2022. This data indicates a significant decrease in seasonal income and a consistent rise in daily food expenses for the villagers.

Overall, the data analysis reveals a declining trend in incomes from fish sales in all three research sites. Kraom Village experienced a gradual decline in daily incomes, Kaoh Snaeng Village reported relatively stable daily incomes, and Tonsang Village showed a decline in seasonal incomes. However, the expenses for food varied among the villages. Kraom Village witnessed a consistent rise in daily food expenses, while Kaoh Snaeng Village maintained

consistent expenses. Tonsang Village also saw an increase in daily food expenses. These findings highlight the economic challenges faced by the communities, emphasizing the need for interventions and support to address the declining fish stocks and ensure the financial stability of the affected populations.

Table 8: Incomes from Fish Sale and Expenses for Food

| Villages | Income from Fish Sales | | | | Expense for Food | | | | Note |
|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | 2019 | 2020 | 2021 | 2022 | |
| Kraom | 40000 to 50000 | 30000 to 40000 | 20000 to 30000 | 10000 to 20000 | 10000 to 15000 | 10000 to 20000 | 15000 to 25000 | 20000 to 30000 | Income & Expense in Riel per day |
| Kaoh Snaeng | 30000 to 50000 | 20000 to 40000 | 20000 to 40000 | 10000 to 30000 | 10000 to 15000 | 10001 to 15000 | 10002 to 15000 | 20000 to 30000 | Income & Expense in Riel per day |
| Tonsang | 1,000,000 to 2,000,000 | 500,000 to 1,000,000 | 400,000 to 600,000 | 300,000 to 500,000 | 5,000 to 7,000 | 7,000 to 10,000 | 10,000 to 13,000 | 13,000 to 15,000 | Income in Riel per seasion, expense in riel per day |

Source: Group Discussion, 2023

**3.2.2. Impacts on Migration**

The research findings indicate that people migrations have occurred in the research sites, with varying numbers and destinations. In Kraom village, a total of 38 people have migrated, with 15 of them being females. Among these migrants, 32 people have moved to other provinces such as Kratie, Phnom Penh, and Siem Reap, while six people, including four females, have migrated to Thailand.

In Kaoh Snaeng village, 15 people have migrated, with 10 of them being females. The data does not provide specific details about the destinations or reasons for migration in this village. In Tonsang village, eight people have migrated, with four of them being females. Among these migrants, six people have moved to other provinces, while two people have migrated to Thailand. Four of the eight migrated people in Tonsang village come from poor families.

These migration patterns suggest that the decline in fish stocks and its impacts on livelihoods and incomes have prompted some individuals to seek better opportunities and living conditions in other provinces or countries. The migration of people from poor families in Tonsang village may also reflect the economic factors driving migration decisions.

Table 9: People Migration in Research Sites

| Villages | Numbers of Migrated People | Remarks |
|---|---|---|
| Kraom | 38 people (15 females) | 32 people migrated to other provinces like Kratie, Phom Penh and Siem Reap.<br>Six people (4 females) migrated to Thailand |
| Kaoh Snaeng | 15 people (10 females) | |
| Tonsang | 8 people (4 females) | Six people migrated to other provinces while two people migrated to Thailand. Of eight migrated people, four people are from poor families. |

Source: Commune Administration, 2023

### 3.2.3. Loss of Equipment and Houses

The research findings suggest that the unpredictable and year-round variations in water conditions have had adverse effects on the community, specifically resulting in the loss of fishing equipment and damage to community housing.

The research findings indicate that the people in Kraom village have been significantly affected by the loss of boats from 2019 to 2022. Additionally, since the construction of the Don Sahong hydropower dam, the village has experienced an annual loss of approximately 12 to 15 sets of gillnets and 8 to 12 sets of fish traps (Lob) due to irregular changes in the water regime. The fluctuation in water levels has also resulted in riverbank slides, forcing the inhabitants of two houses constructed near the riverbank to relocate to other areas.

The research findings reveal that in Kaoh Snaeng village, one house collapsed when the riverbank gave way, and portions of the residential land belonging to four families located near the riverbank collapsed by 2 to 5 meters.

The research findings indicate that in Tonsong village, there were five houses located near a landslide, with a distance of approximately 1.5 to 3 meters. The fishers and residents of Tonsong village have also suffered losses in their fishing equipment, particularly gillnets. For instance, the gillnets submerged when the water level increased rapidly, and when the water in the river receded quickly, the gillnets remained above the water surface, rendering them ineffective in catching fish.

