Research Papers Volume 1 (2013)

# Natural Resource Governance in Cambodia






**Editors**

*Seak Sophat*

*Gary Morrison*

The research paper volume contains part of research findings of PEACE project, a program supported by the ICCO and NPA with the aims of (i) to promote the dialogues between government, private sector, NGOs and Communities on natural resources management aiming at improving environmental governance and livelihoods of local resource dependent communities; (ii) to promote a collaborative research on environmental issues and problems affecting the communities aiming at supporting the dialogues between government, private sector, NGOs and communities, and the advocacy campaign on improving access to natural resources for local communities; (iii) to influence national policies and decision-making on natural resources management and poverty reduction in rural natural resource dependent communities; and (iv) fostering an exchange of information and establishing networks among scholars, researchers, NGOs, government agencies, and media workers working on natural resource and environmental governance, and development ralated issues in Cambodia. These papers are written by researchers who, and also by those who carry out research under NRMD research projects and collaborative research projects.

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## Preface

This publication brings together into one volume some of the work carried out by the Department of Natural Resource Management and Development at the Royal University of Phnom Penh (RUPP) in Cambodia over the last 5 years, an important period for environmental issues within the country.

The papers in this volume tackle a range of issues at the heart of the debates taking place in Cambodia today, from the granting of land concessions and the impacts of hydropower dams, to mining activities and the impacts of development on local livelihoods – particularly those related to fishing. The papers also highlights the high level of dependence local people still have on the natural resources around them.

All the papers explore how people living in rural areas of Cambodia are being impacted often adversely – by the interests of those from 'outside', and in one case, from those in another country, with these interests almost exclusively driven by the desire to 'develop' at a rapid pace along market driven lines, a desire made stronger due to the long period of war and stagnation that took place in the country in the 1970s and 1980s.

As with many other developing countries around the world, local people are rarely included in the consultation process when development activities take place in their local area, either because it is not in the interests of those introducing the change to do so (in the case of economic land concessions (ELCs) and sand dredging (along Cambodia's coast), because they are far removed from the activities shaping their lives (such as those living around Tonle Sap Lake), or even because they live in a different country to where the activities are taking place (the Vietnamese dam on the Sesan River).

One paper in this volume highlights in particular the close relationship that exists between rural dwellers in Cambodia and the natural resources around them (forest ecosystems), sending the message that as the charge towards a market economy gathers pace, with its associated exploitation of oceans, rivers and forests, so local people whose livelihoods depend on such resources are likely to lose out, leading to the loss of unique ways of life (to be replaced by homogeneity), sustainable livelihoods (to be replaced by exploitative methods) and diversity – particularly in terms of ecosystems' services.

The underlying message of this volume is that in Cambodia, as in other developing countries, the changes introduced in the name of development come at a price, one that in the longer term may be too high to pay.

## Contents

# Importance of Forest Ecosystem Services for the Livelihoods of a Rural Community in O' Som Commune, Pursat Province, Cambodia

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## Acknowledgements

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We are also grateful to Dr. Lay Chanthy,and Mr. Khan Lyna for their helpful contributions in terms of comments, recommendations and enthusiasm. This study would not have been completed but for the theoretical expertise and practical know-how they so generously shared with the research team.

Last, but not least, we are indebted to the local government units in O'som Commune and the local people, for their generosity and cooperation.

## Abstract

This paper aims to examine the value of ecosystem services provided by local forest resources in support of people's livelihoods in O'som Commune, Pursat Province, a commune which consists of four villages: Chayluk, Kandal, O'som and Khein Chongrok. The study combines a literature review and the results of interviews held with the local villagers. Seeing first-hand the contribution that the local forest makes to people's livelihoods in the study area, our aims are: (i) to identify those key ecosystem services provided, (ii) to identify and give a value to those ecosystem services related to people's livelihoods, and (iii) to study the behaviours of the local people in terms of their participation in forest resource conservation activities. The research combined qualitative and quantitative data sources in order to examine the correlation between people's livelihoods and their dependency on the forest ecosystems, using group discussions and household interviews where appropriate. The results of the research work provided valuable analysis on the benefits of ecosystem services for people's livelihoods, though less was studied about the non-calculable or invisible value provided by such services. The services provided by ecosystems can be divided into four main categories: (i) provisioning services, (ii) supporting services, (iii) regulating services, and (iv) cultural services. Ecosystems as a whole help support life on earth, and include forest ecosystems. Ecosystems also play an important role in terms of generating an income for rural people and supporting their livelihoods, with the Millennium Ecosystem Assessment tool (MEA) accepted as a way of valuing ES in terms of their contribution to human well-

being.

People living in the study commune, which is located in the Cardamom Mountains area, are mostly dependent on agricultural production activities for their survival, plus generate an income by collecting products from the forest near the villages. Recently, most people in the commune have started to engage in farming, such as growing rice and corn, as well as making pepper and growing cash crops, all of which depend upon the quality of the soil in the area, which is recognized as one of the richest forest resource areas in Pursat Province, Cambodia. Today, a large proportion of people living in the study commune collects both forest products and non-timber forest products from the nearby area in order to sustain their livelihoods, such as high quality wood, construction timber, wild fruits, wild animals and fish. This paper also highlights the correlation that exists between the presence of forest products and people's livelihoods as a result of increasing population growth, and the related issues and concerns this causes. As a result, this case study of O'som Commune seeks to prove the relationship that exists between people and the forest by calculating the income generated by both forest and non-timber forest products, showing that these activities represent the local people's main sources of income. The paper also captures people's perceptions on the adaptive tactics they use to reduce the impacts of deforestation taking place in the study area - such as joining in with community activities in order to preserve the forest resources and sustain people's livelihoods - tactics based on maintaining the richness and diversity of the local forest ecosystem.

**Key words:** Forest ecosystem services, rural livelihoods, natural resoruce dependency, forest ecosystem, natural resource governance

## Introduction

Currently, the Payment for Environmental Services (PES) model is attracting much attention among conservationists, and is receiving a large amount of funding support (Kelly et al., 2009), with forests being the focus of most PES initiatives. Ecosystem services; meanwhile, have been studied by a number of researchers, providing valuable analyses as to the benefits they can generate for local people's livelihoods; however, there has been less research carried out into the non-calculable or invisible value of such resources (Marta, 2012). Until the 1960s, the value of ecosystem services was calculated through markets only (Abson, 2010), with some literature reporting that the non-market aspects of ecosystem services were not valued until the late 1960s. Through a calculation of the "total economic value" of ecosystem services in the 1980s, the non-use value of such systems was recognized, particularly within conservation circles (Abson, 2010; Dan, 2011). According to Dan (2011), ES make a huge contribution towards supporting life on earth, as well as support carbon sequestration and water provision, both of which help support human existence.

Forests form a central component of ecosystem services, helping to support human activities and sustaining standards of living, plus help generate incomes and support rural people's livelihoods, with ecosystem services themselves recognized by the Millennium Ecosystem Assessment (MEA) as a key contributor to human well-being (Marta, 2012). ES represent a core and critical source of support for people's livelihoods, and help to conserve economic development by maintaining sources of income (Koy et al., 2011). Forest and non-timber

forest products are key elements of these services, helping to supply markets and support economic growth; with harvested forest products being a key indicator of the importance of forests for hundreds of millions of poor people who depend on them for their everyday lives (Koy et al., 2011).

Unfortunately, unsustainable development activities are having a significant impact on forest ecosystems, and have attracted much concern due to the increasing number of companies investing in such activities, often in contravention of any government regulations in place. In addition, commercial logging and shifting cultivation activities are challenging conservation efforts, leading to significant environmental degradation. In fact, the cumulative impacts of human activities are significantly harming forests, through commercial logging activities in particular, and drawing increasing concern from scientists due to the adverse impact they are having on global environmental stability, and in particular the earth's atmosphere (Clark et al., 2000). As a consequence, Rudel (1994) notes that population and economic growth are the key causes of deforestation, while Burgess (1992) has argued that population density is actually the key cause.

Hence, this paper aims to: 1) identify the key ecosystem services in the study area, 2) identify and give value to those ecosystem services related to people's livelihoods, and 3) study the behaviour of local people who utilize and conserve forest-related natural resources.

It is important to note that the concept of ecosystem services is not an easy one to understand in its entirety at first glance. Normally, ecosystem services are broken down into four categories: supporting, provisioning, regulation and cultural services. This study used one commune named O'som for its research activities, a commune located in Veal Veng District, Pursat Province in Cambodia. Within ecosystem services as a whole, this study looks at three of the four categories mentioned above: provisioning, regulating and cultural services.

## Methods

### *Study Area*

O'som Commune lies within the Cardamom Mountains Landscape (CML) area, which is located in the southwest of Cambodia, and is close to the Gulf of Thailand. The area has high levels of biodiversity and supports a large range of endemic species of flora and fauna, some of which are endangered. O'som Commune covers 40 square kilometres (84,200 hectares) of Veal Veng District and the landscape helps to regulate water flows over a wide area due to the richness of its forest resources. O'som Commune itself consists of four villages: Chayluk, Kandal, O'som and Khein Chongrok. The Commune is bordered to the north by Promouy Commune, to the east by Tmorda Commune, to the west by Krovang Commune, and to the south by Tmorbang District, which is in Koh Kong Province.

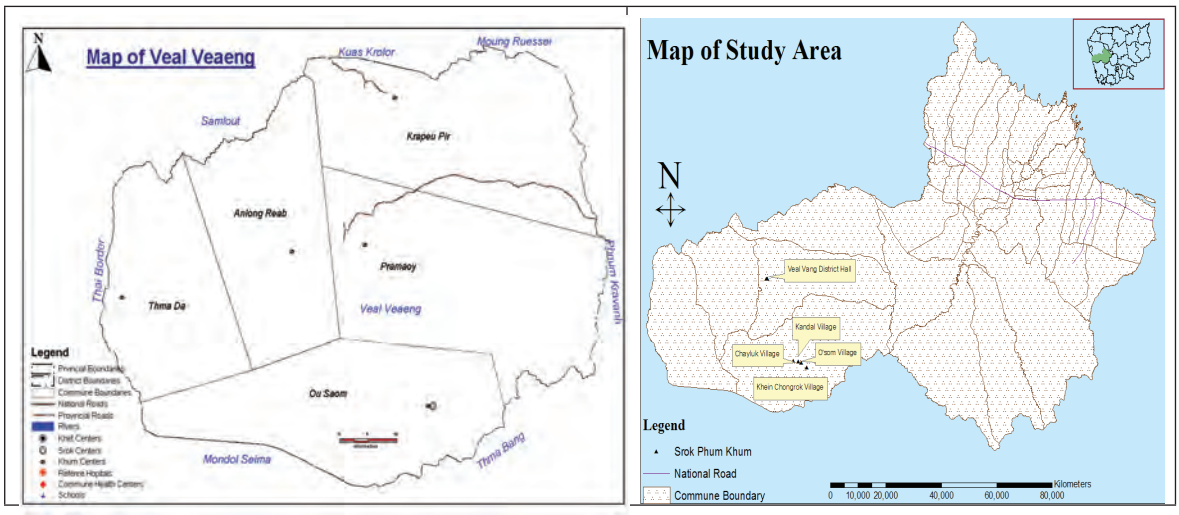



Figure 1: Map of the Study Area - O'som Commune
Source: Ministry of Planning (2008) and JICA (2002)

The number of households in O'som Commune is estimated to be 245, and it has a population of 1,059, 48% of whom (510) are women. The villages in the Commune are settled in the foothills of the Cardamom Mountains, and most villagers there belong to the Cheung ethnic group, which has inhabited the area for more than 600 years. Due to the richness of the forest resources and habitats in the watershed area, villagers in O'som Commune pump water from local streams and small channels located behind the village. Besides these water sources, rainfall helps the local villagers survive during the dry season. In the Cardamom Mountains, annual rainfall levels are between 3,000 and 5,000 mm per year, supporting water provision services across five provinces in western Cambodia, including Pursat Province in which O'som Commune is located.

### *Sample Design and Size*

The study covered all four villages in O'som Commune, each located within a different setting, and the sample design and size were wholly dependent on the key measures used, as follows:

1. **Purposive Sampling:** This method was utilized in order to choose the key informants from each village (whether hunters, fishers or NTFP collectors), and also NGO staff working in the area - those knowledgeable about local ecosystem services, local biodiversity levels and the conservation practices used to maintain these over the long-term.

2. **Simple Random Sampling:** This method was used in order to select the villagers for interview; to gauge their perceptions on the importance of ecosystem services for their livelihoods, both now and in the future (for the next generation). The sample size was chosen based on the 'rule of thumb' method, meaning that 30% of the total number of villagers in the study area was selected. The random sampling method provides an equal chance of each villager/household being selected for the study sample.

### *Data Collection Tools*

The data collection methods were chosen according to the data needs of each ecosystem service and its components, as follows :

1. **Secondary Data Collection:** This method was employed to gather data and information from secondary sources. For example, data on people's dependency on the forest ecosystem in the study area was obtained from relevant government and non-government institutions, including Flora and Fauna International (FFI) and Conservation International (CI). In addition, we also collected secondary data and documentation from online and paper sources, including journals, books and other publications, in order to understand more about the dependency on forest resources concept.

2. **Standardized Questionnaire:** A questionnaire was used to collect data specific to the socio-economic status of those living in the study area, above all in order to glean information on people's perceptions and opinions about each type of ecosystem service provided by the local forest resources, and in particular, income categories and the drivers and impacts of change. After the questionnaire had been designed, a pre-test was conducted in order to test its effectiveness.

3. **Focus Group Discussion:** Group interviews were held with a pre-prepared list of villagers, with a checklist used to ensure the data required was obtained. Tools used as part of this Participatory Rural Appraisal (PRA) included village and resources mapping, seasonal calendars, timelines, flow charts, Venn diagrams and a wealth ranking system.

### *Valuation of Forest Ecosystem Services*

A couple of tools can be used to value forest ecosystem services, and our study into people's dependency on the forest ecosystem used SPSS.18, which was used to analyze the qualitative data collected based on linear regression and simple regression techniques to understand the significance of the contribution of forest ecosystem to people's livelihoods in the study area. Quantitative data was collected using a field survey, which included focus group discussions and was based on an ethnography approach - focusing on people's petions.

## Results

### *Ecosystem Services*

Our survey showed that 90% of the total population in O'som Commune is engaged in farming activities as its primary livelihood source (rice farms and seasonal cropping – mostly corn and beans), with these activities conducted in the local forest area. Villagers in O'som Commune collect non-timber forest products (NTFPs) for additional income, and a small proportion collects timber products (TFPs) also - about 3% (see Figure 2).

The above figure shows that the highest proportion of villagers is involved in farming, and the focus group discussions revealed that 95% of local villagers are engaged in collecting both NTFPs and TFPs in support of their livelihoods. Our survey showed that rattan, orange-

brown gum resin, cardamom fruit, green-cardamom, vines, charcoal, fuel wood, wood used to make perfume, meat, other fruits and honey are collected from the forest located around the study site, as well as timber species such as *beng, kro jung, pa chek* and *neang nun*.

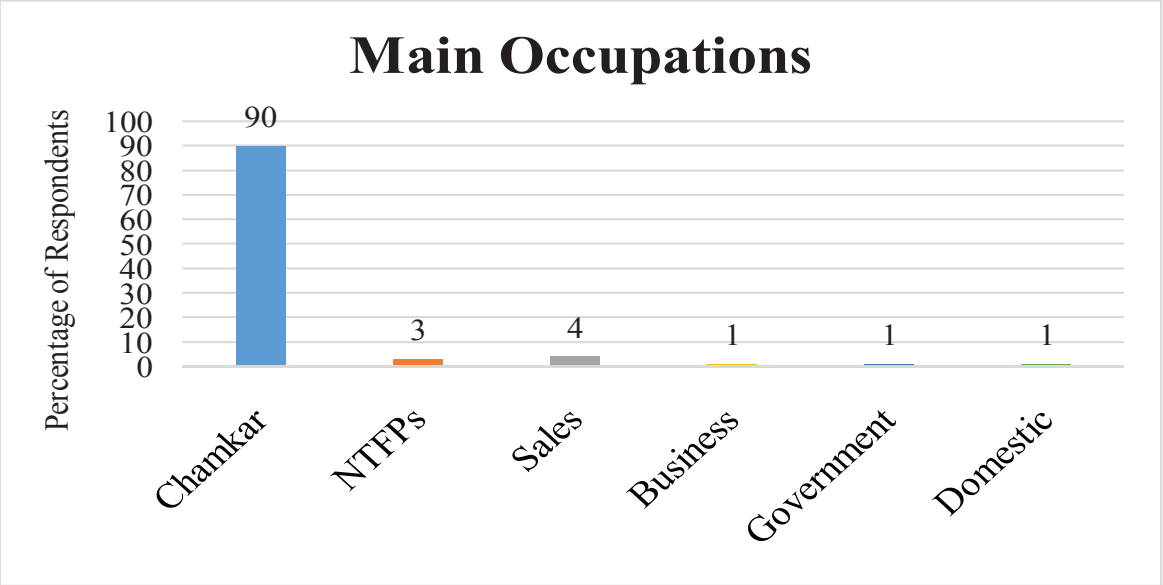



Figure 2: People's Occupations in the Study Commune
Source: Field survey, 2012

Livelihoods-Based Forest Ecosystem Services

Farming, as mentioned above, is the main occupation, with 90% of local villagers engaged in this activity; though only 54% of local people said they benefit from farming. In total, 69% and 27% of the households interviewed said their income is mainly obtained from selling NTFPs and TFPs respectively (Figure 2).

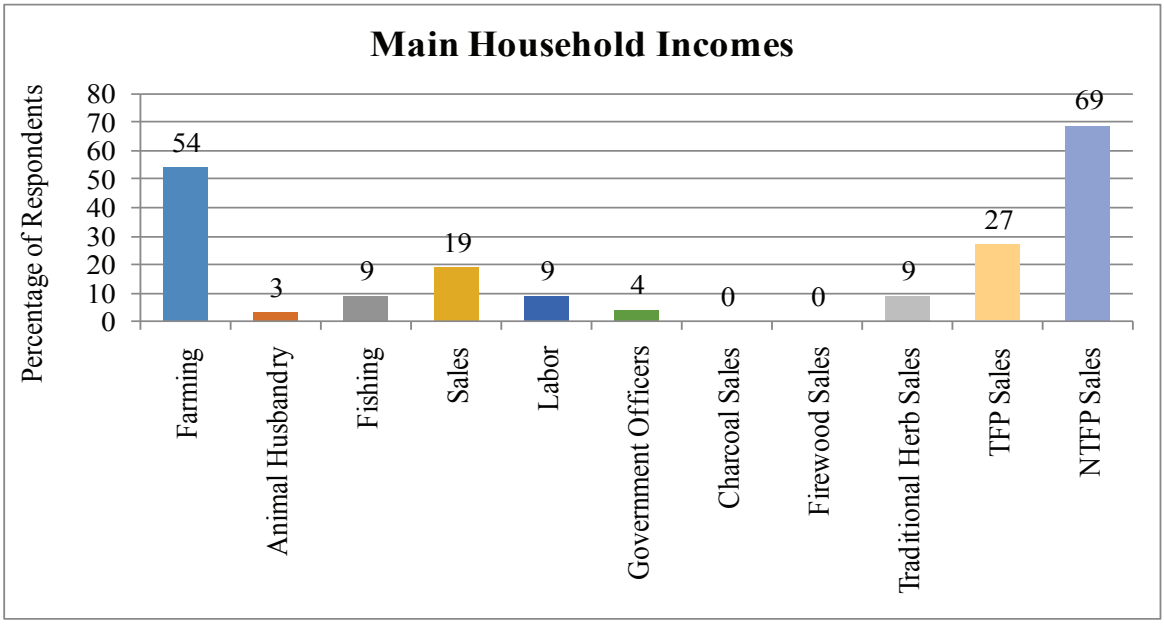



Figure 3: Occupations of People in the Study Commune
Source: Field survey, 2012

Farmers in O'som Commune carry out a nature-dependent cropping system based entirely on nature (so have a rainfall dependency), but these activities are low yield and support only household consumption, that is, they practice only subsistence agriculture and rarely grow enough to sell at the market. Those activities able to generate an income in the commune are also presented in Table 1, including fishing, selling (as vendors) and working as employees.