### 3.2.4. Agricultural Products and Crop Damages

The research findings indicate that the three target villages have experienced crop damages, particularly in vegetable and fruit crops. These damages have been attributed to various factors including irregular flooding, landslides, and fluctuating water levels.

The research findings reveal that prior to 2019, many individuals in the target villages engaged in crop cultivation along the river between November and June. These crops encompassed cauliflower, cabbage, tomatoes, eggplants, lettuce, garlic, beans, corn, watermelon, pumpkin, cucumber, and peppers. However, since 2019, a majority of people have ceased planting crops along the river due to the difficulties posed by irregular flooding and landslides.

The research findings indicate that in Kraom village, approximately 60% of families were previously engaged in crop cultivation along the river prior to 2019. However, the persistent occurrence of flooding and landslides along the river has rendered it unfeasible for them to continue growing crops, resulting in the abandonment of this practice.

The research findings indicate that in Kaoh Snaeng village, approximately 80% of the population used to engage in crop cultivation along the river before 2019. However, the presence of irregular tides and fluctuating water levels has presented challenges for growing vegetables. Furthermore, landslides along the riverbank have further impeded the cultivation of crops. Consequently, only a few households in this village are currently involved in crop cultivation.

The research findings indicate that in Tonsang village, approximately 80% of the population used to cultivate vegetables along the river before 2019. However, as a result of landslides occurring along the river, no one is currently engaged in crop cultivation. The specific vegetables that were grown in this village included squash, cabbage, peppers, and cucumbers.

The research findings reveal that all three villages have encountered damages to their fruit trees. In Kraom village, the affected fruit trees include mango, coconut palm, banana, and bamboo. Similarly, in Kaoh Snaeng village, the damages have been observed in fruits such as papaya, oranges, mangoes, tamarind, bananas, and peppers. Tonsang village has

reported damages to coconut, mango, tamarin, bamboo, papaya, milk trees, Putrea tree (local name), and banana.

### 3.2.5. Water Consumption and Health Impacts

The research findings highlight those alterations in the water quality of the Mekong River, particularly the presence of lime and algae, have had an impact on the utilization and well-being of the residents in the targeted villages. The villagers heavily depend on river water for various daily activities, including crop irrigation, drinking, bathing, cooking, laundry, and livestock rearing.

The research findings reveal that in Kraom village, 10 families rely on pumping wells for water supply, while 5 families utilize ponds. However, all villagers continue to use river water. Following the construction of the Dong Sahong dam, the river water has become contaminated with lime. As a precaution, the villagers boil the water before consumption, but lime deposits are still observed in their pots. To mitigate this problem, the local authorities have distributed water tanks to impoverished families. Some families in Kraom village have opted to purchase purified water for drinking, which has increased their daily expenses. Nevertheless, they still utilize river water for cooking rice.

Similarly, in Kaoh Snaeng village, around 30 families utilize wells for their water supply, while the remaining families (260 families) depend on river water. When the river water is boiled for drinking purposes, lime deposits are observed in the pots and floating in the water. Consequently, some families in Kaoh Snaeng village have made the switch to using purified water for drinking, although they still use river water for cooking rice.

In Tonsong village, although there are 7 wells available, the majority of families still rely on river water for their needs. The presence of moss in the river water has caused itching during bathing, and consuming untreated river water has resulted in diarrhea for certain individuals. This issue has been affecting the villagers since 2020. Similarly to the other villages, some families in Tonsong village have transitioned to using purified water for drinking, while still utilizing river water for cooking rice.

These research findings emphasize the negative consequences of water quality changes on the daily activities and well-being of the villagers. The presence of lime and moss in the river water not only impacts the taste and usability of the water but also poses health

hazards. It is promising to observe that certain families have successfully transitioned to using purified water for drinking, which can help alleviate the adverse effects on their health. However, the continued utilization of river water for other purposes, like cooking rice, still exposes them to potential risks.