Table 1: Sources of Household Cash Income in the Study Area

| Main Cash Income Activities | Mean ncome (KHR yr-1) per Household (n = 60) | No. of Households |
|---|---|---|
| Fishing | 17,083,330.33 | 6 |
| Sales | 13,169,230.76 | 13 |
| Government worker/NGO salary | 22,502,630.16 | 3 |
| Wage labor (construction, factory etc.) | 2,450,000.00 | 6 |
| Livestock rearing | 252,000.00 | 5 |
| Rice sales | 22,502,630.16 | 38 |
| NTFP sales | 11,426,660.67 | 48 |
| TFP sales | 30,894,730.68 | 19 |
| Traditional herb sales | 300,000.00 | 3 |
| Total Mean Income | 5,799,514.29 | - |

Source: Field survey, 2012

As seen in Table 1, forest related services such as collecting and selling NTFPs and TFPs seem to contribute a significant amount towards total household incomes in the study area.

According to our field survey, 80% and 60% of local villagers in O'som Commune harvest TFPs and NTFPs respectively from the natural forest - for sale, and to contribute towards the household economy. Vines, rattan, orange-brown gum resin, cardamom fruits and green cardamoms can be counted as NTFPs, and these are usually harvested by local villagers for sale. However, as seen in Figure 4, a large proportion of villagers in the commune harvest TFPs and NTFPs for household consumption; 20% and 30% respectively. These, together with charcoal and fuel wood, are collected entirely for household consumption, not for sale. As seen in Figure 4, honey, tree roots, tree bark and vines are sometimes used to make traditional herbs - to treat illnesses among the villagers.

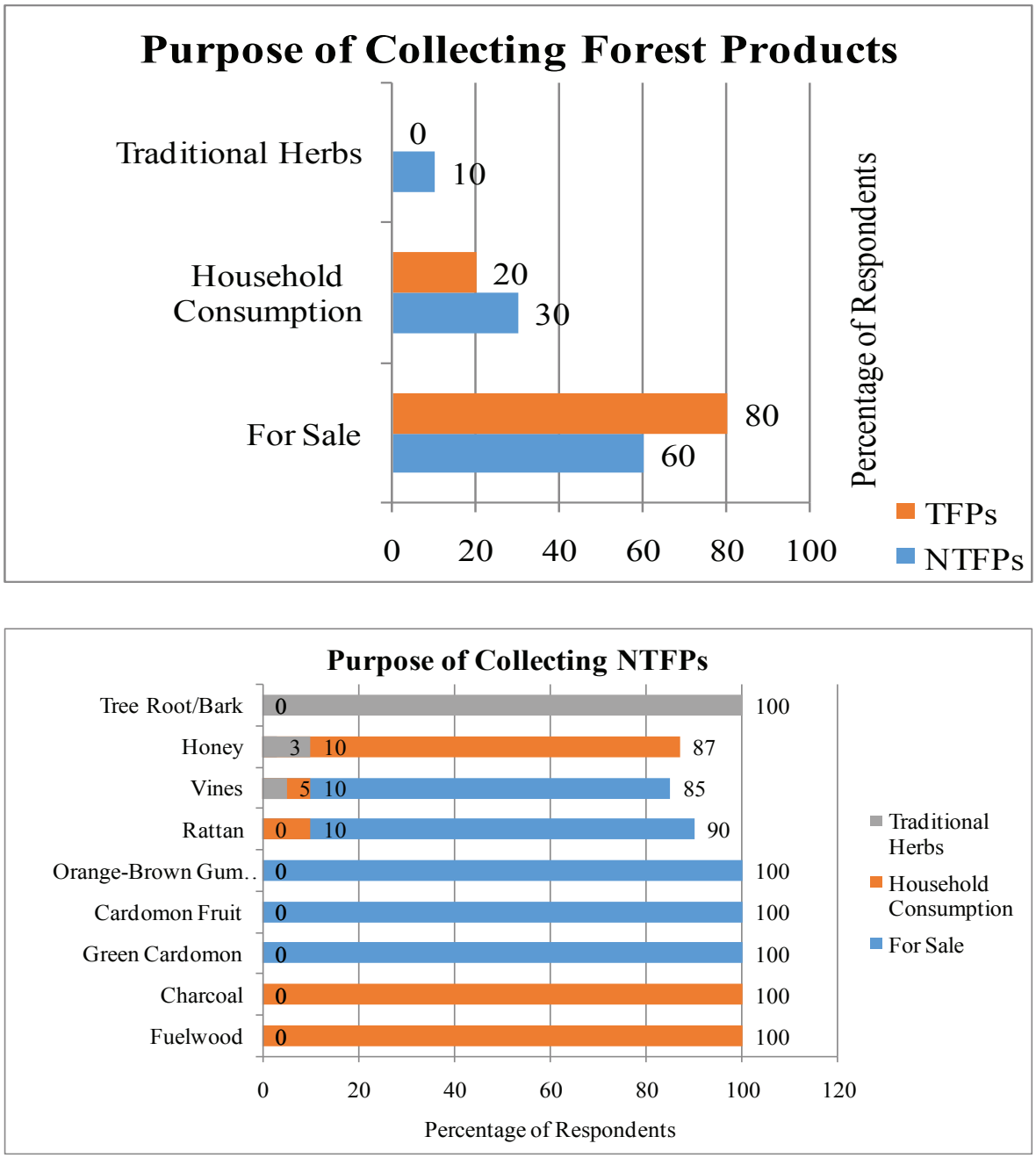
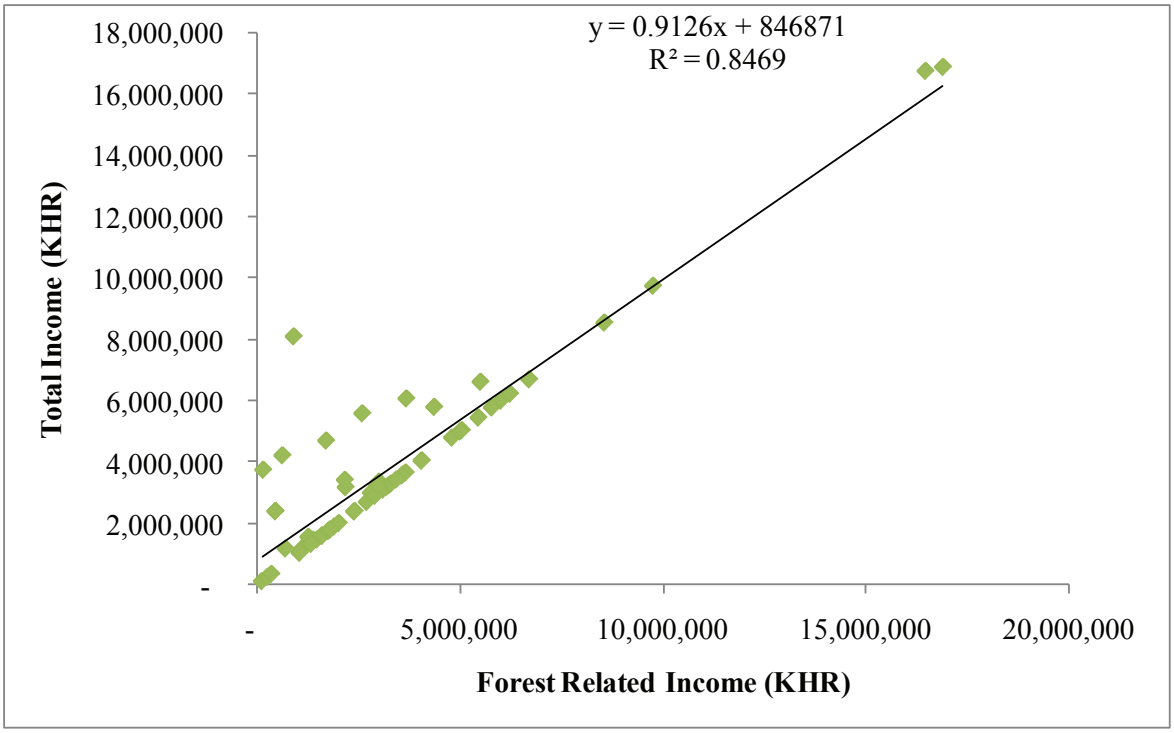



Figure 4: Reasons for Collecting TFPs and NTFPs
Source: Field survey, 2012

Based on the same survey and on local perceptions and opinions, there are plenty of sicknesses cured using traditional herbs, including a high temperature and fever, which were mentioned by 87% and 95% of respondents respectively.




Total incomes and forest related incomes (n = 60, R = 0.563, adjusted $R^2$ = 0.8469, SE = 2640742.182, F = 29.302, t = 5.413, $p$ = 0.000)

Figure 5: Total Incomes and Forest Related Incomes
Source: Field survey, 2012

As seen in Figure 5, we tested to see if there was a significant relationship between the incomes earned from forest products and households' total incomes. The results showed that there is a significant relationship between the cash income earned from forest products ($R^2$= 0.8469, $p$ = 0.000, n = 60) and total household incomes, suggesting that forest product incomes (represented by SE = 0.000) make a significant contribution to total household incomes. This means that forest management plays an important role in maintaining and improving household incomes now, and is likely to in the longer-term for future generations.

***Drivers of Forest Degradation***

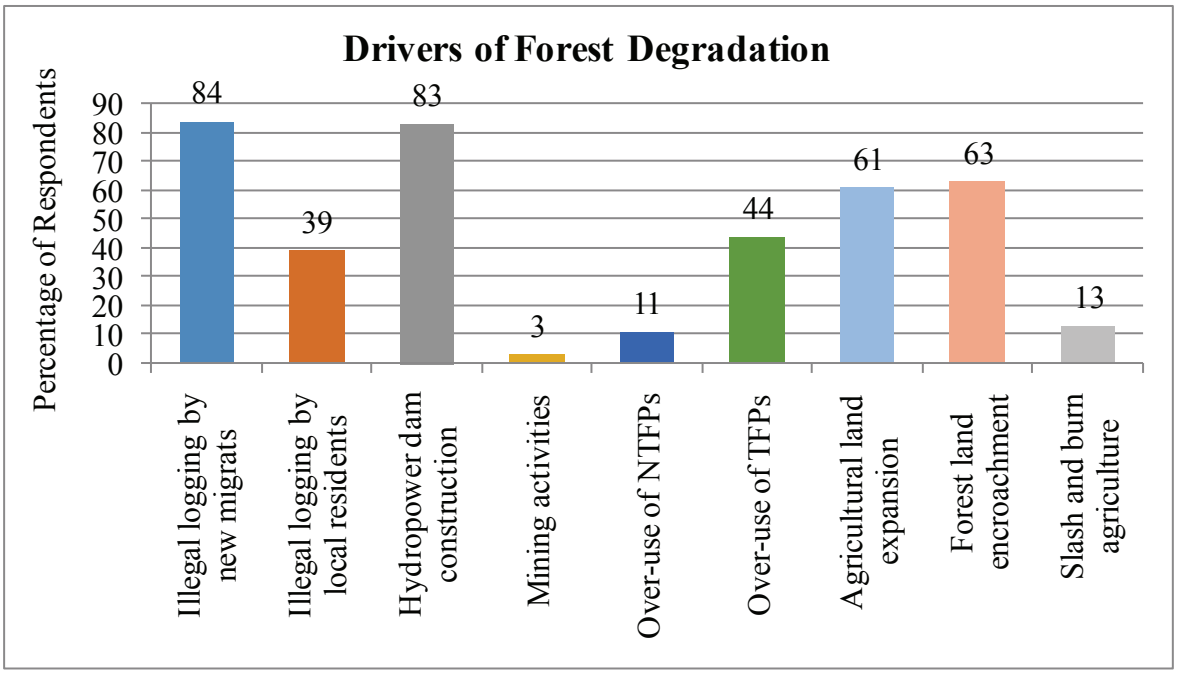



Figure 6: Drivers of Forest Degradation
Source: Field survey, 2012

Figure 6 shows the respondents views on the key causes of forest degradation in the study area, with illegal logging among new migrants being viewed as the key cause (84% of respondents), and with the construction of a new hydropower dam following close behind at 83%. Differences can be discerned between the native ethnic groups and the new migrants in terms of their views on natural resources use, and especially forest resources, The new migrants tend to cut and clear the forest in response to market demands without thinking about the longer-term health of the environment, and as a result, the local ethnic groups accuse them of clearing the forest without considering the villagers' culture and long term dependence on such resources.

According to the literature, hydropower generates 19% of the world's electricity, and plays a key role in helping to restrict and reduce global fossil fuel emissions and consumption, without having too much of an impact on the environment and human beings (Mauricio, 2011). The same authors report; however, that the operation of hydropower dams is often damaging to local people's livelihoods, as it can cause increased sedimentation and deforestation. The construction and operation of a hydropower dam around O'som Commune has thus been identified by the villagers as a key cause of the degradation of forest resources in the area, with 12% of local villagers (30 households) saying they have suffered as a result of forest clearance activities near their settlements (which have increased due to the operation of the dam), and that this has adversely impacted on their crop yields.

Due to the decreasing annual crop yields, local villagers in O'som Commune have sought a way to expand their agricultural land in order to supply their household needs; however, 61% of respondents told us that the expansion of agricultural land started in the beginning of 1995, when crop yields started to decline. Around 63% of respondents claimed that, due to

the increase in demand for agricultural land, local villagers have been forced to encroach upon forest areas, resulting in a dramatic change to the forest cover area at the study site.

Our key informant interviews showed that a lack of law enforcement in terms of conserving and protecting the forest area has led to a significant change in forest cover in the area, with illegal logging, over-exploitation of forest resources (timber and non-timber forest products) and forest encroachment occurring as the result of lax enforcement of the law by the relevant officers.

The degradation of forest resources has had two significant impacts (see Figure 7). First, the livelihoods of local villagers have been impacted due to the loss of household incomes, those based on degraded forest products. As a result, to survive people in the commune have had to find other solutions to support their livelihoods, caring little for the impacts on other living organisms and human-beings. Under these survival strategies, concern for the environment is not a paramount aim, as they tend to use as many natural resources as possible, such as timber, and non-timber forest products. With people thinking only along self-interest lines, some of the social and cultural aspects of local life have broken down, having a knock-on effect on social networks among the local villagers (see Figure 7).

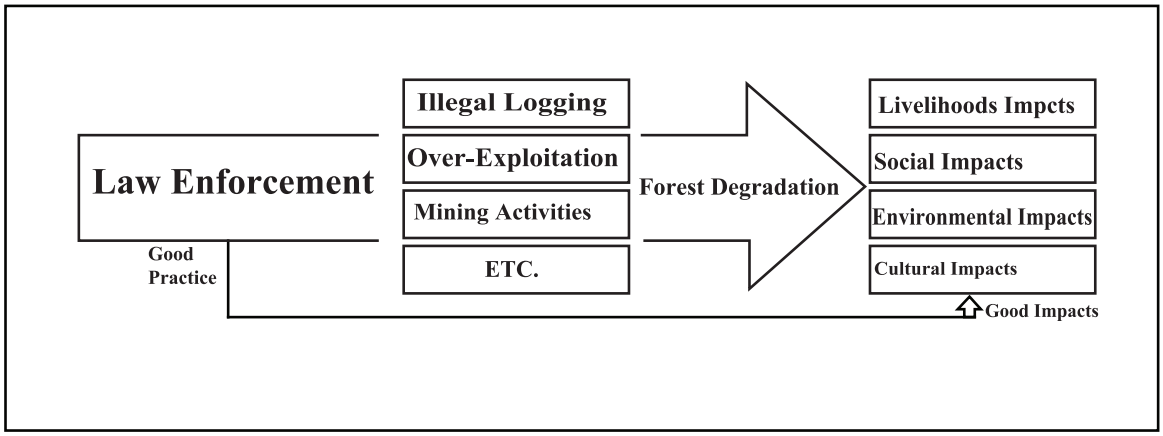



Figure 7: Drivers of Forest Degradation and their Impacts
Source: Field survey, 2012

Based on our survey, then in order to deal with the above issues, strengthening law enforcement activities should be considered. As seen in Figure 7, the negative impacts of illegal logging, over-exploitation and mining activities could be avoided through the reinforcement of existing regulations and by stopping the relevant officers taking bribes from the perpetrators.

Figure 8 below shows the flow of forest products in the study area, those related to illegal logging. The timber extracted from O'som commune has two key destinations: Pror Mouy commune and Koh Kong Province (then on to eastern Thailand). Due to Koh Kong's proximity to Thailand, middlemen usually carry timber products along well-known transportation corridors into the country. Taking the other route, once the products reach Pror Mouy Commune they go on to Pursat provincial town, and thereafter on to Phnom Penh.

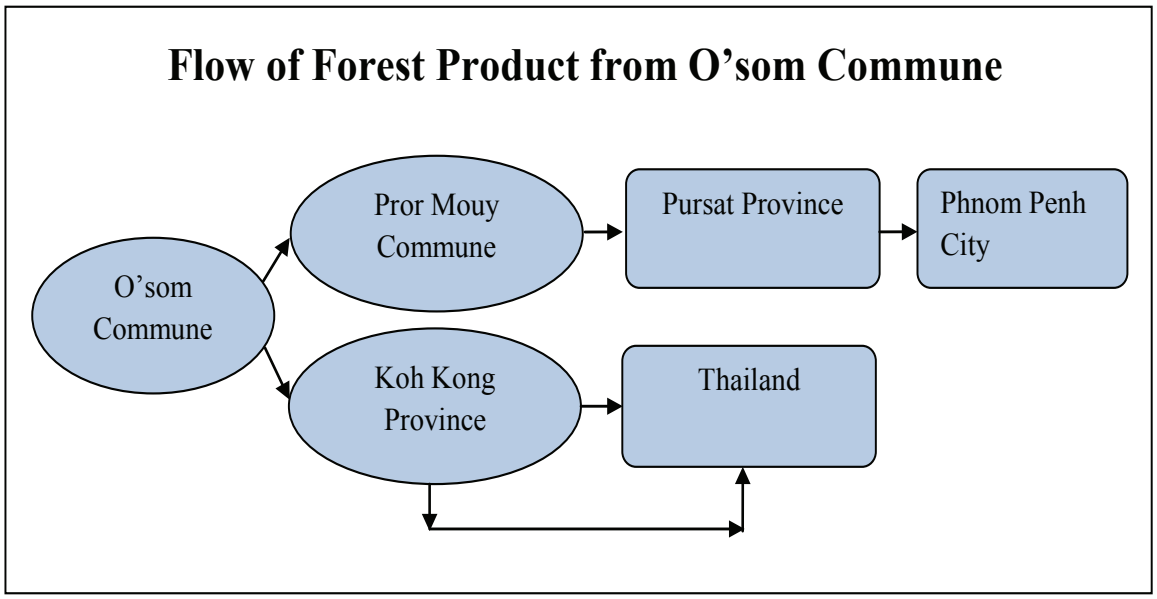



Figure 8: Flow of Forest Products from O'som Commune
Source: Field survey, 2012

***Willingness to Conserve Forest Resources among Local People***

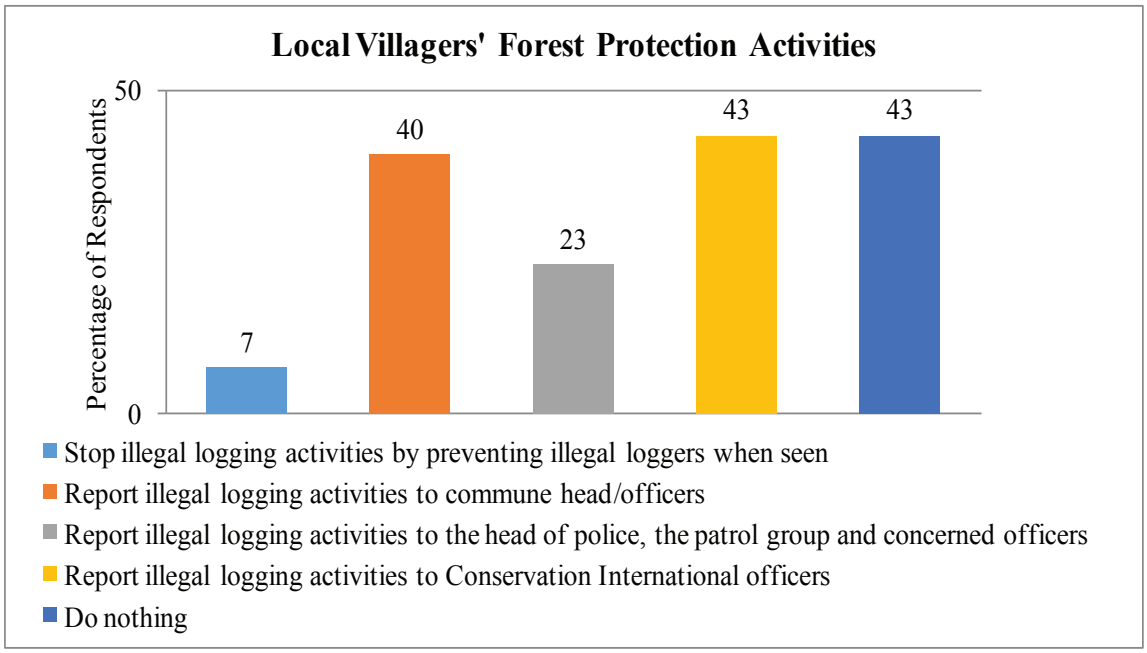



Figure 9: Local Villagers' Forest Protection Activities
Source: Field survey, 2012

A large proportion of household income is generated by forest resources, through the collection of timber and non-timber forest products. Most importantly for the forest ecosystem within the commune, 43% of our respondents said they have reported illegal logging activities to officers from Conservation International (CI), expecting them to intervene and stop the activities, while 40% said they report such activities on a regular basis, such as to the head

of the Commune, members of the commune council, the head of police and the chief of the village. Another 43% of respondents said they have appealed to other villagers not to get involved in illegal logging activities.