# CHAPTER 4: CONCLUSION AND RECOMMENDATION

## 4.1. Conclusion

It was concluded that the three target villages of Kraom, Kaoh Snaeng, and Tonsang have experienced significant changes in various aspects of their environment. The first notable change is seen in the fishery resources, as there has been a decline in fish catch across all three villages between 2019 and 2022. This decline can be attributed to factors such as population growth, illegal fishing activities, the loss of flooded forests, and the presence of hydropower dams. Gillnets and Castnets are commonly used fishing gear in these villages.

Another significant change is observed in the extent of flooded forests, which has significantly decreased in all three villages. This decline has negative implications for fish populations and the overall ecosystem. Irregular and nonseasonal water regimes, strong water flow during the rainy season, and the presence of lime in the water due to hydropower dams are contributing factors to this decline.

Furthermore, water level fluctuations have become irregular since 2018 in the three villages. The water level during the rainy season has been lower compared to previous years. Changes in water flow patterns and the presence of hydropower dams have played a role in these irregular fluctuations.

Riverbank landslides have also been a concern in the Kraom and Kaoh Snaeng villages, occurring in different areas. The construction and operation of hydropower dams, along with deforestation and erosion, have increased the risk of these landslides. This poses threats to the safety and livelihoods of the villagers and the stability of the river ecosystems.

Lastly, there has been an increase in the growth of algae in the rivers of one village and declines in algae in two villages. Excessive algae growth can deplete oxygen levels in the water, negatively impacting fish and other aquatic organisms. Nutrient pollution from agricultural runoff and alterations in water flow due to hydropower dams contribute to this increase.

The research findings highlight significant changes in fishery resources, flooded forests, water level fluctuations, riverbank landslides, and algae in the target villages. These changes are influenced by various factors, including population growth, illegal fishing, loss of flooded forests, hydropower dam operations, irregular water regimes, deforestation, erosion, and

nutrient pollution. It is crucial to address these issues and implement sustainable management practices to safeguard the well-being of the villages and their ecosystems.

Secondly, the impacts of ecological changes on the livelihood of communities in Kraom, Kaoh Snaeng, and Tonsang villages are significant. The research findings indicate a decline in income from fish catch in all three villages, with Kraom Village experiencing a consistent decline, Kaoh Snaeng Village maintaining relatively stable income, and Tonsang Village reporting a seasonal income decrease. Expenses for food varied among the villages, with Kraom Village witnessing a consistent rise, Kaoh Snaeng Village maintaining consistent expenses, and Tonsang Village experiencing an increase. These findings highlight the economic challenges faced by the communities and the need for interventions and support. The research findings also reveal migration patterns in the villages, with individuals seeking better opportunities and living conditions in other provinces or countries due to the decline in fish stocks and its impacts on livelihoods and incomes. Loss of fishing equipment and damage to community housing have been observed, further exacerbating the challenges faced by the communities.

Crop damages, particularly in vegetable and fruit crops, have been attributed to irregular flooding, landslides, and fluctuating water levels. The research findings indicate a significant decrease in crop cultivation along the river in all three villages since 2019, rendering it unfeasible for many families to continue growing crops.

Changes in water quality, including the presence of lime and algae, have impacted the utilization and well-being of the residents. The villagers heavily depend on river water for various daily activities, and the contamination of the water has led to the adoption of precautionary measures such as boiling the water before consumption. Some families have transitioned to using purified water for drinking, but the continued use of river water for other purposes still poses potential risks to their health.

Overall, the research findings highlight the multifaceted impacts of ecological changes on the livelihood of communities in Kraom, Kaoh Snaeng, and Tonsang villages. These findings underscore the importance of addressing the declining fish stocks, providing support for economic stability, implementing measures to mitigate the loss of equipment and housing, and improving water quality to ensure the well-being of the affected populations.

The impacts of the Don Sahong Dam and cross-boundary influences on river ecology and livelihoods have been significant. The research findings indicate a decline in fish catch and income in all three villages of Kraom, Kaoh Snaeng, and Tonsang. This decline can be attributed to various factors, including population growth, illegal fishing activities, loss of flooded forests, and the construction and operation of the Don Sahong Dam. The decrease in fish stocks has led to economic challenges for the communities, with increased expenses for food and a decrease in crop cultivation.

Furthermore, the research findings reveal migration patterns among the villagers, as individuals seek better opportunities and living conditions elsewhere due to the decline in fish stocks and its impact on livelihoods and incomes. The loss of fishing equipment and damage to community housing have further exacerbated the challenges faced by the communities.