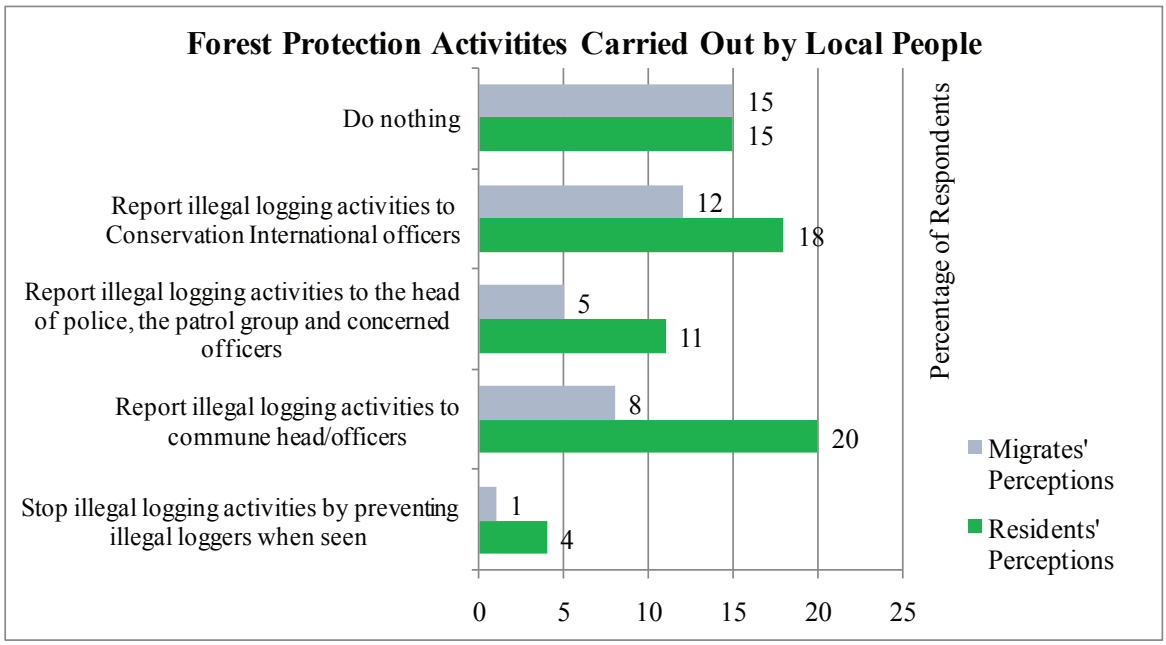



Figure 10: Forest Protection Activities carried out by Local People
Source: Field survey, 2012

Comparing the views of the long-term ethnic residents and the new arrivals on forest protection activities, 20% of those from the ethnic group said they have reported illegal logging activities to the head of the commune and to relevant officers, while 18% said they have reported illegal logging activities to officers working for CI – as a priority. However, only 8% and 12% of the new migrants said they have reported illegal logging in the same way. However, 15% of respondents from both the ethnic and migrant groups said have done nothing in relation to forest protection, saying their ability and power to do anything is limited.

In addition, and as mentioned at the start of this paper, O'som Commune is dominated by the Cheung ethnic group, and the participation of this group in terms of actual numbers within forest protection activities in O'som Commune is actually higher than for the new migrants. According to our study, 90% of the new migrants own farmland and run businesses based on processing timber forest products, and as a result, these people are not happy with the conservation efforts being made by those from the Cheung ethnic group.

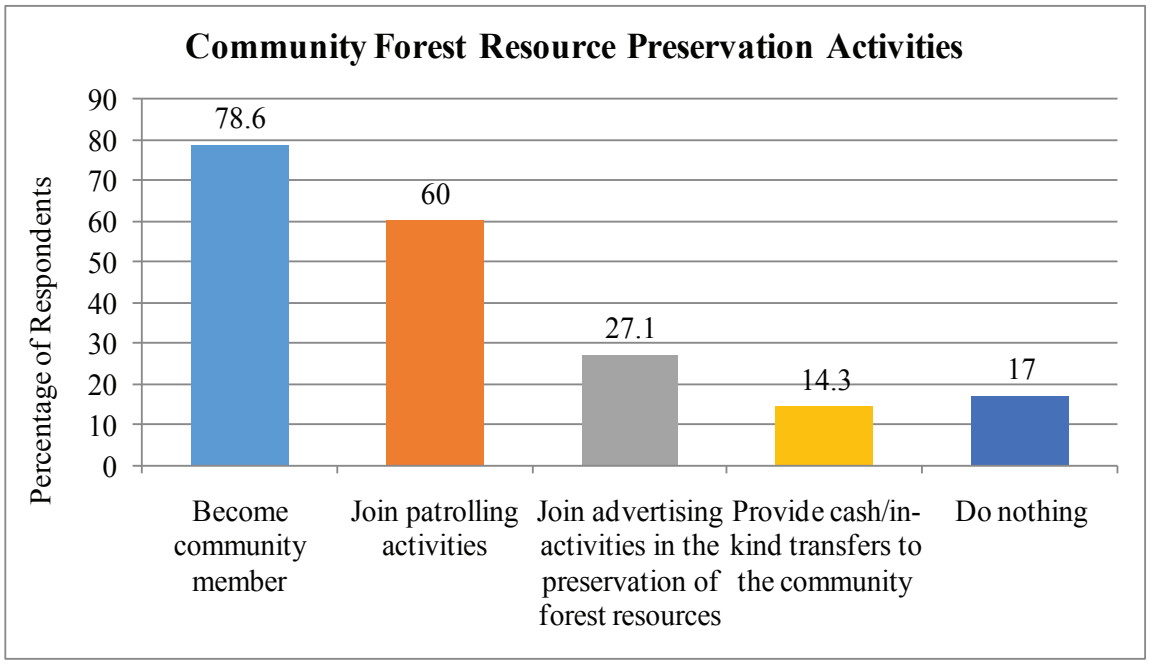



Figure 11: Community Forest Resource Preservation Activities
Source: Field survey, 2012

In O'som Commune there is one community forest called the Green Cardamom Preservation Area, or in Khmer *Sahakum Prey Krovanch*, which is located within the mountain range, and the local Cheung people are considered to be members of this preservation area. However, the new migrants do not wish to be included as community members, as their main income sources are derived from the collection of timber forest products. From our survey, 79% of respondents said they joined the community specifically in order to prevent outsiders from destroying the local resources (see Figure 11).

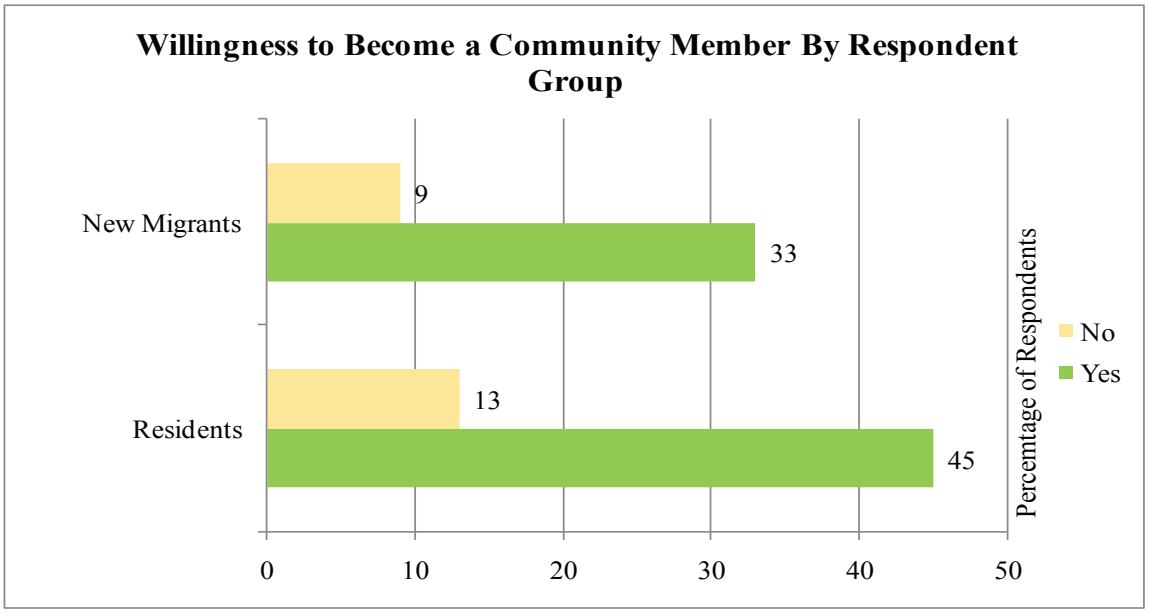



Figure 12: Respondents' Willingness to become Community Members
Source: Field survey, 2012

Figure 11 shows the different perspectives of the ethnic Cheung and the new migrants, while Figure 12 shows the willingness of people from these different groups to join the community group. In total, about 23% of the new migrants said they are willing to become community members, while 32% of the Cheung respondents said they are happy to be community members, as they are completely dependent upon the local natural resources for their survival.

At the study site, 79% of interviewees said that encouraging all villagers to join-in with community activities is key to preventing illegal logging activities, while 70% of respondents claimed that stopping people from burning the forest to hunt wild animals would help. In addition, 73% said that establishing another community forest near the commune should be considered (see Figure 13).

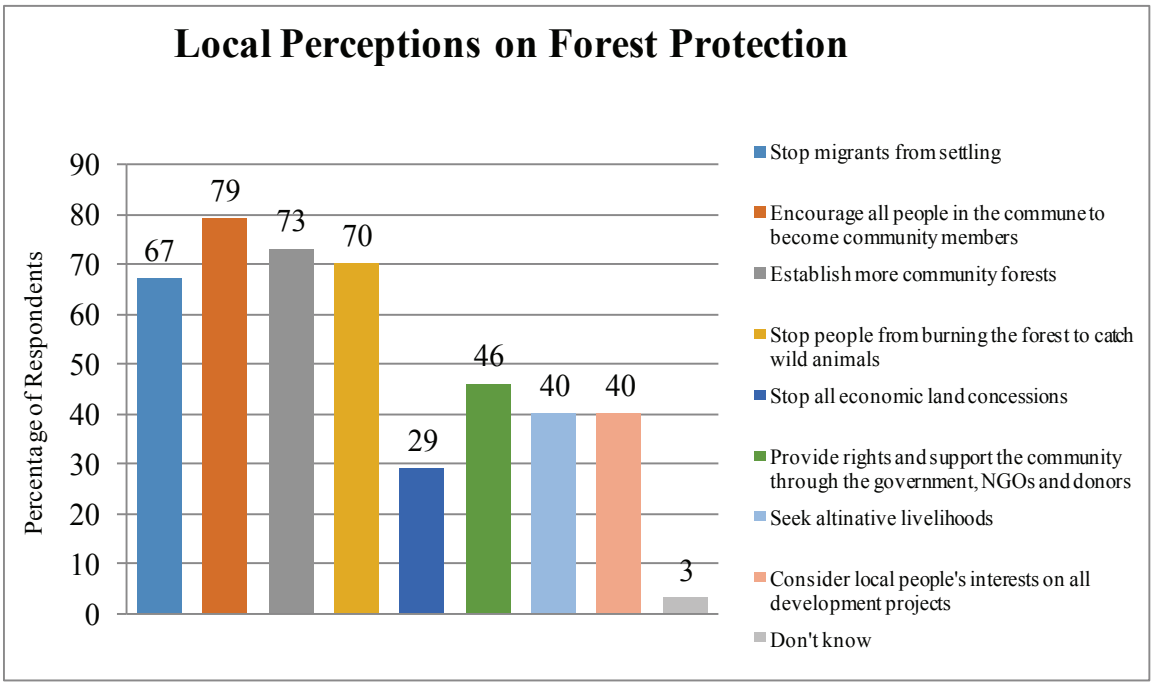



Figure 13: Local Perceptions on Future Forest Protection Activities
Source: Field survey, 2012

## Discussion

Based on the above results, in the study area forest resources make a significant contribution to people's livelihoods – helping to enhance household incomes; as recognized by local villagers. The local forest ecosystem provides a wide range of benefits, such as the provisioning, regulation and maintenance of cultural services, and also provides them with both timber and non-timber forest products, food (including wild fruit) and sources of drinking water, as well as a habitat and sources of energy, plus helps stabilize the local climate. Based on this, people can use products taken from the forest ecosystem both to support household incomes and also for consumption purposes. As shown by our survey, the composition of the forest is significant to any discussion of its relationship with the local human population.

Our main research question was related to the relationship between forest dependence (on timber and non-timber forest products) and local people's level of well-being (their livelihoods). From our survey it can be seen that natural forest products are closely linked to human-well-being in the area in terms of livelihoods, and are closely associated with maintaining a low unemployment rate among people at the study site. The results of our research confirm that people in the study area depend closely on forest ecosystems, and that these services make an important contribution to local households' economic statuses. Based on our survey results, the relationship between dependency on forest resources and household incomes would appear to be strong, which aligns with the theory; that we should value the importance of forest ecosystems.

The positive impacts of forest ecosystems have been discussed here based on the correlation between total households incomes and total forest related incomes, and we have shown that the forest ecosystem in the study area provides positive benefits and supports a large proportion of household economies.

Hemmavanh et al. (2009) claim that changes in forest use can have a significant impact on existing ecosystems and decrease household incomes, especially for households which depend on forest timber products and non-timber products to survive. The results of our survey support the above authors, finding that people's livelihoods in the study area are likely to be adversely impacted by a loss of income if forest resources should dwindle. The loss of forest area at the study site would have a significant impact on human livelihoods and also animal life, given that the forest is a key habitat.

To deal with the above issues, local people have proposed a number of changes. To support the long-term sustainability of forest resources at the study site, they told us that (i) the flow of new migrants into the commune from outside should be stopped, (ii) local people should be encouraged to become community members, (iii) villagers should be educated on the impacts of burning the forest when catching wild animals, (iv) an assessment should be made of all the economic land concessions and their activities ceased, and (v) funding should be provided to the community in support of patrolling activities. Based on our survey, we now understand that the current management system within the study area is not capable of protecting the forest from encroachment, and cannot sustain the needs of the villagers there. Most importantly, the implementation of these mechanisms needs to take place in collaboration with the relevant government officers.

## Conclusion

The forest in the study area provides a range of benefits, sustaining the livelihoods and incomes of local people and helping to regulate the local environment. Most people living close to the forest are completely dependent on the resources it provides, and the Cheung people in particular depend on the forest and see it as a spirit, one that supports their traditional social structure. People's livelihoods in O'som Commune depend mainly on the forest, though they grow rice and corn, make pepper, and also generate an income from animal husbandry activities such as rearing buffaloes, cattle (for beef), pigs and chickens. Due to the low agricultural production levels in the area; however, local people are under pressure to exploit the forest in order to supplement their household incomes.

Clearly, forest products (both timber and non-timber forest products) such as wood (for construction), fire wood and tree bark are collected from the forest by all households in the village. However, the increased desire among households in the study area to generate cash has changed the way in which they collect forest products in recent years.

Demand patterns in the study area differ between the Cheung people and the new migrants. Usually, the Cheung collect timber and non-timber forest products for household consumption, while the new migrants tend to harvest the forest to supply the market. Our study has found that the new migrants do not fully understand the value of the forest to the Cheung people, meaning they cut down trees without taking into consideration the area's role in providing them with spiritual support.

## Recommendations

Based on our study and on discussions with the local authorities and people in O'som Commune, we would like to make the following recommendations for change:

1. ***Alternative livelihoods approach:*** A key problem faced by the local people in O'som recently has been the over-exploitation of the local forest, with logging activities conducted mostly to generate an income and to make way for agricultural production. As a result, alternative livelihoods within the local economy should be encouraged with the support of donors, providing local people with the skills and knowledge needed to generate an income from sources other than the forest.

2. ***Clarification of the land tenure system:*** Given the increasing demand for land in support of paddy production - from both local villagers and outsiders, land titles should be given-out in the village area, as this will help protect the forest from clearance due to the expansion of cropping activities.

3. ***Provide support to the community:*** The community in O'som has a very important role to play in making sure any logging activities that take place do so within the regulations and rules; however, at the present time, it is isolated from any donor activities. This isolation should end and the local community encouraged to participate in such activities.

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# Experiencing the Implications of Economic Land Concessions and Local Community Livelihood Options: A Case Study in Tum Ring Commune, Kampong Thom Province

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## Abstract

This paper presents a study of local people's livelihood experiences in relation to land use and ownership due to the introduction of an Economic Land Concession (ELC) in Tum Ring Commune, Kampong Thom Province in Cambodia, and it looks at the changes to have taken place in the community in the ten years since the establishment of a rubber plantation, as granted by the government under the ELC arrangement. Three research tools - key informant interviews, group discussions and in-depth interviews, were used in order to collect qualitative information on both the land compensation process and the changes to have taken place over the last decade. I found that local community livelihood options have changed dramatically over the last ten years due to the establishment of the rubber plantation. Before the plantation arrived, local livelihoods depended on the collection of timber and non-timber forest products, and these were the local people's major incomes sources. Subsistence agriculture, including rice and shifting cultivation, was also considered an essential source of food at this time. The implications of the ELC being introduced were both direct and indirect. Some problems were initially encountered with the land compensation process in terms of its transparency and equity, as the local communities depend on the land for their livelihoods. In addition, the external market became much more important in the lives of local people, and the changes that occurred, from the carrying-out of subsistence agriculture to the growing of commercial cash crops - plus a depletion in the number of forest products available - meant people started to depend much more on the level of productivity of their land. While productivity from the land has; therefore, become the key livelihood asset for people living at the study site, land ownership risks now threaten their livelihood security.

**Key Words:** Economic land concession, community livelihoods, land use, natural resource governance.

## Introduction

The rate of transformation from agricultural practices based on subsistence to those driven by commercial forces, has increased dramatically over the last decade in Cambodia, as well as across the whole Mekong sub-region (Marsh and MacAulay, 2002; Hall et al., 2011; Gilmour et al., 2000). While the government's policies have focused on agricultural expansion based on the operation of agro-industries, the use of Economic Land Concessions (ELCs) has also been prominent, and as a result, 66 ELCs covering a total area of 1,006,777 ha had been granted in fifteen provinces across the country by 2007 (MAFF, 2007; Touch, 2009). The social and environmental implications of such land concessions have been addressed by NGOs, academics and the media (Touch, 2009; LICADHO, 2005; Yem et al., 2011), with conflicts over land use, access to land and forest destruction being seen as major issues to be addressed. While land in particular - one of the most essential livelihood assets - plays an important role in characterizing local people's socio-economic status, changes to people's level of access to land and their land practices have also led to changes in livelihood options (SNEC, 2007).

Local livelihoods are considered to have been impacted greatly by the introduction of the ELCs (LICADHO, 2005; Touch, 2009). While more than 80% of Cambodians still lives in rural areas and depends on the natural resources surrounding them and on agricultural activities, the regulations regarding access to land for basic agricultural activities, such as rice cultivation and non-timber forest products (NTFPs) collection, have posed questions in terms of local economic security (Touch, 2009; SNEC, 2007; NIS, 2008). While impact assessments have been conducted to legitimize the land concession process, and NGOs have carried out advocacy research in response, little research has attempted to understand the long term impacts of such developments on local livelihoods.

As well as the restrictions that have arisen in relation to access to natural resources such as forests, fish and water, those upon which local people depend, the reallocation of land has posed a major challenge in terms of causing livelihood transformation (Yem et al., 2011). The level of compensation provided by the concession companies for reallocating community land has been set by government policies, the aim being to enhance community livelihoods. However, challenges remain with the compensation process, as well as in terms of land security and people's land practices. To investigate the impacts of the study ELC on local livelihoods, it is essential to examine the initial land reallocation and compensation process that took place, as well as local people's experiences of the ELCs as a reflection of their coping and livelihood adaptation strategies.

Tum Ring Commune is located in Preylong forest, one of the largest remaining lowland evergreen forests in Indochina, an area with a lot of potential in terms of providing natural forest products and land resources, and which is also important in terms of supporting biodiversity. The forest and its non-timber products have supported thousands of families over many generations, and before the concession was introduced, local villagers depended entirely on subsistence produce and non-timber forest products (Yem et al., 2011; NGO Forum, 2005). In 2002, one of the first ELCs in Cambodia covering 6200 ha of forest land was granted to the Chup Company, to develop an industrial-scale rubber plantation, of which 1841ha was granted to the local communities as part of a compensation package (Yem

et al., 2011). A three hectare plot of land was provided to each local family whose land was affected by the establishment of the commercial-scale plantation, and the local communities were also encouraged to grow rubber on this land. However, issues were raised regarding the land compensation process in terms of its transparency and equity, plus the land security and land practices introduced thereafter (Yem et al., 2011; NGO Forum, 2005). Since that time, there have been few studies carried out into the impacts of ELCs on local livelihood options, and in particular the compensation process followed elsewhere in Cambodia.

This paper investigates the implications of the study ELC on local livelihood options, plus attempts to understand these implications by reflecting on the experiences of the local community over the last ten years since the ELC was introduced. In particular, the paper: 1) examines the compensation processes followed in terms of land allocation during the initial concession stages, and 2) identifies the adaptive or coping mechanisms chosen by local community members in order to deal with the changes introduced. This paper is of importance, as it will help generate a greater level of knowledge on the long term implications of ELCs on local community livelihood options. The paper also attempts to provide a narrative of the local people's experiences regarding the impacts of the ELC in relation to land security issues, their agricultural practices and the changes that have occurred to their livelihoods. Given that the ELC at the research site is one of the first to have been introduced in Cambodia, the results of this study should help identify the long term implications of such concessions on the livelihoods of local people, with implications for ELCs in other parts of the country.

## *An Overview of ELCs*

The first ELC in Cambodia was initiated in 1874 by the French colonial authorities to cultivate unoccupied land, on the condition that the concession land had to be fully cultivated within three years (Slocomb, 2007). As a result, the concession area granted for rubber plantations had gone up to 105,000 ha by 1925 in Cambodia and Cochinchina. After 1925 and up to 1953, concessions continued to expand under the French colonial regime, as they did after the French left the country and up to 1975, when the Khmer Rouge took power. The Khmer Rouge regime then continued with plantation activities, though also cleared land to make way for agriculture, with the previous ELCs ceasing to exist. Since the Khmer Rouge lost power, forests have played an important role in helping Cambodia to engage economically with the free market economy (Le Billon, 2000), and land concessions in the form of forest extraction activities have been introduced. As a result, during the 1990s, more than 30 forest concessions covering a total area of 6.5 million ha were granted to both national and international companies, their main purpose being to collect timber forest products and maximize the economic value of the hardwood grown. Sustainable logging was mentioned in the law; however, its implementation was limited, and a suspension of forest concessions was introduced across the country in 2001, due to criticism concerning the over-exploitation carried out by concessionaires. This suspension was subsequently replaced with the establishment of the ELCs, the aim being to increase agricultural production levels, mainly through the use of industrial-agricultural exploitation (Broadhead and Izquierdo, 2010). Under the Cambodian Land Law, up to 99 years of state private land can be granted to private companies under the ELC status.

More than one million hectares of land has now been granted as ELCs (GTZ, 2009; MAFF,

2007; Michaud, 2012; Broadhead and Izquierdo, 2010) and between 1992 and 2006, 97 ELCs were granted, each of which is larger than 1000 ha - located across sixteen provinces. By June 2010, an area of 956,690 ha had been granted to 85 concessions, but this figure does not include the 47 companies that have less than 1000 ha in nine provinces, consisting of eighteen companies in Kratie, two in Preah Vihear, ten in Kompong Thom, one company in Pursat, four companies in Kompong Speu, three in Kompong Cham, six in Rattanakiri, one company in Stung Treng and two in Oddar Meanchey (Broadhead and Izquierdo, 2010).

Complications are encountered when defining the territorial area under an ELC and with other types of zoning. A lot of ELCs are located in forest areas even if the forest is classified as public state land (Broadhead and Izquierdo, 2010), which means it should be virgin forest. However, Figure 1 shows that many concessionaires are located inside forest areas, these being deciduous or evergreen forest. Figure 1 also shows some overlapping and complex zoning between the economic areas, concessions, protected areas and community forests. As a result, some concessions are located inside protected areas, while community forest areas are located very close to, or even overlap with concessions.

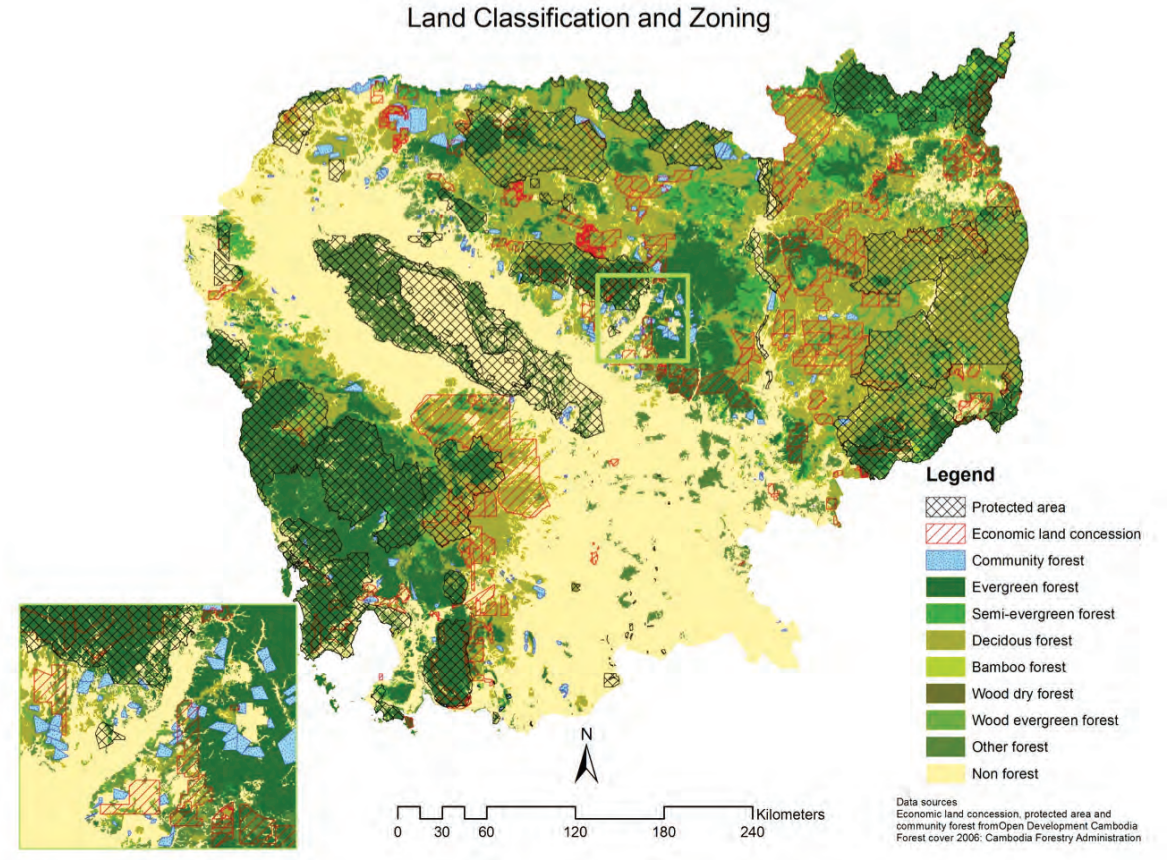


*Figure 1: Land Classification and Zoning Map of Cambodia*

## *ELC and Policy*

Under the relevant sub-decree, an ELC is a mechanism used to grant private state land to concessionaires based on specific, economic land contracts, the aim being to make use of the land for agricultural and industrial-agriculture exploitation. Industrial agriculture activities

include growing food and industrial crops, raising livestock and construction. Under the sub-decree, land granted as an ELC has to be registered and classified as state private land, state private land being any state land that does not provide a public service or come under any of the other state public land categories. The requirement to carry out Environmental and Social Impact Assessments (ESIA) is also set out in the law, and any resettlement issues have to be solved by the contracting authorities. The sub-decree also states that involuntary resettlement must not take precedence over lawful land holdings and that access to private land must be respected. In addition, consultation has to take place between the concessionaire, the local authorities and local residents. Therefore, based on the sub-decree, the impacts of any changes on local livelihoods and local resources should be accounted for before the concession is established.

More than just being protected, local livelihoods are expected to be improved through the establishment of these concessions, and since a World Bank report was published which says that more 70% of people living in rural areas of Cambodia survive on low agricultural productivity, enhancing productivity is seen as a key way to improve rural economic growth and reduce poverty (Opend Development Cambodia, 2012). The sub-decree states that one of the major purposes of establishing the ELCs is to increase employment levels in rural areas through the intensification and diversification of livelihood opportunities using appropriate natural resource management techniques and based on appropriate ecosystems.

The livelihood opportunities stated in the sub-decrees have failed to materialize upon implementation however, and both local and international NGOs, the UN and development partners have reported land having been taken away from communities without appropriate compensation paid or resettlement solutions found (Opend Development Cambodia, 2012; Neef and Touch, 2012). As testimony to this view, the rate of landlessness across the country has been increasing by 2% per year recently (Neef and Touch, 2012). Access to resources such as water and land has also been blocked in some cases, even though in the Land Law it states that land concessions may not violate road or transportation ways (OHCHR, 2007).

## Methods

### *Contextualization*

To understand the implications of the study ELCs on local livelihood options, during my research I explored the relationship between land ownership and practices, as this represents a major livelihood asset. I also investigated the livelihood options chosen by the local communities since the establishment of the commercial rubber plantations. The reallocation of land as part of the compensation package was expected to complement local livelihoods, with technical support provided by the concession companies and local government in order to help local people grow rubber. Every family in the village, and those whose land was affected by the concession, were offered three hectares of land by the concessionaire, plus technical agricultural support, to grow rubber. However, according to my research, not all the families were given this land and some; thereafter, sold the land they were given (Chann, 2009; Yem et al., 2011; NGO Forum, 2005). This research paper first examines the land compensation process followed during the initial stages of the concession, before then discussing the views of the local people regarding their livelihoods options, land ownership

issues and land practices over the last ten years.

### *Study Site*

The study site is Tum Ring Commune, which is located in Sandan District in Kampong Thom Province. The centre of the commune can be accessed along an unpaved road, running for about 100 km northeast from Kampong Thom provincial centre. The commune consists of eight villages with a total population of 5139, of which 2583 are women. Currently, the majority of the Commune is covered by forest and rubber plantations, while before the concession it was surrounded only by evergreen forest. Most of the villages are located in the rubber plantation area (see Figure 1). Based on a survey carried out by Yem et al. (2011), before the existence of the rubber plantation, the main occupations of the local communities were rice cultivation (31%), cash crop cultivation (18%) and forest product collection (28%); however, since the establishment of the plantation, labouring (26%), work for other businesses (19%) and rice production (19%) are reported to have become the major incomes source (Yem et al., 2011).

During the Khmer Rouge period, part of the commune was converted into a cotton plantation, but this is now covered by rubber trees (Chann, 2009). During the 1990s, the area was covered by three logging concessions owned by Colexim, Mien Ly Heng and GAT (Chann, 2009; NGO Forum, 2005; IFSR, 2004); however, over-exploitation by these concessions led to public disapproval, and as a consequence of increased donor pressured, by 2001 all the logging concessions nationwide had been suspended, including the three in the study area (Hansen and Top, 2006). However, immediately after the suspension of the rubber concessions, the excellent soil and availability of land in the area encouraged commercial rubber plantations to open instead.

Three of the eight villages in the commune were selected for this study, these being Khaos, Samraong and Roneam. These three villages are located within the rubber plantation areas and so have been impacted by the concessions since the early 2000s. Khaos is the largest village of the three, with 213 families, and is located in the centre of the commune. In total, 70% of its population is represented by immigrants from other parts of the province or country. Samraong has 97 families, and has less than 10% immigrants, while Roneam is the smallest village among the three, with only 67 families, of which five are immigrants.

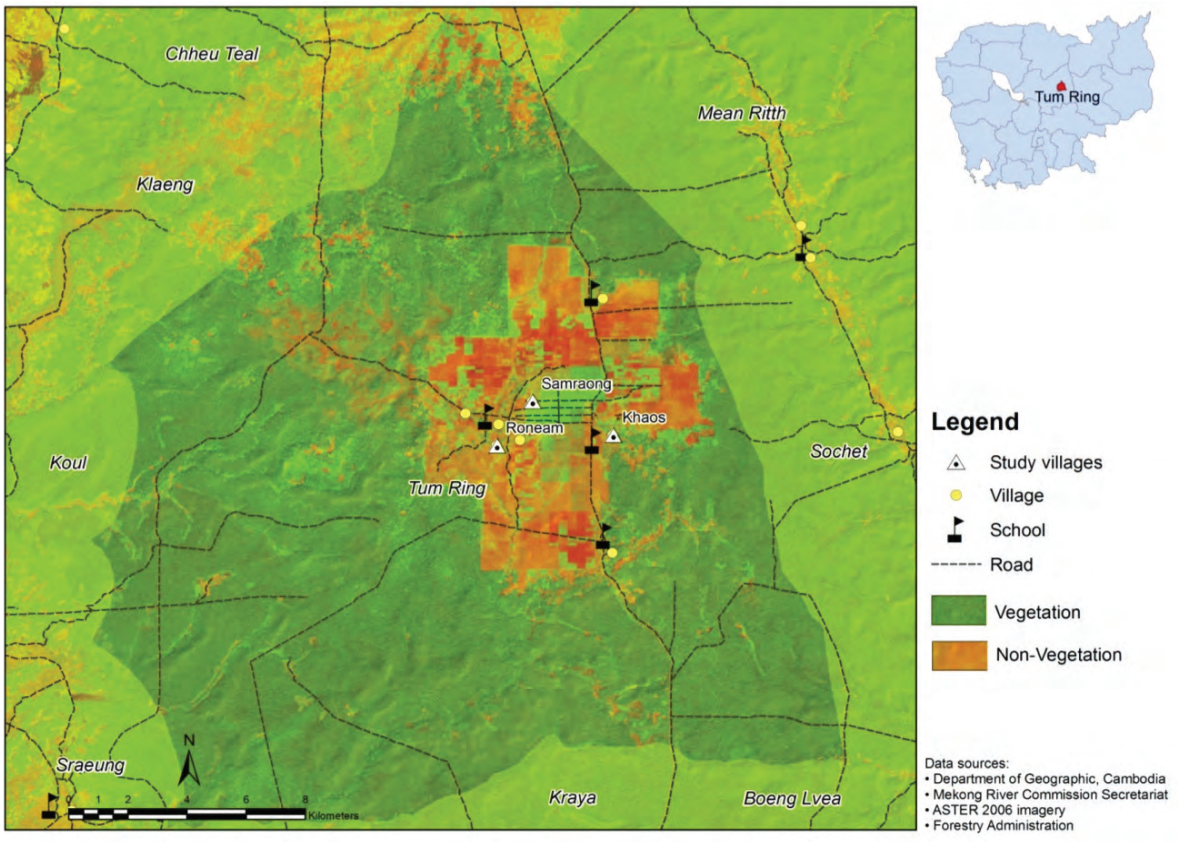


*Figure 2: Study Site*

## *Data Collection*

The aim of the field work was to collect qualitative information regarding local people's experiences of the ELC. Three data collection tools were employed for the study, including in-depth interviews, focus group discussions and key informant interviews. The same themes were investigated using these three tools, these being:

- A brief history of the local communities over the last 30 years
- The land compensation process followed during the initial stages
- The changes in livelihood options to have occurred over the last ten years in relation to land use
- The relationship between the people and the compensation awarded, and
- Local livelihood options in relation to other resources, such as forest and non-timber forest products.

Focus Group Discussions

Focus group discussions were conducted in order to collect general information and to supplement the information gathered using the other methods. Participatory mapping and timeline investigations were also conducted as part of these discussions. The villagers were asked to draw a timeline in relation to land use and ownership, particularly since the establishment of the ELC. These discussions also addressed the land compensation process

followed during the initial stages of the concession, discussing how people were informed and what negotiation and consultation processes were followed. Special events, such as changes to agricultural practices and demographics were also investigated.

Three discussions were conducted, one in each of the three selected villages. In each discussion there were approximately twelve participants, including men and women, village heads, elders who have been living in the area for more than ten to twenty years, villagers who did and did not receive land, and also migrants.

In-depth Interviews

This tool was used to collect narratives regarding the changes to have taken place in livelihood options among three different types of household and also among those impacted by the land compensation process. Three main types of family were selected for the in-depth interviews, as follows:

- Families who received land during the land reallocation process and have retained it
- Families who received land and then sold it, and
- Families who did not receive land as part of the compensation process.

A narrative analysis was conducted across the three sets of interviewees, with five to six people from each village interviewed. The narratives were recorded based on the significant events in each case, with the reliability of the responses taken into account. In total, seventeen households were interviewed.

Key Informant Interviews

Key informant interviews were used as a supplementary tool during the study, and these were designed to collect general information regarding the research themes from key stakeholders, such as commune heads, forestry administration staff, forestry community members, village chiefs, MLUP Baitong staff (a local NGO) and other relevant local stakeholders. These interviews helped provide a good overview of the changes to have taken place at the study sites, plus gain perspectives on the local authorities' actions and the villagers' involvement in the decision making and implementation process for the concessions. This tool also helped gather information missed from the other data gathering activities.

## Results

### *History of Tum Ring and the Introduction of the ELC*

Livelihood History

Tum Ring is an old community, and has been located in Preylong Forest for hundreds of years. The major livelihood activities of the villagers in the past were collecting timber and non-timber forest products and also practicing shifting cultivation. Before the Khmer Rouge came to power, the area was rarely visited by outsiders, as there was no road, just a track. At this time the villagers travelled by oxcart, meaning it took them more than two days to get to

Kampong Thmar, the closest town. The villagers' cash income was primarily derived from exchanging their resin and other non-timber forest products (NTFPs). Shifting cultivation was practiced in order to produce food for consumption, such as rice and fruit crops. Also, the ready availability of forest products, such as animals and plants, provided them with sufficient food, plus wood to help construct their houses.

The arrival of the Khmer Rouge (in 1975) ushered in a new era to the study area, and one of the major changes the Khmer Rouge brought in was the introduction of cotton plantations due to the high quality of the red soil in the area. Approximately 1000 ha of forest land was cleared at this time to grow cotton; however, the plantation was abandoned after the regime fell in 1979, though the area remained under Khmer Rouge army control until the late 1980s. The abandoned cotton plantation then re-grew to become secondary forest, but surrounded by valuable primary timber.

During the 1990s, as timber began to contribute significantly to Cambodia's economy, then similar to many others parts of the country, forest concessions were introduced into Tum Ring. The rapid expansion of logging concessions and the potential economic gains to be made from them saw three different logging concession companies set up within the study area, these being: GAT International Co. Ltd, Pheapimex Funchan Cambodia Co. Ltd and Colexim Enterprise (Chann, 2009; NGO Forum, 2005; IFSR, 2004). These companies also increased the level of accessibility of the area to outsiders, with larger roads constructed through the forest, primarily in order to carry logs. Hundred of outsiders settled in the area at this time in order to work for the logging companies and to set up small businesses.

Cash was thus introduced into the area in larger amounts, and local livelihoods began to depend more on logging than they had done before. However, collecting resin and other non-timber forest products continued to play an important role in the local people's livelihoods, plus they could gain access to other communities and markets, more so than before. As a result of these changes, a more money-oriented livelihood economy began to emerge, while connections with outsiders strengthened. The population of the community also rose.

Arrival of the ELC

The suspension of the logging concession was followed immediately by the introduction of the ELCs. The exploitation carried out by the logging companies had led to public disapproval, and as a consequence of increased donor pressured, by 2001 all logging concessions throughout the country had been suspended (Hansen and Top, 2006), including the three logging concessions in the study area. However, the fertility of the local red soil attracted the attentions of rubber plantation companies, who said rubber would enhance both the local economy and also government revenues. In 2000, an agricultural potential assessment was conducted by the Ministry of Agriculture, Forestry and Fisheries, after which it was decided the area would be good for growing rubber. A sub-decree was issued in 2001, granting a total land area of 6200 ha to three companies - to establish rubber plantations in the form of ELCs. The local communities' lands were included within the areas granted ELCs.