Changes in water quality, including the presence of lime and algae, have also affected the residents' well-being and utilization of river water. The contamination of the water has led to the adoption of precautionary measures, such as boiling water before consumption. However, the continued use of river water for other purposes still poses potential risks to their health.

Overall, the research findings highlight the multifaceted impacts of the Don Sahong Dam and cross-boundary influences on river ecology and livelihoods. The decline in fish stocks, economic challenges, loss of fishing equipment, damage to housing, decreased crop cultivation, and water quality issues all underscore the need for interventions and support to ensure the well-being and sustainable livelihoods of the affected communities. It is essential

### 4.2. Recommendation

Based on the research findings regarding the impacts of the Don Sahong Dam and cross-boundary influences on river ecology and livelihoods, the following suggestions and recommendations are proposed:

Engage Partner Organizations and Authorities: Collaborate with partner organizations, relevant institutions, and authorities to create career options and livelihood opportunities for the community members. This can involve vocational training programs, job creation initiatives, and support for entrepreneurship to diversify income sources and reduce dependence on fishing.

Strengthen Enforcement against Illegal Fishing: Request relevant authorities to enhance efforts to combat and deter illegal fishing activities. This can involve stricter enforcement of fishing regulations, increased surveillance, and penalties for offenders. This will help protect fish stocks and ensure sustainable fishing practices.

Promote Riverbank Stabilization and Reforestation: Request the relevant authorities, in collaboration with partner organizations, to implement riverbank stabilization measures and promote reforestation along the river. This can help prevent erosion, maintain riverbank integrity, and provide spawning habitats for fish during the rainy season.

Conduct Research on Factors Influencing Algae Growth: Request partner organizations and government experts to conduct scientific studies to better understand the factors contributing to the increase in algae growth. This research can help identify the root causes and inform targeted interventions to mitigate the growth of algae.

Provide Access to Clean Water: Request local authorities, particularly at the commune level, to provide water tanks or other means of access to clean water for the community. This will help ensure that people have access to safe and clean water for their daily needs.

Conduct Scientific Studies on Water Quality: Advocate for scientific studies to be conducted on the changing water quality in the affected areas. This research will provide valuable insights into the specific changes and help guide efforts to improve water quality.

Allocate Budget for Restoration and Conservation Efforts: Advocate for the allocation of a budget to support the restoration of collapsed flooded forests, fish conservation efforts, and the restoration of livelihoods. This will provide the necessary resources to implement effective measures and support the affected communities.

Engage the Company in Mitigation Efforts: Request the relevant company to consider the impacts of their operations on lost crops and materials. Encourage dialogue and collaboration between the company and the affected communities to develop mitigation measures and compensation mechanisms.

Sustainable Fishery Management: Implement sustainable fishery management practices, such as regulating fishing activities, promoting responsible fishing techniques, and enforcing regulations to prevent overfishing and illegal fishing activities. This can help restore fish stocks and ensure the long-term viability of the fisheries in the affected villages.

Improved Water Management: Enhance water management practices to mitigate irregular water level fluctuations and maintain a more stable water regime. This can involve coordination between upstream and downstream stakeholders, including the operators of the Don Sahong Dam, to ensure that water flow patterns are regulated in a way that minimizes negative impacts on the affected villages and their livelihoods.

Strengthening Livelihood Opportunities: Provide support for alternative livelihood opportunities for the affected communities. This can include training and capacity-building programs to enhance skills in other income-generating activities such as agriculture, aquaculture, tourism, or handicraft production. Diversifying livelihood options can help reduce dependence on fishery resources and increase resilience to ecological changes.

Cross-Boundary Collaboration: Foster collaboration and coordination among relevant stakeholders, including government agencies, local communities, NGOs, and international organizations. This can help address the cross-boundary impacts and ensure that sustainable management practices are implemented effectively. Regular communication, information sharing, and joint decision-making processes can contribute to more holistic and inclusive approaches to managing the ecological changes and supporting the affected communities.

Long-term Monitoring and Research: Establish long-term monitoring programs to assess the ongoing impacts of the Don Sahong Dam and other cross-boundary influences on river ecology and livelihoods. This can help track changes, identify emerging issues, and inform adaptive management strategies. Continued research efforts can also provide valuable insights into the effectiveness of implemented measures and contribute to the development of best practices for managing similar situations in the future.