Land Allocation and Compensation based on the sub-decree and promises made by the companies, all families in the three villages were promised land as compensation; however,

in reality not all of them received it. The compensation package was meant to provide three hectares of land to each affected family, regardless of the amount of land owned before. Based on my key informant interviews with the village chiefs and on my group discussions, ten families in Khaos, seventeen families in Samraong and nine families in Roneam did not receive land. On average, each family had five hectares of shifting cultivation land prior to the concession, and the land located in the concession area was meant to be compensated at 0.5 million riel per ha.

However, the level of transparency during the compensation process was limited. The process started in 2001, when the village chiefs collected the names of every family in the affected villages. The names of the families and the number impacted were then sent to the commune councils, though the final decisions were made by the companies, who posted the final list of those to receive land. Though the names of every family in the three villages were sent to the commune council, some of these were taken off, according to the village chiefs I spoke to. The village chief from Samroung said, *"My child and his family did not receive land, even though I am the village chief; I don't really know why."* Some of the villagers believe this was down to the carelessness of the companies.

The land was allocated by household, and a household can consist of more than one couple. As a result, even though in some households there was more than one family living there, only one allocation of three hectares was made. In addition, newly established families and recent migrants did not receive any land either.

Most of the land provided to the householders was sold by them during the initial allocation stage, due to their feelings of insecurity over owning land. During my in-depth interviews and group discussions, most of the participants mentioned that they were told they might not be able to own the land, and this view spread around the community during the initial compensation stage and before the land was even allocated. Some people believed that the company would take the land back, whether the householders wished to sell it or not. During a group discussion in Samroung village, one of the informants said, *"We thought if we did not sell the land to them, they would take it back anyway"*. Most of the land was sold straight back to the ELC company, though some was sold to outsiders. The price given for the land was between half and one million riel (approximately 125 to 250 US Dollars) per ha. Some villagers said they had not even had the chance to see their land, because they sold it so quickly; just enough time to know it was three hectares. Expecting to be able to clear the forest and get free land also encouraged people to sell their compensation land, and some villagers told me that they were still able to go to the forest and clear land for themselves, meaning that keeping the land allocated by the company was not the only option. Some people also had additional land to that in the concession area. Another reason given for selling the land was that it was not suitable for cultivation, and one of the participants in a group discussion said, "*My land was very steep and rocky, and the soil quality not so good; so it was not easy to cultivate on this land*."

Eventually, all the land sold by members of the local communities was then used by the company to grow rubber. Some of the land was cleared and ploughed by the company, which then provided small rubber plants (seedlings) to those community members who had retained their land. The villagers were encouraged to grow rubber, but this was easier said than done.

*"We had no experience in terms of growing rubber. The company supported us, but it takes a lot of time and money, so it was not easy for us to grow rubber. Rubber trees take more than four years before they can be harvested, and we need money and food for our daily lives",* said one of the group discussants. The need for immediate cash also led to people selling their land, and my group discussions showed that people sold their land because they needed money urgently. "*If we did not have cows or buffalo to sell, land was the only asset we could sell for cash when someone in the family fell seriously ill*", said one person during the group discussions. As a result of the above, less than 20% of households in each of the study villages now own the land originally provided to them by the company.

## *Three Land Ownership Cases*

This section reviews and discusses three different land ownership cases, including a family who received land but did not sell it, a family who received land and sold it all straight away, and a family who did not receive any land. The histories of the individual families will be outlined, their stories revealing the impact of the rubber plantation on their livelihoods. These cases capture the life stories of the villagers before and since the creation of the ELC, focusing mostly on land ownership issues and the livelihood options they chose.

### The Family That Still Owns its Land

Yun is a 45 year-old man and has lived in the area since he was born, and there are three members of his family. Farming has been the family's main source of income and food since before the arrival of the ELC. The family has a total of six hectares of land, which includes the three hectares provided as part of the compensation package. The crops they grow have changed since the arrival of the company. Prior to 2000, the family grew rice and sesame seeds, plus collected resin from the forest – another cash income generating activity. Now, under the ELC, the types of crop they grow are based on the prices to be found on the market.

The arrival of the concession in 2000 impacted upon the family's original five hectares of land. The company promised to compensate the family with 0.5 million riel per hectare and to give three hectares of cleared and ploughed land ready for cultivation. The family was encouraged to grow rubber on the three hectares. In 2001, the village chief collected the name of the family and sent it to the commune chief – in order to get the three hectares, and this was added to the random selection process for land plots on offer. As well as the land, the family also received 25,000 riel for the five hectares impacted. Having received the land, the family decided not to grow rubber but to grow soybeans instead, and to start them off, the company also lent them the soybean seeds. The family also rented some land from the company, in order to cultivate cassava and more soybeans, as only these crops could be grown on the concession land.

Between 2005 and 2007, the family continued to grow cassava and soybeans; however, the land rented from the company became unavailable because the company needed the land back to grow rubber. By 2008, his family had already cleared another three hectares of land in the forest. In total; therefore, his family ended up with six hectares. In 2008, the family started to grow rubber on the land received under the allocation, with cassava grown along

the edges of the plantation. The reason they stopped growing rice was because the price of cassava was very high at that time, plus rice could not be grown on the edges of the plantation due to the excessive shade. In addition, as his land was surrounded by rubber plantations, so he could not burn the rice, in case of causing a fire. Normally when cultivating their rice, every year the farmers burn the plant residues in order to prepare the land.

According to Yun, his family's economic situation has improved since the arrival of the concession. His agricultural practices have improved, as has the road to the village and accessibility in general, due to the existence of the ELC, which has also brought new technology and a market for his agricultural products. He said, *"There are tractors and other modern equipment that can help us to cultivate faster. They also help us to clear the land even faster than before.*" None of his family have worked for the rubber company, because most of the workers at the company come from other provinces, such as Kampong Cham.

The Family That Sold its Land

Oun Leam is a 59 year-old head of household with four other family members. He is the vice-head of Samroung village and his family cultivates five hectares of land, on which they grow mostly rice. They do not have title to their land as yet, because most of the land in the village is forest land on which shifting cultivation is practiced. Similar to other families in the village, the collection of non-timber forest products played an important part in supporting the family's livelihood before the arrival of the rubber plantation.

During the land allocation process in 2001, his family received three hectares of land, as all his land was impacted by the establishment of the rubber plantation. The company also promised to compensate each family with 0.5 million riel per hectare for land lost (as well as the three hectares), and his family's name was also collected by the commune chief and then sent to the company; to receive the three hectares. The family was asked to join the random selection process, to decide which plot of land they would receive, eventually receiving the land and also 250,000 riel for land taken by the company. He told me that families who got married after 2000 were not eligible to receive the land, and he also mentioned that some older families in the village also did not receive any land. On this issue, he said, "*This was a mistake and due to carelessness on the part of the company.*"

Having received their land from the company, the family started to cultivate it, shifting from growing only rice to growing rice, soybeans and cassava, with land allocated for each. He said "*Soybeans and cassava fetch a better market price, and since the ELS arrived, the condition of the local road has improved. This might be the reason why the soybean and cassava prices are rising*". The family decided not to grow rubber because they did not have enough labour and financial capital available, and decided not to sell their land in the early stages, even though there was speculation that they would not own the land and that the company would take it back.

The family eventually decided to sell the land in 2007; they had a financial problem because a member of the family became very sick and they needed the money urgently. They sold the land to the company, but retained 0.5 ha. After that they also started to clear the forest to create new land, which was located in the forestry community some three kilometres away

from the village. In total, they have now cleared three hectares of land. Apart from agriculture, three members of the family work for others, harvesting cassava, but have never worked for the rubber company because they do not have the requisite skills. Oun Leam added, "*Mostly they prefer people from other places*"; however, he added that his family's economic situation is better than it was before 2000, mainly because there is a healthy market for soybeans and cassava, generating more cash for the family than rice. They have also been able to continue to collect non-timber forest products, plus use their cleared forest land and take advantage of the better road conditions since the ELS was opened.

The Family That Received no Land

Pang Houen is 41 years-old and has lived in Roneam village since she was born. There are nine members of her family, including four sons and three daughters, with three of the seven children being mature enough to work, but the other four still very young. The family's main sources of income come from growing cassava and soybeans, and raising pigs.

Before 2000, her family had 5.5 ha of land which they used for shifting cultivation, and 0.5 ha they used for permanent rice and corn cultivation. Apart from farming, her family's livelihood also depended a lot on collecting non-timber forest products such as resin, firewood and rattan. In 2001, the establishment of the ELC affected all their shifting cultivation land; however, her family received no land as part of the reallocation process. She said, "*For the affected land, each hectare was compensated with 200,000 riel, but they promised to give us 500,000 riel per hectare*". Her family's name was also collected by the village chief and sent to the commune chief, and then on to the company; however, when they announced the names of the families to receive land plots, her family's name did not appear on the list. She raised a complaint with the village chief and the commune council, and their response was for her to wait. They were told that anyone who had not received land by that time would get it later. However, to this day her family has never received any land.

Because her family did not receive land from the company, instead they have used land within the community forest and in other unprotected areas. In 2007, her family started to clear forest to make a new plot of land, and in one year cleared one hectare. In 2011, they then received two more hectares from the Community Forest, and have since used these plots to cultivate cassava. Pang Houen told me, "*The ELC took our land, and even though we still have land, it is all located in the Community Forest area and we cannot find as many non-timber forest products as we did before, as the places available to collect them are becoming more scattered. I am not sure if we can own these plots because they are located in the Community Forest.*"

None of her family work for the rubber plantation company, as most of their workers are from other provinces. She added, "*The villagers here do not have the skills required to work on the rubber plantation. We have our own land to cultivate, and I really don't want the rubber plantation located here, as the benefits flow mainly to outsiders. Most of the poor villagers have ended up selling their land and instead clearing more forest land in the Community Forest or in the restricted forest area. We lost our land and we did not get anything back, so we have had to clear more land".*

## Discussion

### *Compensation Processes*

My research found that the compensation process was problematic in terms of its transparency and equitability, and this supports the findings of other research and media reports; that these processes are not transparent (FIDH, 2011; Touch, 2009; NGO Forum, 2005). The International Federation for Human Rights (FIDH) found that the Environmental and Social Impact Assessment (ESIA) carried out before the concession was approved was only partially completed (FIDH, 2011); however, conducting only a partial ESIA helps to legitimize the start-up process of such projects, as revealed at the research site where consultation was not carried out in the appropriate manner. The local authorities, such as the village and commune chiefs, were only involved in order to provide demographic information, with the decision-making left to the companies and higher level authorities. My results show that local villagers, including the village chiefs, did not receive enough information on how the land compensation process was to be conducted; the processes were centralized within the company and the higher level authorities, with the decisions on who should receive the land or how much land should be given out based on the demographic data provided by the village and commune chiefs. As a result of this lack of transparency, the land was not distributed equitably to the local communities, and those households who did not receive any land have been given no further idea as to whether they will receive land or not. This has led to inequality developing in relation to property ownership among villagers within the same communities - a direct result of the introduction of the concession.

### *Livelihood Change and the Selected Options*

The introduction of the ELC has had both a direct and indirect impact on local livelihood options, with the livelihoods of local people changing dramatically since the arrival of the rubber plantation. The direct impacts on livelihoods are related to the re-allocation and use of land, as the establishment of the rubber plantation took shifting cultivating land away from the local community and replaced it with permanent agricultural practices. Most of the community's land was affected, so compensation of three hectares was given; however, as already mentioned, most of this land was then sold back by villagers to the company, after which they encroached on to other land. Shifting cultivation practices have disappeared and been replaced by permanent cash crop practices, and livelihoods now depend more on the market than on locally sourced produce. Cassava and soybeans have replaced rice and sesame seeds as the crops of choice for the villagers, though a minority who managed to keep their land and grow rubber appears to now have a more stable economic position. However, those who received no land and those who decided to sell back their land have ended up clearing more forest land, and so face uncertainty in terms of land ownership.

Indirectly, improvements in the road infrastructure and the introduction of technology into agriculture have enhanced cash crop productivity, meaning more cash has flowed into the area. Added to this, market-based livelihoods have been introduced into the community, with the depletion of non-timber forest products and restrictions on logging encouraging people to rely less on forest products. As a result, the land itself has become a vital asset. Rubber cultivation is quite reliable, but requires significant capital investment and a longer period of

time to set up; therefore, not many poor villagers could afford to enter into it. The most popular crops grown are cassava and soybeans, as these have a much shorter lead time between the initial planting and harvesting stages when compared to rubber.

The villagers' dependency on land has increased since the ELS was introduced. With shifting cultivation, land is generally abandoned for a certain period of time until it has regained its fertility with the re-growth of the forest. As a result, a large number of plots are not needed at a given time, particularly as shifting cultivation is a labour intensive practice. The productivity generated is mainly used for food security and to support basic needs, with non-timber forest products also playing an important role; to complement the shifting cultivation. The collection of non-timber and timber forest products used to play an important role in terms of generating cash for the villagers; however, now a more permanent and intensive form of agriculture based on the use of technology is practiced. Cash crops such as cassava and soybeans also require a lot of labour and the use of technology; however, due to the accessibility and availability of this know-how, growing such crops has become easier. The money received from these cash crops is now the dominant source of income and food for the study households; therefore, larger amounts of permanent land are needed.

Alternative jobs are not yet an option for the local villagers, as land is still available and their skills are limited. The jobs offered by the concession company have mainly been taken by outsiders who don't own land in their home towns. My in-depth interviews and group discussion revealed that most of the rubber plantation workers are outsiders from other provinces, and the company offers these workers incentives to stay permanently in the housing offered, making their work and lives easier. However, those villagers who come from outside the area prefer to stay in their own houses, because they are not too far from the company's own location. Also, the local villagers prefer to work seasonally, because they still have their own land to cultivate. As one person said during our group discussion, *"The cash generated from working for the company is not as good as that from our own land"*.

### *Level of Uncertainty*

Beyond the compensation process and the livelihood changes that have occurred over the last decade - directly and indirectly influenced by the ELC, here I attempt to discuss some of the challenges faced by the community in terms of the level of uncertainty over land ownership, as well as the livelihood options available. The compensation of three hectares of land given was meant to improve and stabilize local livelihoods; however, uncertainty over land ownership and a lack of financial capital and technical skills have created uncertainty in terms of the villagers' future livelihoods. With agricultural productivity now based on access to and ownership of land, this has become a primary income source, meaning that any uncertainty in relation to land ownership has also become a major concern. Most of the land that villagers cultivate is used illegally; it is either located in the Community Forest area or in the forest protected by the Forestry Administration. As can be seen in the following image (Figure 3), the rubber plantations are surrounded by Community Forest, and it is illegal to clear the forest and carry out agriculture there. However, the image and my interviews show that a lot of land the villagers cultivate is actually located at the edge of the rubber plantation and within the forest areas.

The contest for space, in relation to both price and legislation, can impact on the potential ownership of land (Hall et al., 2011). When poor villagers have a good chance of selling their land, overlapping and contested space can be a push factor encouraging them to do so. As mentioned by Hall et al., in Southeast Asia, the price of land is pushing local people out of agricultural activities, rather than promoting the agricultural utility of land, plus the legitimation of forest protection activities is also an exclusion factor; threatening local land ownership (Hall et al., 2011). In the study area, then apart from concession areas - within which land is used to maximize commercial agricultural products such as rubber - other areas are either part of the community forest or strictly protected by the FA. This means that all three of these activities are not helping to legitimize the rights of local people to own the land they are cultivating.

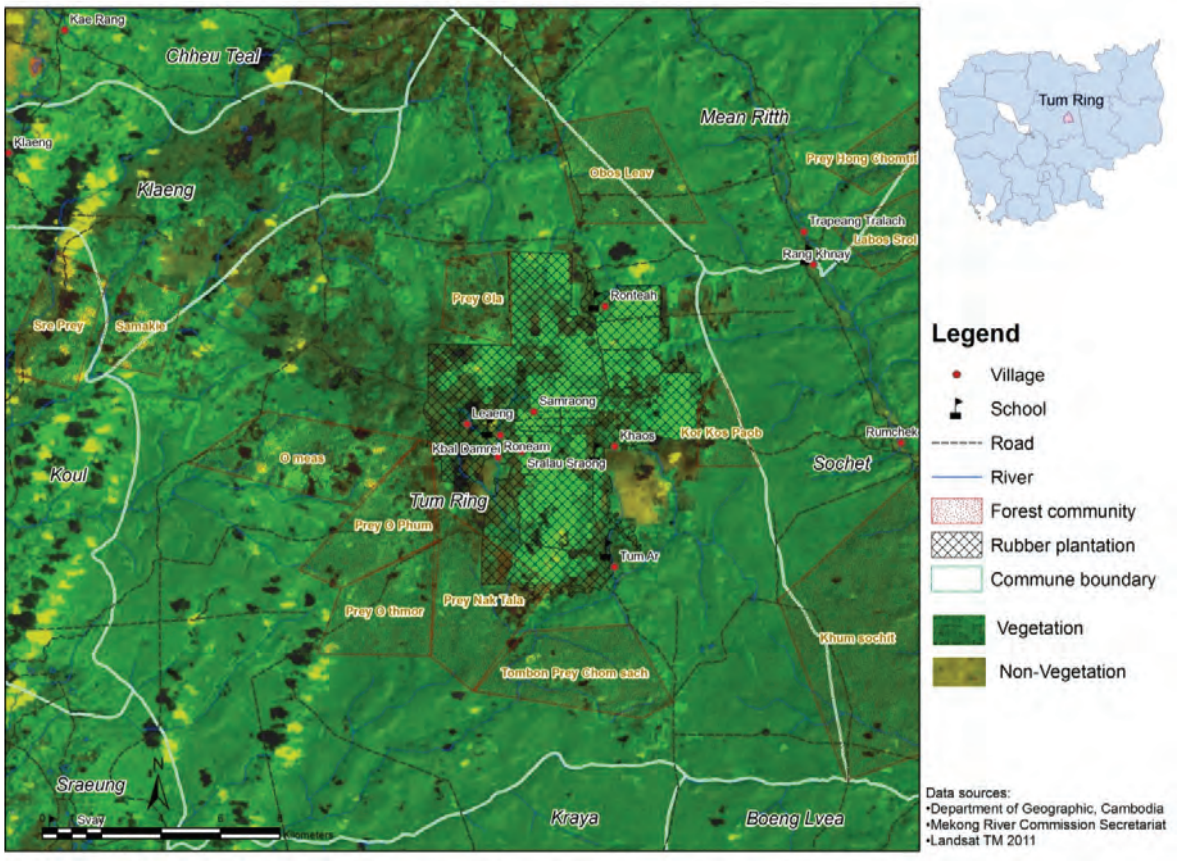


*Figure 3: Map of Tum Ring Commune in 2011*

## Conclusion

In the study area, some problems occurred during the initial stages of the establishment of the ELC in relation to the compensation process, and in particular its transparency and accountability, leading to the development of an iniquitous situation which has continued to this day. Decisions were made over compensation without any proper consultation taking place with the local authorities, the village chiefs or the villagers during the establishment of the concession. These people were only informed when the decisions had already been made. Once the compensation was set, it was not distributed properly – and some villagers received no land at all as compensation. The feeling of security in terms of land played an important

role in determining whether the villagers decided to keep their compensated land or not, and many sold the land before they had even seen it, due to their feelings of insecurity over ownership.

The implications of the concession do not stand in isolation, and the dynamic nature of the changes that have occurred need to be taken into consideration in any future studies on the topic, as should the historical context plus the influences of other factors such as the market. Different types of concession may also impact differently on communities; for example, promoting a long term crop such as rubber may provide long term livelihood security, but securing and processing the land in the first place represents a major challenge for local people. How can both the government and local NGOs enhance local communities' feelings of security in terms of land? Providing technical skills in support of agricultural activities would certainly be helpful, as would alternating crops rather than relying on rubber alone, as this would also increase the likelihood of local people being able to own and make use of the land.

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# DPSIR Analysis of Sand Extraction and Use in a Coastal Community Fishery: A Case Study of Boeng Tuk Commune, Tuek Chhou District in Kampot Province

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## Acknowledgements

The need to study the impacts of sand extraction and use on coastal resource dependent communities in Cambodia is becoming essential, as the increasing number of development activities taking place along the country's coastal areas is becoming a key issue. Moreover, educational and research institutions, and in particular academics, have an important role to play in bridging the information gap between local communities and the relevant policy- and decision-makers on such issues. The aim of this study is to link the relevant theories related to natural resources management with the real-life practices of local communities in Cambodia. With this in mind, the Department of Natural Resource Management and Development at the Royal University of Phnom Penh (NRMD-RUPP), with the cooperation and support of local partner NGOs and international organizations, has conducted a number of research projects in relation to environmental, natural resources, biodiversity and conservation management issues in the coastal areas of the country. Based on its research findings, NRMD-RUPP has already hosted a national workshop focused on the existing key issues in this field, which was attended by researchers, students, members of local communities and the local authorities, NGOs and other relevant stakeholders.

I would like to take this opportunity to thank Dr. Seak Sophat**,** Head of the Department of Natural Resource Management and Development, for his initiation of and kind support for this research project, as well as the Interchurch Organisation for Development Cooperation (ICCO) and Norwegian People's Aid (NPA) in Cambodia for their financial support of these research projects.

I am grateful to Ing Mala, Pheung Sophea and Kim Dararith for their steadfast commitment to and active participation in this research project. I hope and believe that some of the findings here will be useful for practitioners and decision-makers, plus will help support further research studies by other institutions and researchers at all levels. I, personally, will continue to support other participatory research activities and would be appreciative of all constructive comments in relation to this paper.

## Abstract

Coastal resources need to be maintained in order to support the livelihoods and well-being of local coastal resources-dependent communities, as well to provide a balanced set of ecosystem goods and services. However, development projects along the coastal areas of Cambodia have been implemented at an alarming rate in recent decades, including infrastructure projects such as ports, modern settlements, resorts and tourist destinations. In

addition to these development projects, coastal areas have been exposed to mining exploration and exploitation activities, and as a result, the coastal environment has not been able to avoid the negative consequences of these.

Among such development projects, those aimed at sand extraction and use have a particularly large impact on the natural environment and on the livelihoods of coastal fishing communities, such as those assessed and documented in this study. In order to analyze the consequences of such activities in the study area, an holistic DPSIR framework was applied to assess their activities based on five elements: 1) driving forces, 2) pressures, 3) states (environmental change), 4) impacts, and 5) responses.

Based on the results of this study, there are two main driving forces behind the changes taking place in the area, these being the sand dredging activities and infrastructure developments, both of which are placing pressure on the coastal environment and leading to environmental change, plus having a negative impact on coastal ecosystems and community livelihoods. As a result, coastal resources such as seagrass, mangroves and fish are under increasing pressure, damaging community livelihoods, causing changes to the local natural and social environment, leading to decreasing fish yields and reductions in income levels, and also causing labor, migration, health and sanitation problems, as well as instigating local conflicts. The responses of the key stakeholders, such as the communities, local authorities, NGOs and private companies, to the above issues, have been limited and unacceptable thus far from the local communities' perspectives.

In order to solve these problems, we propose the following: 1) develop a mediation mechanism in the area, in order to reach formal agreements on local problems, 2) conduct a full Environmental Impact Assessment (EIA), 3) strengthen participatory community-level action and good governance, and 4) expand the Integrated Coastal Management (ICM) approach to cover all coastal provinces in Cambodia.

**Key Words:** Sand mining, DPSIR Analysis, impact assessment, coastal resource impact assessment

## Introduction

Like other ecosystems such as tropical forests and wetlands, coastal areas are vital at helping to maintain a balance within both the natural and social environments through the provision of ecosystem goods and services. Coastal resources, such as coral reefs, seagrasses and mangroves are vital for local environments, biodiversity levels and communities, helping to improve livelihood options and protect communities from natural problems such as storms, erosion and salinity intrusion (Saker, 2010). Moreover, coastal ecosystems provide ecological niches and habitats, plus food sources, for marine species, those which play an important role within local people's livelihood activities. Due to the service value of such resources, users tend to migrate to such areas in order to invest in and access them, both directly and indirectly.

Among the coastal provinces of Cambodia, Kampot Province is considered to have the greatest potential in development terms. The Japan International Cooperation Agency

(JICA, 2010) has reported on the current state of private investment projects in Cambodia's coastal areas, saying that according to the Cambodia Development Council (CDC), 117 projects have so far been approved as Investment Projects or Qualified Investment Projects (QIPs) over the last fifteen years across the four coastal provinces of Preah Sihanouk, Koh Kong, Kampot and Kep. Kampot Special Economic Zone (SEZ) was created in order to develop an international port in the area, with the total development cost of the entire SEZ estimated to be 80 million US Dollars. Together with shipways and a deep sea water port, other activities are taking place in the area, such as sand dredging, the expansion of seashores and other infrastructure constructions. Johnsen and Munford (2012) mention that sand and other marine construction material resources, those used to help build other infrastructures and facilities, are causing many environmental problems for the local communities in Cambodia's coastal areas.

With the number of construction projects currently underway in the SEZ and international port, there is a high demand for construction materials, and especially silica sand, to help with general construction activities, the building of dykes and with seashore expansion activities. These infrastructure developments, plus the dredging of the deepwater port and shipways, have had a number of impacts on the coastal environment, these being coastal erosion, disturbance of coastal ecosystem services, reductions in sea water quality, plus the destruction of natural marine processes and coastal habitats, such as mangroves, seagrasses and coral reefs. Fish yields have also declined, having a direct impact on coastal resources-dependent dwellers (Seak, 2012; CES, 2008 and Seak Som, 2007). So far, there have been no studies carried out in order to assess the impact of sand mining activities on the coastal provinces of Cambodia, meaning there is an urgent need to develop a more in-depth understanding of the DPSIR aspects of such activities - in order to ensure appropriate planning, policy recommendations and environmental protection mechanisms are put in place to protect community livelihoods and ensure the sustainable development of coastal areas.

To this end, this study aims to identify and analyze five DPSIR elements in relation to sand extraction and use activities and their consequences on the Kampot coastal community, applying a DPSIR model adopted by the European Environmental Agency (EEA). According to the EEA, a DPSIR model consists of the following five elements:

- Drivers: The underlying forces that drive change in the environment, both material and societal, among coastal fishery communities
- Pressures: The channels through which these material and societal forces affect the environment
- States or statuses of change: The resulting states of the environment, including the socio-economic uses it is put-to
- Impacts: The resulting impacts of these pressures and states on biodiversity and human well-being, and
- Responses: The ways in which stakeholders respond to these changes and the results of such responses.

## Methods

This research project used both quantitative and qualitative methods to collect the primary data; for identification, measurement and analysis of the above DPSIR framework components.

The research activity was divided into two action phases and an analysis phase, as listed below:

(i) Field establishment: Established the field location, including stakeholder identification

(ii) Field data collection: Workshops, direct observation, informal focus group interviews and discussions, and questionnaire surveys were all carried out among the local fishing communities, with the local authorities and with other external stakeholders, and

(iii) Analysis: Detailed and systemic analysis of the five DPSIR framework elements.

### *Research Site*

The research was conducted entirely within Rolous and Kep Thmey villages, Boeng Tuk Commune in Tuek Chhu District, Kampot Province, largely at the construction sites of local development projects.

Boeng Tuk Commune is located about seven kilometres from Kampot provincial town on national road 3 (Phnom Penh to Preah Sihanouk provincial town). The commune is about 2,467 ha in area and is characterized by coastal plains, with the Bokor Mountains close by.

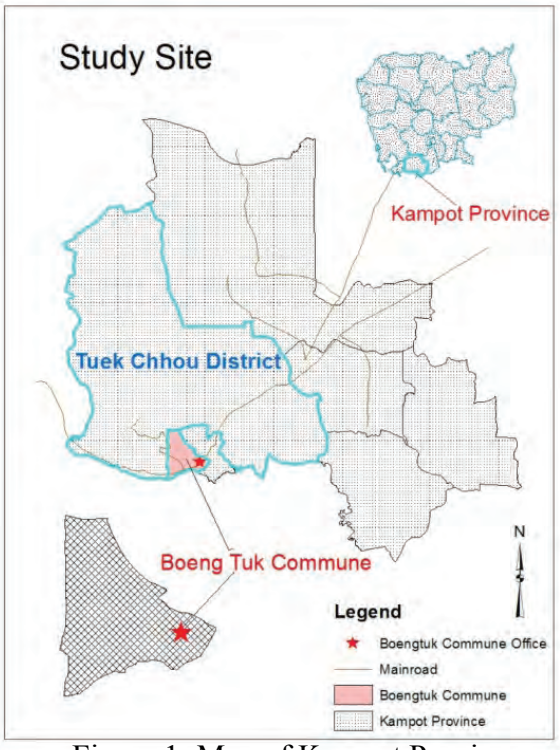


Figure 1: Map of Kampot Province and the Research Site

The field research area has a number of construction projects, plus hosts sand extraction activities. There are two coastal fishery communities in the study area: Rolous and Kep Thmey villages, both of which are totally dependent on coastal resources.

### *Research Approach*

We used the DPSIR framework to identify and analyze the aforementioned five key elements, as shown in Figure 2 below:

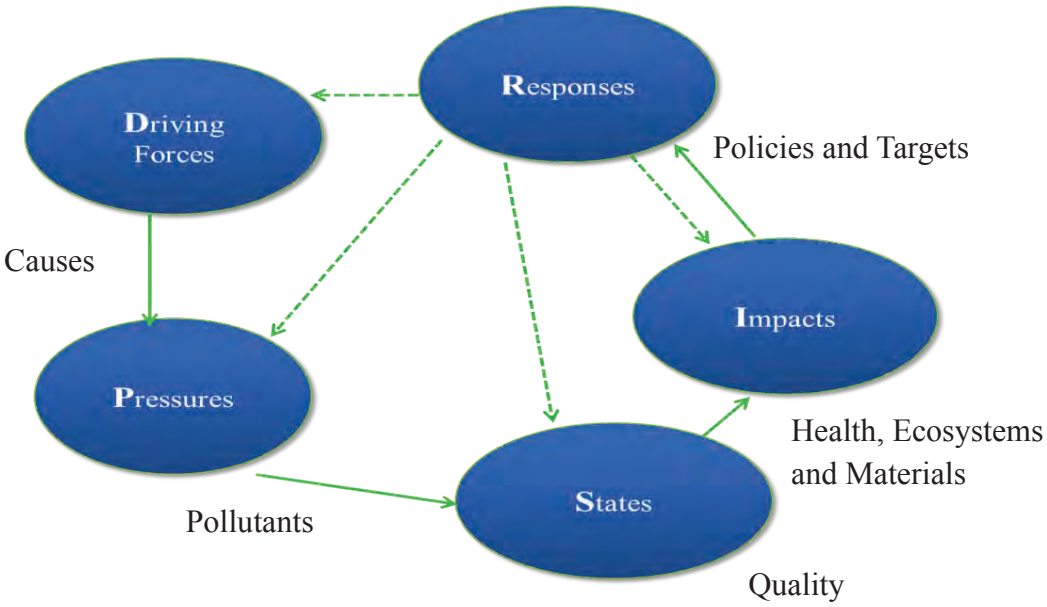


Figure 2: The DPSIR Assessment Framework
Source: Modified from Peter Kristensen, 2004

The DPSIR framework is a model recommended by the EEA for the development of Integrated Environmental Assessment strategies, and provides the indicators needed to enable the provision of feedback to policymakers on the environmental impacts of political choices made. This framework focuses on five key areas associated with change: driving forces, pressures, states, impacts and responses, and these five areas can all be linked (Kristensen 2004). Driving forces represent the main causes of the problems found, and this category tends to focus on those human activities that lead to the problems experienced. Due to human activities, driving forces place pressure on the environment, and this pressure changes its state. Finally, this environmental state affects environmental quality, the responses to which can be defined as the solutions introduced to the problems experienced.

Bidone and Lacerda (2003) used the DPSIR framework to evaluate the sustainability of coastal areas in Guanabara Bay, near Rio de Janeiro in Brazil. They found that urbanization and industrialization are the key drivers of pollution and wastewater diffusion there, and that these two problems have changed the water quality, leading to eutrophication and pollution, and disturbing local economic activities such as fishing and tourism. The policy response to the problems described in this case study has been the 'Guanabara Bay Recuperation Program' – a water pollution control plan that aims to reduce the inflow of wastewaters into Guanabara Bay.

Lin et al. (2007) also used the DPSIR model to analyse coastal wetland changes in a case study carried out in Xiamen, China, collecting data from the coastal wetlands in the area. They also analyzed the temporal changes that took place in the regional coastal wetland ecosystem's structure and functions between 1950 and 2005. Their study period was divided into four for a comparative analysis: pre-1980s, the 1980s, the 1990s and from 2000 to 2005.

The results show that anthropogenic drivers of coastal wetland degradation in this region increased steadily after the 1950s, and that these changes correlated with a decline in coastal wetland functions over the same period.

Another case study, 'An Integrated Approach to Watershed Management within the DPSIR Framework: Axios River Catchment and Thermaikos Gulf', mentions that industry, agriculture, livestock breeding and urbanization are the key activities placing pressure on the environment, in particular reducing freshwater and nutrient enrichment. These environmental pressures have also changed the condition of the ecosystem and the economy of the study area, as well as its aesthetics and the health and livelihoods of local people. Other significant impacts include the development of phytoplankton blooms, species toxicity, anoxic conditions in the water column, and the aesthetic degradation of the marine environment. Measurements taken to deal with these problems included improving the area's wastewater treatment activities, controlling the use of fertilizers, and the continuous monitoring of the Axios River and its catchment areas (Karageorgis et. al., 2004).

### *Field Data Collection Methods*

**Sampling approach**: A rule of thumb method was used to ascertain the number of households needed to create a suitable sample from the two coastal fishing villages of Rolous (344 households) and Kep Thmey (432 households), with 25% of the total of 776 households randomly selected - making a sample size of 194 households.

**Household survey interviews:** In total, 194 households living in Rolous and Kep Thmey villages were randomly selected for interview from all areas of both villages. During the interviews, questionnaires were used in order to collect quantitative data related to household status plus the five key criteria outlined above: driving forces, pressure, states, impacts and responses.

**Focus group discussions:** A total of twelve active fishermen were selected for the group discussion. A visualization technique was used here in order to develop a social map and a natural resources map, to ascertain the zoning areas used and to gather other qualitative information, such as the local communities' perceptions regarding their livelihoods, including any threats and vulnerabilities, the key stakeholders, plus the culture in existence and local conflict management mechanisms used. The results of this group discussion were cross-checked with the results of the household survey.

**Key informant interviews:** Key informants, such as the village chiefs, the commune chief, the heads of the community fishery, and representatives from government agencies and non-governmental organizations, were all interviewed in order to collect qualitative information regarding stakeholder perceptions of existing issues in the study area, including policies, regulations, current trends, responses to the problems and their effectiveness.

### *Data Analysis*

A final analysis was undertaken of the data collected from a number of sources, these being:

(i) Notes from the initial reconnaissance survey
(ii) Summaries of the secondary data
(iii) Notes from our consultations with stakeholder representatives
(iv) Outputs from the field data analysis workshop
(v) Quantitative data generated by the household survey
(vi) Diagrams and figures from the visualization exercise, and
(vii) Qualitative information from the interviews and participant observations.

Three computer programs were used in order to support the research tasks, these being:

(i) SPSS V.16 - to analyze the quantitative data collected during the household survey,
(ii) Microsoft Excel - to collate the data and create charts from the household survey, and
(iii) ArcGIS V.10 - to create a map of the study sites.

## Overview of Sand Extraction and Use Activities and their Impacts

Lovell (2005) found that sand extraction and use causes water turbidity, increases sedimentation and threatens coral reefs. Other research studies have also highlighted the impacts of dredging activities on coastal environments, including coastal erosion, the disturbance of coastal ecosystems, turbidity of sea water, and the destruction of natural marine processes and marine habitats, plus a negative impact on fishery resources - leading to problems for local communities whose livelihoods are based on fishing (Otay et. al. 2003; Pilkey et al., 2007). In order to mitigate the impacts of sand extraction and use on the natural environment and local communities, all development projects that involve such activities should have a comprehensive environmental impact assessment (EIA) conducted first.

### *Impacts on Cambodia's Marine Fisheries*

Marine fishing activities can be split into two: coastal and offshore fisheries. Coastal fishing activities involve mostly small family-scale fishing operations which operate along the coast and to a depth of twenty metres. The boats used for such operations either do not have an engine or use just a small engine. Offshore fisheries; meanwhile, consist of larger-scale fishing operations which fish at a depth ranging from twenty metres to the limit set by the Exclusion Economic Zone (EEZ), and they use boats with larger engines.

Most of the marine fishing activities that take place in the study area are conducted along the coast, because most of the fishermen's boats are not suitable for offshore fishing. Offshore fishing; however, is practiced in several fishing villages in Preah Sihanouk and one fishing village in Koh Kong.

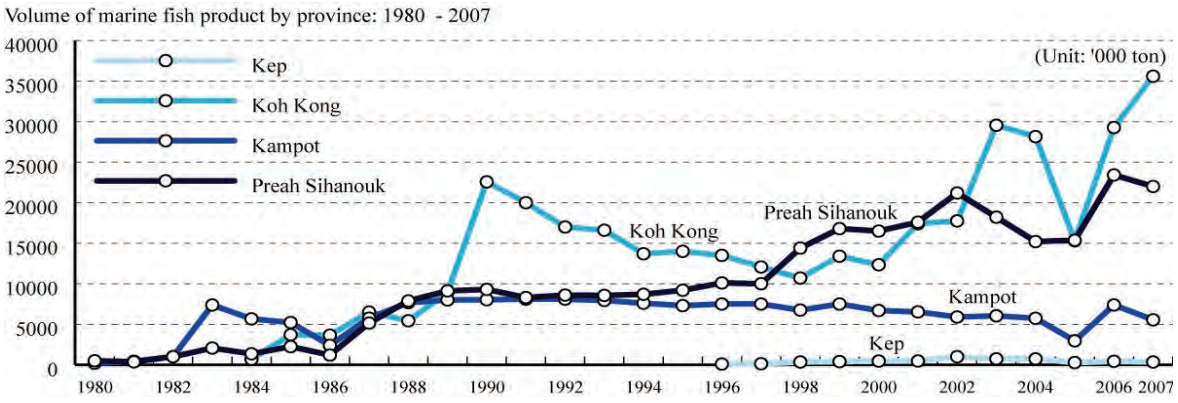


Figure 3: Volume of Marine Fish Products Caught by Province: 1980 – 2007
Source: JICA, 2010

As shown above in Figure 3, the size of the marine fisheries' fish catch along the Cambodian coast has increased significantly in most areas over the last 30 years. In 2007, the sea fish catch in Koh Kong was 35,600 tons (56.1% of the total fish catch from marine fisheries in the entire country), followed by Preah Sihanouk with 22,000 tons (34.6%), Kampot at 5,550 tons (8.7%) and Kep with 350 tons (0.6%) (JICA, 2010).

### *Impacts on Kampot Coastal Resources*

Cambodia's coastal areas include Koh Kong, Kampot, Preah Sihanouk and Kep provinces, and cover an area of about 17,237 km$^2$. The coastal zone contains diverse natural resources, and is an important coastal environment for the local economy; however, the current rapid development of the area has caused many problems in relation to resources depletion and environmental degradation (Bauld, 2005). Reuy (2012) mentions that the SEZ in Kampot includes the construction of an international port, which has involved the pumping-out of sand in some areas, plus the dredging and also filling-in of sand in others, causing many problems for the communities who live around the construction site. Moreover, the Fisheries Action Coalition Team (FACT, 2000) has reported that two private companies: Keo Chea and Vinh Hour - the developers, received government approval for the development of the SEZ and the international port, and started construction work by filling-in a large area with sand around Kep Thmey and Roluos villages. These two development projects have already had a serious impact on the coastal environment and local resources, both of which are important for the coastal fishing communities who live in the villages. In particular, the seagrass beds and mangrove forests have been severely damaged by these development activities (Seak, 2011). The Cambodia Environment Service (CES) (2008) and Sek Som (2007) have also reported that local communities have had to change their traditional fishing activities, with some becoming workers in other sectors due to the decreasing fish yields and the rice field salinity intrusion problem, and this has impacted on cultivation activities.

Furthermore, conflicts have also occurred between the communities and developers, with prolonged protests against the construction activities, and in particular the filling-in of the fishing grounds and the crab conservation area – referred to as the 'crab bank' (Seak, 2011). Based on an Initial Environmental Impact Assessment (IEIA) carried out by the CES (2008)

and Sek Som (2007), the SEZ development project managed by Keo Chea company and the international port developed by Kampot Port company, have directly affected the coastal environment, destroying mangrove forests and seagrass – the habitats for many marine species such as fish and molluscs (e.g. clams, blood cockles and mussels), plus changing sea water flows and temperatures, and the water quality. Moreover, the changes have caused mental and physical health problems among members of the communities living around the project site, with noise and air pollution leading to insomnia, eye irritation and sore throats (Sek Som, 2007).