**References**

Asia and the Pacific Policy Society. (2022). Hydropower dams in Cambodia: Balancing economic development and environmental impacts. Retrieved from https://www.policyforum.net/hydropower-dams-in-cambodia-balancing-economic-development-and-environmental-impacts/

CGIAR. (2015). Mekong River Commission. Retrieved from https://www.mrcmekong.org/our-work/hydropower-database/

DFID. (1999). Sustainable livelihoods guidance sheets. Retrieved from https://www.eldis.org/keyissues/macro/economic-policy/guides/dfid-sustainable-livelihoods-guidance-sheets

Edwards, J. (2005). Fishery resource approach: Concepts and applications. In Fisheries Management: A Manual for Still-Water Coarse Fisheries (pp. 17-18). Springer.

Fishery Law. (2006). Cambodia's Fishery Law, 2026. https://cambodiantr.gov.kh/kcfinder/upload/files/Law%20on%20Fisheries%20-%20EN.pdf

My Village. (2023). MVi Project Report 2023.

National Geographic. (nd). Ecosystem. Retrieved from https://www.nationalgeographic.org/encyclopedia/ecosystem/

The University of Memphis. (nd). Sustainable livelihoods framework. Retrieved from https://www.memphis.edu/ees/pdfs/sustainable_livelihoods.pdf

## Annexes

Annex 1: Local and Scientific Names of Fish Species in Research Report

1. Dry Season:

1) Trey Riel (Scientific name: Henicorhynchus siamensis)
2) Trey Chorpin (Scientific name: Hypsibarbus lagleri)
3) Trey Chlang (Scientific name: Hemibagrus nemurus)
4) Trey Chkok (Scientific name: Cyclocheilichthys enoplos)
5) Trey Po (Scientific name: Pangasius larnaudii)
6) Trey Arch Kok (Scientific name: Labiobarbus siamensis)
7) Trey Kanhchos (Scientific name: Mystus albolineatus)
8) Trey Kahe Loeng (Scientific name: Barbonymus schwanenfeldii)
9) Trey Choviet (Scientific name: Pangasius siamensis)
10) Trey Kamphor (Scientific name: Hampala macrolepidota)
11) Trey Sraka Kdam (Scientific name: Cyclocheilichthys mekongensis)
12) Trey Pra (Scientific name: Pangasius djambal)
13) Trey Kman (Scientific name: Hampala dispar)

2. Rainy Season:

1) Trey Kya (Scientific name: Hemibagrus wyckioides)
2) Trey Proul (Scientific name: Cirrhinus microlepis)
3) Trey Kes (Scientific name: Micronema apogon)
4) Trey Chlang (Scientific name: Hemibagrus nemurus)
5) Trey Krabei (Scientific name: Bagarius yarrelli)
6) Trey Troseak (Scientific name: Scaphognathops stejnegeri)
7) Trey Andeng (Scientific name: Clarias batrachus)
8) Trey Po (Scientific name: Pangasius larnaudii)
9) Trey Chorpin (Scientific name: Hypsibarbus lagleri)
10) Trey Krai (Scientific name: Chitala blanci)
11) Trey Choviet (Scientific name: Pangasius siamensis)

3. Whole Year:

1) Chlang (Scientific name: Hemibagrus nemurus)
2) Trey Chorpin (Scientific name: Hypsibarbus lagleri)
3) Trey Chrakeng (Scientific name: puntioplites proctozystron)
4) Trey Khman (Scientific name: Hampala dispar)
5) Trey Chorviet (Scientific name: Pangasius siamensis)
6) Trey Po (Scientific name: Pangasius larnaudii)

Annex 2: Local name and Scientific Names of Flooded Forest in Research Report

1. ដើមទន្លា/Tonlea ( Scientific name: crateva religiosa )

2. ដើមរៃ/Rey ( Scientific name: Homonoia riparia Lour )

3. ដើមរំចេង/Rom Cheng

4. ដើមត្រស់/Tros ( Scientific name: combretum trifoliatum )

5. ដើមអញ្ចេង/An Cheng

6. ដើមរាំងទឹក (Scientific name: Barringtonia acutangula - Freshwater mangrove)

7. ដើមរំចេក (Scientific name: Pandanus odoratissimus - Fragrant screw pine)

8. ដើមផ្កាអណ្តែង