### *Private Sector Investment Issues in Kampot Province*

JICA, 2010 reported that within the industrial sector in Kampot, three cement projects (two Cambodian companies and one Cambodian-Thai joint venture) were approved as Qualified Investment Projects (QIPs) and all of them were "active" by the end of 2008. The biggest investment project in Kampot is 'Preah Monivong Park Development (Bokor)', which was approved in July 2008 and now includes the Sokha Hotel. There are also two power supply projects in the SEZ worth 24.1 million US Dollars, and one port development project. According to recent newspaper reports, the port development project may cost eighteen million US Dollars - to deepen the port to a depth of nineteen meters.

One issue to highlight here is that the success of these planned projects is by no means guaranteed, as some do not have adequate and sound financial plans in place. Another key issue is that no meaningful industry has been established, except for the cement manufacturing plants. For the time being, whether the development of non-traditional or export-oriented industries will succeed or not will depend on how well and how rapidly Kampot SEZ can be developed (JICA, 2010).

Table 1: Active, Approved Projects in Kampot Province

*Thousand USD*

| | 1995-1999 | 2000-2002 | 2003-2005 | 2006-2008 | **Total** |
|---|---|---|---|---|---|
| Industry | 53,680 (1) | | 191,248 (2) | 138,652 (2) | 383,580 (5) |
| SEZ (Port) | | | 8,914 (1) | | 8,914 (1) |
| Infrastructure | | | | 24,208 (2) | 24,208 (2) |
| Tourism | | | | 1,000,000 (1) | 1,000,000 (1) |
| **Total** | 53,680 (1) | | 200,162 (3) | 1,162,860 (5) | 1,416,702 (9) |

*Note: The category 'industry' includes mainly cement plants. Numbers in brackets are the number of projects*
Source: JICA, 2010

## Results

### *Livelihood Activities and Occupations*

The results of the household survey show that there are two main occupations among those living in the two study communities: farming and fishing. In total, 24.5% of the residents who responded are farmers, 21.6% are fishermen, 18.4% are workers, 4.8% are civil servants and 14.5% sell goods. Approximately 16% are engaged in other livelihood activities.

Based on our field data analysis, the community mainly depends on coastal resources such as swimming crabs (39.1%) and shrimps (30.8%), and these are the most important resources for the local fishermen, while 19.9% said they like to catch sea fish species. In terms of less important activities, 0.4% said they go into the mangrove forests to find medicinal herbs and plants, as well as fire wood, and 2.3% said they use dead wood from the shrub forest on the mountain side near the villages. Finally, 0.8% said they also use seagrasses to make medicines.

The surveyed households reported several problems faced by the two fishing communities. A total of 87.6% said that a decrease in local fish yields is the most significant problem in the area, as a consequence of habitat loss within the seagrass and mangrove areas (61.8% of households surveyed) and due to pollution and other increasing problems such as species decline, obstacles to mariculture/fishing, land grabbing, deteriorating health and land conflicts.

### *DPSIR Element Analysis*

Driving Forces

The above environmental problems are a consequence of two key driving forces. A total of 64.6% of households reported that the sand extraction and use activities are a key factor behind the problems they face. The other driver identified is the infrastructure development taking place within Kampot port and the SEZ development projects, with 52.2% of the households surveyed mentioning this is a key factor behind the problems they face.

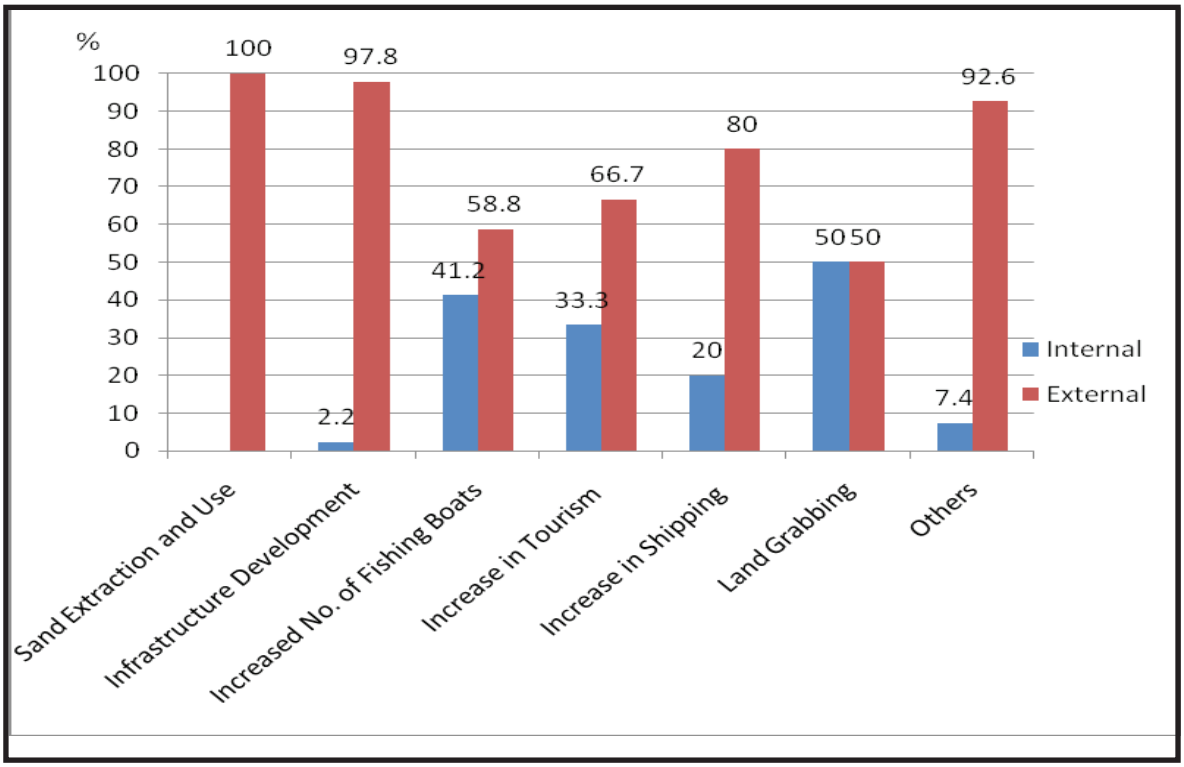


Figure 4: Internal and External Drivers of Environmental Problems (% of Respondents)
Source: Field survey, 2012

Pressures

The households survey and focus group discussions identified the above two key drivers behind the pressure being placed on local resources, coastal biodiversity levels and community livelihoods. The consequences of these pressures include a decrease in the size of the mangrove forests and a decrease in the number and size of other valuable marine ecosystems such as seagrasses and coral reefs, both of which have a direct impact on coastal biodiversity and local habitats as a whole.

Moreover, the communities' livelihoods, those which are dependent on these resources, have been directly and indirectly impacted by the environmental pollution, health and sanitation problems, leading to a fall in household incomes, to conflicts and outward migration (see Figure 6 - page 54, and Table 6 - page 56).

States

The results of the household survey showed that local resources face varying levels of degradation. In total, 67.1% of respondents reported that molluscs are decreasing in number, with 42.5% of these saying they are decreasing at a rapid rate and 39.7% at a very rapid rate, when compared with the other resources.

In addition, 71.9% of respondents claimed that the mangrove forests are in decline, with 39.1% of these saying they are declining at a very rapid rate. For swimming crabs, 57.1% of respondents said they are decreasing at a rapid rate, while for crabs, stomatopods and prawns, 61.2% said they have noticed a decline in numbers, with 51.4% of these saying the decline has been rapid.

Furthermore, 79.8% said that seagrasses are in decline, and 35.9% of these respondents feel the decline has been rapid, while 42.7% noted that the coral reefs are shrinking, with 25% of these respondents saying the rate of decline has been quick. Moving on to seaweed (algae), 78.8% of interviewees said this is decreasing, with 45% of these saying it is declining at a rapid rate and 36% at a very rapid rate.

With respect to seabird species, 51.1% of households surveyed said they are decreasing in number, with 42.9% of these respondents saying they are disappearing at a rapid rate, and 28.6% at a very rapid rate. Finally, for sea fish, 74.2% of the respondents noted that these are in decline, and of these, 49% said the decline is rapid (see Table 2, page 52).

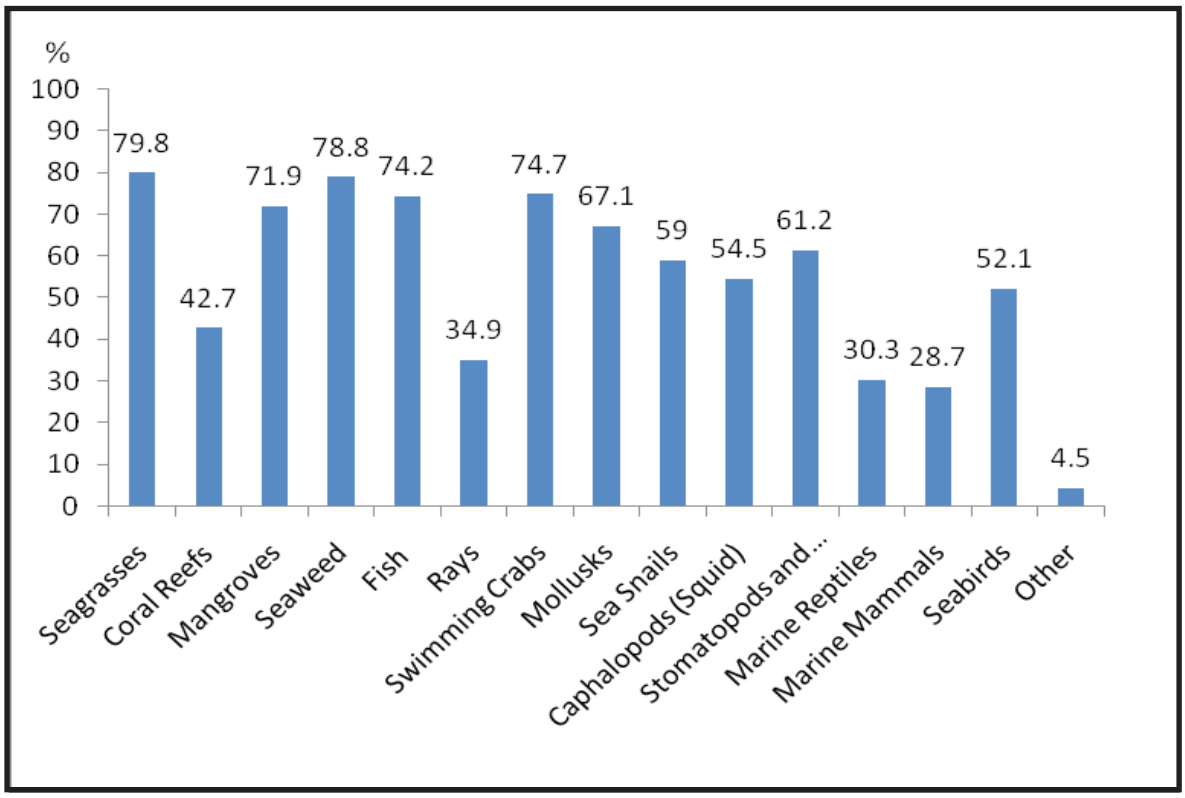


Figure 5: Percentage of Respondents Noticing a Decrease in Marine Species
Source: Field survey, 2012

Table 2: Rate of Decrease of Marine Species in the Study Area – Respondent Views

| Marine Species | Percentage Decrease (%) | | | | |
|---|---|---|---|---|---|
| | Very Small | Small | Medium | Large | Very Large |
| Seagrasses | 7.1 | 9 | 17 | **35.9** | 31 |
| Coral Reefs | 14 | 15 | 23 | **25** | 23 |
| Mangroves | 7 | 7 | 12.4 | 34.5 | **39.1** |
| Seaweed (algae) | 2 | 1 | 18 | **45** | 36 |
| Marine Fish | 2 | 2 | 28 | **49** | 19 |
| Rays | 22 | 4 | 10 | **34** | 30 |
| Marine Crabs | 2 | 2 | 17.4 | **57.1** | 21.5 |
| Molluscs | 1 | 3.3 | 13.5 | **42.5** | 39.7 |
| Sea Snails | 0 | 4 | 13 | **48** | 35 |
| Cephalopods (squid) | 2 | 1 | 24 | **50,5** | 22,5 |
| Stomatopods and Prawns | 3.2 | 1 | 24.4 | **51.4** | 20 |
| Marine Reptiles | 18 | 8 | **29.5** | **29.5** | 15 |
| Marine Mammals | 22 | 9 | **27.5** | **27.5** | 14 |
| Seabirds | 5,5 | 3 | 20 | **42.9** | 28,6 |

Source: Field survey, 2012

Besides the decreasing biodiversity levels, there have also been significant changes to other ecosystem elements; for example, 41.6% of the study households said there has been a change in the wind strength – it has increased in recent years, and while 20.2% noted that there has been salinity intrusion, 41.7% said there has been a high level of salinity intrusion. Added to this, 52.6% said that a moderate amount of shore erosion has occurred, 41.2% that water turbidity has increased, 47.1% that noise pollution is at a medium level, and on air pollution, 53.1% said that this is a moderate problem and 43.8% a significant problem.

Table 3: Rate of Change in Ecosystem Elements – Respondent Views

| Changing Ecosystem Elements | Rate of Change/% Respondents | | |
|---|---|---|---|
| | Small | Medium | Large |
| Erosion | 36.8 | **52.6** | 10.5 |
| Water Turbidity | 35.3 | 23.5 | **41.2** |
| Wind Strength | 57.3 | 32 | 10.7 |
| Noise Pollution | 38.2 | **47.1** | 14.7 |
| Air Pollution | 31 | **53.1** | 43.8 |
| Salinity Intrusion | 27.8 | 30.6 | **41.7** |

Source: Field survey, 2012

As well as these environmental problems, social problems have also started to occur, and 30.9% of households said the most common occupations in the communities have changed. For instance, 90.4% of total households stated that they are fishers by trade, but 56% of these said they have had to change their occupation, becoming construction and factory workers. However, 38.8% of households said that being a fisherman has a high level of stability - more than when a worker, and 49% of the surveyed villagers admitted that being a waged worker has a low level of stability.

Impacts

In terms of changes to the environment, the surveyed households rated pollution as having from a very low to a very high level of impact. For instance, 36.4% of households claimed that there is water pollution - 37.1% stated that this is a moderate problem, while 22.5% said that air and noise pollution are a cause for concern (with 38.5% and 28.6% of these saying air and noise pollution are of moderate concern). Besides the water, air and noise pollution, 18.5% of households said that land pollution is a concern, with 35.7% saying it is having a big impact.

Table 4: Types and Levels of Impact – Respondent Views

| Types of Pollution | % | Impact Level | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Medium | High | Very High |
| Air pollution | **22.5** | 10.3 | 7.7 | **38.5** | 35.9 | 7.7 |
| Water pollution | **36.4** | 14.5 | 9.7 | **37.1** | 21 | 17.7 |
| Land pollution | **18.5** | 10.7 | 17.9 | 25 | **35.7** | 10.7 |
| Noise pollution | **22.5** | 22.9 | 20 | **28.6** | 11.4 | 17.1 |

Source: Field survey, 2012

Of the households surveyed, 27.5% said that the habitats of the swimming crabs have altered in recent years, and of these 64.2% stated that the impacts have been high. In addition to swimming crabs, 22.8% said that some of the sea fish are facing habitat loss, and of these 66.7% said this the rate of loss is increasing. In total, 15% stated that shrimp (stomatopods) and prawn populations also have this problem, with 65.5% of these saying the problem is significant. A total of 12.2% also claimed that seabirds are facing habitat loss as a result of the mangrove forests being altered, and 46.8% of these respondents said the impact of this problem is high and that habitat degradation is increasing. Finally, 100% of respondents noted that the loss of marine mammals is a serious problem, with sea cucumbers and *Lingula anatine* (Kachive) entirely lost to the local area (see Figure 6, page 54).

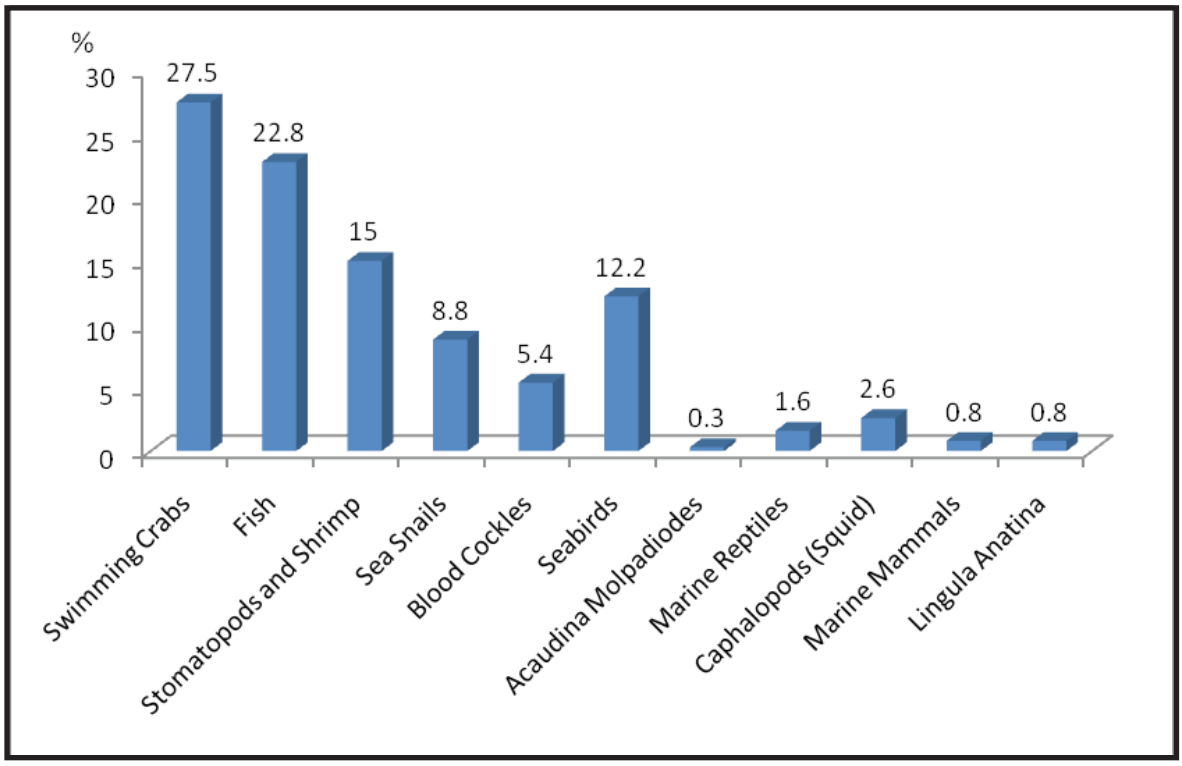


Figure 6: Habitat Loss by Type of Species – Percentage of Respondents
Source: Field survey, 2012

Table 5: Habitat Loss Levels – Percentage of Respondents

| Species | Levels of Loss (%) | | | |
|---|---|---|---|---|
| | Low | Medium | High | Entirely |
| Swimming crabs | 3.8 | 22.6 | **64.2** | 9.4 |
| Sea fish | 8 | 14.9 | **66.7** | 10.3 |
| Shrimps and prawns | 1.7 | 20.7 | **65.5** | 12.1 |
| Sea snails | | 17.6 | **76.5** | 5.9 |
| Blood cockles | | 4.8 | **57.1** | 38.1 |
| Seabirds | 6.4 | 23.4 | **46.8** | 23.4 |
| Sea cucumbers | | | | **100** |
| Marine reptiles | | | 50 | 50 |
| Cephalopods (Squid) | | 30 | **60** | 10 |
| Marine mammals | | | **100** | |
| *Lingula anatine* | | | | **100** |

Source: Field survey, 2012

As well as the impacts on biodiversity levels, significant impacts were also reported regarding the local communities' livelihoods, with 54.5% of the households surveyed accepting that the economically valuable resources in their communities have decreased in abundance, as has their daily income generating capacity. In total, 57.9% claimed that incomes have decreased along with fishing yields when compared to the past.

In addition, about 45.5% claimed that they now face difficulties having lost their traditional occupation as fishers, 29.2% said they are in debt and 39.9% stated that a number of fishermen have had to move to other provinces or abroad in order to find new jobs, while about 32% said that the communities' traditional occupations have changed. Another significant impact felt by the local communities has been the rise in the number of conflicts, for 39.3% said that conflicts now occur within the communities due to the SEZ projects and the sand extraction activities.

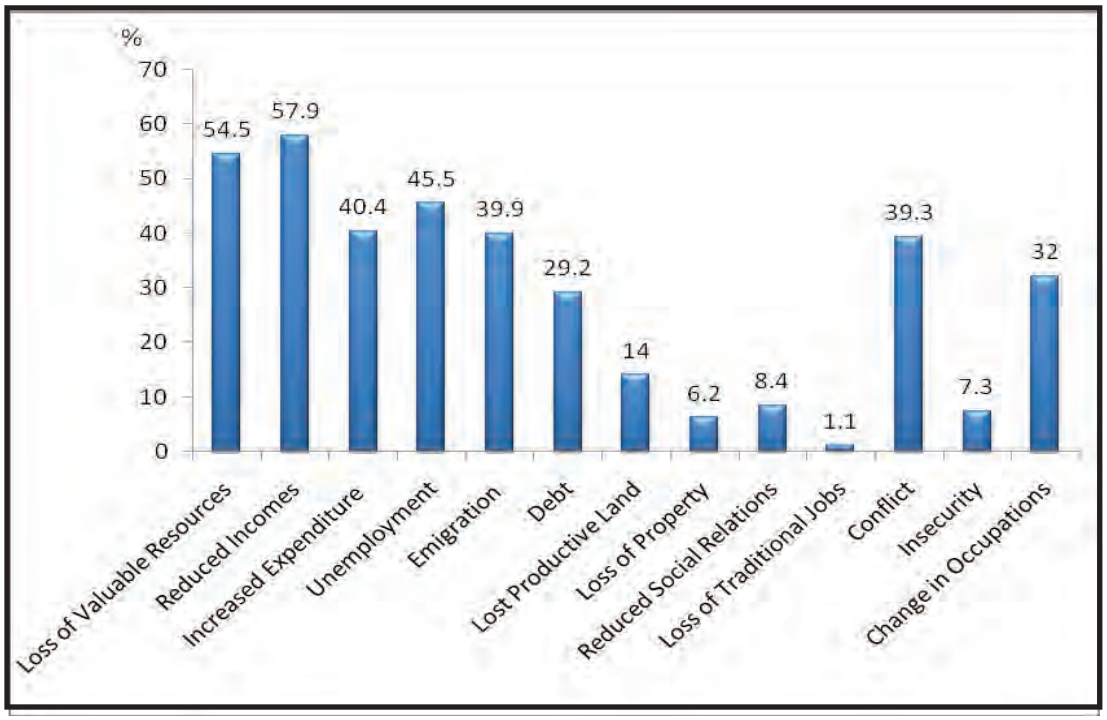


Figure 7: Impacts on Community Livelihoods – Percentage of Respondents
Source: Field survey, 2012

Moreover, health and sanitation issues have also started to cause problems within the study communities. Of the respondents, 47.2% stated that they now suffer from fevers or headaches due to the noise pollution coming from the construction activities, 11.8% said that they suffer from irritated eyes due to the air pollution, and 18.7% said they suffer from high blood pressure and become stressed easily. Added to this, 5.1% said they suffer from skin problems caused by the poor water quality and/or pollutants, while 3.9% stated they suffer from mental problems due to the environmental pollution, and, in particular, suffer from bad nerves as a consequence of their unstable livelihoods and the unresolved conflicts that take place (57.1% saying this has a big impact on their lives - see Table 6, page 56).

Table 6: Health and Sanitation Problems and their Level of Impact According to the Respondents

| Health Problem | Percentage | Impact | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| No proper toilet | **48.3** | **65.1** | 26.7 | 8.1 |
| Dirty water | **10.1** | 33.3 | **38.9** | 27.8 |
| Malnutrition | **28.1** | **42** | 34 | 24 |
| Mental problems | **3.9** | 42.9 | | **57.1** |
| High blood pressure | **19.7** | **57.1** | 20 | 22.9 |
| Headaches and dizziness | **47.2** | **78.6** | 11.9 | 9.5 |
| Throat inflammation | **6.7** | **75** | 16.7 | 8.3 |
| Irritated eyes | **11.8** | **71.4** | 14.3 | 14.3 |
| Gastritis | **28.1** | **66** | 20 | 14 |
| Skin problems | **5.1** | **44.4** | **44.4** | 11.1 |
| Malaria | **16.3** | **51.7** | 27.6 | 20.7 |
| Dengue fever | **21.9** | 41 | **35.9** | **23.1** |

Source: Field survey, 2012

In terms of social-cultural issues within the study communities, conflicts have become a problem in recent times, and 79.8% of the households surveyed said that conflicts regularly take place between villagers and the developers (private investment companies), and 69% of these said it is having a significant impact on their lives. Also, 18% said that conflicts are also occurring between local dwellers and the local authorities, with 37.5% of these respondents saying this is having a medium-level impact.

However, 5.1% mentioned that conflicts also take place between the local authorities and the developers, as well as among villagers, though 44.4% and 55.6% of these respondents, respectively, said that this has a low impact (see table 7, page 57)

Table 7: Social and Cultural Impacts and their Severity

| Social and Cultural Impacts | % | Severity of Impact (%) | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Breakdown in solidarity | **15.2** | 40.7 | **44.4** | 14.8 |
| Insecurity | **11.8** | **50** | 31.8 | 18 |
| Conflicts between the authorities and developers | **5.1** | **44.4** | 11.1 | **44.4** |
| Conflicts between the authorities and villagers | **18** | 28.1 | **37.5** | 34.4 |
| Conflicts between villagers and the developers | **79.8** | 15.5 | 15.5 | **69** |
| Conflicts among villagers | **5.1** | **55.6** | 22.2 | 22.2 |
| Lost place of worship | **3.4** | | 28.6 | **71.4** |
| Loss of fishing culture | **4.5** | 25 | 25 | **50** |

Source: Field survey, 2012

Responses

Based on our analysis of the households' responses, 53.4% said that the local fishing communities have decided to face-up to their problems, with 12. 4% saying the communities have been proactive in replanting mangroves, though 47.8% of these said this has not been so effective. Another 24.7% stated that the communities have responded by helping to clean the environment themselves, with 61.4% of these respondents saying this response has been reasonably effective.

In terms of health care services, 54.5% of the households surveyed said the response of the public health centre has been good, with 71.1% of these saying it has been very good. Pharmacies also provide private health care services such as the selling of medical supplies and cures, and 25.3% of the households noted these services, with 93.2% of these saying they provide an average level of service. Moreover, 59% of households stated that the communities' advocacy rights are supported by local NGOs, though 87.7% of these respondents said they are not very effective.

In relation to conflicts in the study area, 20.8% of the households we asked noted that there are conflicts between the villagers and the local authorities, but 64.9% of these said it is a

small problem. In total, 12.4% of households said they had noticed outward migration as a response to the local problems, though 63.6% of these said it has not been a big movement.

Table 8: Responses to Recent Issues and their Effectiveness

| Responses | % | Effectiveness Levels | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Mangrove replanting | **12.4** | **47.8** | 39.1 | 13 |
| Substitution of resources | 3.4 | 33.3 | 66.7 | |
| Loans | **11.2** | 70 | 20 | 10 |
| New occupations | **18** | 53.1 | 43.8 | 3.1 |
| Community financing | **18.5** | **54.5** | 27.3 | 18.2 |
| Clean water program | 6.2 | 27.3 | 36.4 | 36.4 |
| New latrines | 7.3 | 7.7 | 46.2 | 46.2 |
| Cleaning the local environment | **24.7** | 18.2 | **61.4** | 20.5 |
| Prevention of environmental pollution | 1.7 | | 100 | |
| Self-medical treatment | 9.6 | 23.5 | 64.7 | 11.8 |
| Health services | **54.5** | 1 | 27.8 | **71.1** |
| Traditional cures | **15.7** | 46.4 | 42.9 | 10.7 |
| Visit the pharmacy | **25.3** | 2.2 | **93.2** | 4.4 |
| Praying | **11.2** | 20 | 55 | 25 |
| Advocacy | **59** | **87.7** | 9.4 | 2.8 |
| Mediation | **20.8** | **64.9** | 27 | 8.1 |
| Legal solutions | **23** | **81** | 14.3 | 4.8 |
| Migration | **12.4** | **63.6** | 27.3 | 9.1 |

Source: Field survey, 2012

On the issue of conflict, although only 1.7% of households said they have noticed conflicts occurring between the local authorities and the developers, 7.9% said that conflicts occur between them and the local authorities. However, a much larger 40.4% said they have noticed conflicts taking place between the villagers and the developers, though only 0.6% said they have also noticed conflicts taking place among villagers, mostly related to land-grabbing.

Table 9: Conflict Types and the Effectiveness of Mediation Efforts

| Conflicting Parties | Roots of Conflict | (%) | Effectiveness of Mediation | | |
|---|---|---|---|---|---|
| | | | Low | Medium | High |
| Authorities and Developers | Overlapping territory | 1.7 | **100** | | |
| Villagers and Authorities | Protests and responses | 7.9 | **76.9** | 23.1 | |
| Villagers and Developers | Development activities | **40.4** | **90.3** | 6.9 | 2.8 |
| Among Villagers | Land-grabbing | 0.6 | | 100 | |

Source: Field survey, 2012

## Discussion

### *Livelihood Activities and Occupations*

The results of our field work analysis have identified those resources of value to the study communities, and these include swimming crabs, shrimps, prawns, sea fish, squid, seagrasses, algae, the mangrove forests and others marine resources, all of which they depend on for their daily livelihoods.

In relation to the value of coastal resources for communities' livelihoods, Sek Som (2007) mentions how essential seawater is for local dwellers, and 100% of our respondents said that the quality of the sea water is critical for sustaining their livelihoods, particularly in relation to fish productivity and yields. Moreover, seawater is used to cultivate algae and salt, activities which contribute to the government's aim of poverty reduction. As well as its direct use value, the quality of the water also has a significant influence on coastal resources, such as mangrove forests, seagrasses and coral reefs, all of which are important ecological habitats.

Similarly, CES (2008) report that in the past people living in Kep Thmey village were fishermen, and that now fewer people fish; many have alternative occupations as construction and garment workers in the city. The number of rice fields has also reduced due to the external demand for residential land along the national road and outward migration. Moreover, the saltpans have tended to change in recent years. However, fishing activities have continued thus far, and in particular crab fishing is still the most common activity among the local communities.

### *DPSIR Elements*

Driving Forces

In addition to the two main driving forces (sand extraction and infrastructure development) mentioned in Figure 4, page 50 a number of other driving forces have led to environmental problems within the local fishing communities, such as the increased number of fishing boats, an increase in tourism activities, increasing boat traffic and land grabbing, mainly as a result of external demands.

Related to the above mentioned main drivers, Johnsen and Munford (2012) have noted that human development activities are one of the key driving forces behind the negative environmental trends in Cambodia's coastal zone, and in particular sand dredging around the Koh Kong and Kampot coastal areas. In addition to these factors, increasing and unrestricted transportation and tourism infrastructure development has been a key driver of environmental degradation. The dredging of sand without the use of adequate safeguards also risks damaging local livelihoods, and in the study area, communities have reported reduced fish stocks and much smaller swimming crab harvests in recent years. They have also reported the incidence of oil spills from the dredging vessels, leading to water pollution in the area.

Pressures

Based on our field data analysis, there are several activities putting pressure on coastal resources and local communities' livelihoods, such as the changing natural and social environment status.

As highlighted in an initial environmental impact assessment carried out by the CES (2008), coastal resources and community livelihoods are under significant pressure in the study area. Biodiversity levels have been reduced by construction activities such as drainage and the reclamation of mangrove wetlands in order to expand the harbor, as well as land fill activities and dust/noise pollution. These activities have also had an impact on local livelihoods, degrading marine fishing resources (see Table 2, page 52), creating obstacles for saltpan irrigation, fragmenting the fishing zones, damaging crab nurseries, as well as creating dust and noise pollution.

Significant social issues have also impacted upon the livelihoods of the local communities, with a breakdown in the traditional social networks occurring, as well as increased livelihood risks, health and sanitation issues, outward migration, conflicts, and mental problems.

States

About 41.2% of the interviewed households said there has been a change in the quality of the sea water due to sand pumping and land/sand filling activities. Sek Som (2007) reported on sea water quality in the study area, noting that during construction work, turbidity increases and debris from the construction sites and drainage pipes pollutes the area. Transportation activities also tend to pollute the water with waste and oil.

Based on information from the focus group discussions held in Rolous village, some of the most valuable marine resources are in jeopardy, such as seaweed (algae), marine dolphins, rays, sea snails (*Nonle volute*), blood cockles (*Arca granosa*), sea cucumbers (*Holothuroidea*), sharks, whales, sea turtles and blue-barred parrot fish, the latter of which has declined most rapidly. Moreover, since 2002, mangroves, seagrasses, shrimp, squid and the Leopard Cat (*Prionailurus bengalensis*) have been placed on the Least Concern (LC) list as developed by the International Union for the Conservation of Nature (IUCN), the latter animal widely distributed but threatened with habitat loss and by hunting activities within its range, in addition to these species, cranes, moorhens, the Lesser Whistling Duck (*Dendrocygna javanica*), sea snakes and the crab (*Galene bispinosa)* are also declining in numbers at a rapid rate.

A report on the communities' perceptions by Seak (2011) found that the development projects in Boeng Touk Commune have had a negative impact on both livelihoods and the environment, and some 50% of the villagers have had to change their jobs from fishing to casual labouring. However, the vice-chief of Boeng Touk Commune stated that there has been little impact on people's livelihoods, a view which contrasts with local people's perceptions. He said that the companies' operations have contributed significantly to the area, such as their road building activities, plus micro-credit has also been made available to people.

Impacts

Table 4. page 54 shows that 36.4% of the respondents recognize that sea water pollution is a significant problem in the area, with another 22.5% acknowledging the presence of air and noise pollution - rating it as having a moderate impact.

According to the findings of Johnsen and Munford (2012), there are strong indications of widespread seagrass habitat destruction, due to the degradation of water quality as a result of increased turbidity caused by forest clearing, sand dredging and reclamation activities, as well as the use of destructive fishing practices (trawling and push nets). Coral reefs are also under threat from overfishing, the harvesting of corals (for trade), a reduction in water quality and the use of destructive fishing practices (such as dynamite or "blast fishing").

During the focus group discussion in Rolous village, the villagers said that dust from the construction activities has caused significant air pollution problems in the village, and that this is having a big impact on the environmental quality and community members' health. They stated that water and noise pollution problems are also significant. One of the impacts of these significant natural, social and environmental changes has been the adaptations that local fishery communities have had to undertake due to the impacts on coastal resources, such as degradation of the seagrasses, mangrove forests and coral reef ecosystems, all of which have tended to indirectly impact upon valuable marine habitats.

Johnsen and Munford (2012) state that mangrove forest clearing is being carried out illegally – to obtain firewood, charcoal and salt, plus to reclaim land for development and carry out intensive shrimp aquaculture. Mangroves are reported to have been further damaged and degraded by offshore sand dredging activities. The combined effects of these activities are of significant concern, since mangrove ecosystems are highly productive and play an important role in the life cycle of many marine species.

Due to habitat degradation and the decreasing fish yields, 40.4% of the study households said that they have had to change their fishing practices, having to go further offshore into deeper waters to catch fish, and spending more on gasoline as a result.

Beside the natural, environmental impacts, local communities are also facing a number of social problems. The household survey and focus group discussions revealed that each study village has its own social network, plus groups such as savings groups, fishery community groups, crab banks, mangrove forest groups and funeral support associations. Unfortunately, some of those groups have recently been dissolved, and in fact, the fishery community group in Rolous village had to be dissolved because around 800 ha of community land around the village was grabbed by one of the development projects.

Seak (2011) states that because of the tourist resort and port development projects, Roluos community fishery disappeared in 2010, as the village's fishing ground was granted to the port developers. Totoeng Thngay and Kep Thmey communities' fishing activities also suffered because a small part of their fishing grounds was given to the two companies involved. As a result of these developments, conflicts occurred between the fishers and developers, and among the fishers. The villagers tried their best to protect their fishing

grounds against the developers - organizing protests, but their protests were ultimately in vain.

Responses

As shown in a report on stakeholder percaptions by Sek Som (2007), at the beginning of the development project in Kompot port, the developers consulted with the local provincial departments, the local authorities and the villagers. However, the Director of Kampot Department of the Environment claims that little information was received from the developer, but that no response was necessary as it was believed the plans would enhance local economic opportunities and improve local livelihoods. Some questions were raised by villagers, such as whether seagrasses and coral reefs would be adversely impacted by increased boat traffic and so have a direct impact on small-scale fishing activities; the answer given being that local dwellers would have the opportunity to become employees in the harbour.

The Director of Kampot's Department of Public Works and Transportation suggested introducing project zoning, and the Deputy Director of Kampot's Department of Agriculture, Forestry and Fisheries also expressed concern over the likely impacts of the projects, such as mangrove forest and seagrass damage, with the resulting direct impacts on local small-scale fishing operations; however, the local authorities said they welcomed the development projects and looked forward to the job opportunities they would bring for local people.

The Governor of Kampot District and the commune chief are both concerned about the provision of environmental protection within the development zone, with the commune chief of Koh Toch particularly concerned that the offshore dyke which would act as an obstacle to fishing boats. In the case of Kilo 12 village in Koh Toch Commune, close to the research site, villagers participated in a consultation during which 93.15% accepted the development project, anticipating better job opportunities. However, most of them received little or no information about the project in advance, and only later came to understand the full impacts of the construction activities – obstructing their fishing activities and inundating their rice fields.

The driving forces behind these development activities have tended to cause many problems for the coastal ecosystem and the local fishing communities, and increased conflict is one serious and sensitive problem now faced by the communities on different levels and across different groups (see Table 9, page 58 for details).

Due to these conflicts, a number of local people have responded by finding alternative job opportunities and/or migrating outside, while those remaining have continued to advocate for compensation to be paid for the loss of jobs and earnings due to the development projects. Of those interviewed, 33.1% said that they want to receive adequate compensation for their losses, and another 13.5% say they should be given job opportunities within the development projects.

On the other hand, some of the local fishers have had little choice but to try out alternative, illegal fishing activities to maintain a livelihood, using illegal gear to catch a greater number

and variety of fish, as mentioned by Ms. Kem Da, the former head of Rolous fishing community.

During the focus group discussions, villagers mentioned that mediation had been provided by external stakeholders, but that it had not been effective, and added to this, Rolous fishing community undertook a campaign led by a female activist, in order to avoid violence, but still was not able to obtain a positive response from the negotiating parties.

In addition to the community responses, several local NGOs and the local authorities have also tried to resolve these problems, including Cambodia Human Rights and Development Association (ADHOC), the Partnership for Development Organization and the Thieng Tnaut Association, all of which have organized activities such as advocacy rights promotion campaigns and demonstrations, as well as provided legal support and supported projects on health and sanitation, road construction, cultivation and ecological restoration activities (including mangrove forest re-planting and an environmental clean-up campaign).

Other supporting organizations have included the provincial authorities, the commune council and the Cambodia Red Cross, who have all participated in local NGO projects. The local authorities, in particular, have played an important role in helping to mediate between the developers and the local villagers. However, thus far only verbal agreements have been made, such as the developers promising to provide job opportunities for people in the local communities, introducing electricity to the villages, developing a small fishing port, building toilets and compensating the villagers with 500 US Dollars each in cash. However, these verbal undertakings have still not been carried out, plus the companies have still not conducted a full Environmental Impact Assessment (EIA) - as recommended in the Initial EIA reports in 2007 and 2008, nor introduced an Environmental Management Plan - as required by the Fisheries Administration.

In terms of future livelihood strategies, Seak (2011) reported on a number of alternative strategies that the villagers have identified and decided to use for those livelihoods impacted by the development projects. Some of the residents continue to rely on subsistence activities for their survival; 39.3% are now employees (the most common approach), while 38.5% said they change their occupations from time to time.

## Conclusion

Current and rapid coastal urbanization in Cambodia, and in particular in the study area in Kampot Province, has led to significant issues arising in relation to sand extraction and use activities, including sand dredging. In particular, the development projects at the study site have impacted adversely on the coastal ecosystem and the coastal resources-dependent fishing communities. As mentioned in this study, sand extraction and infrastructure construction activities around the SEZ and at Kampot port have led to significant pressure being brought to bear on coastal resources and communities' livelihoods, leading to changes in the environmental status of the area and having negative impacts on the local communities.

The consequences of these project activities have led to unresolved issues within and around the study communities, such as a degraded natural habitat, the presence of environmental

pollutants, adversely impacted community livelihoods, outward migration, conflicts and mental stress. However, in order to resolve these problems, the communities have responded in a number of different ways - drawing in a number of different stakeholders, but with limited success thus far.

## Recommendations

Based on our discussion of the research findings, there are a number of key ways in which the issues present at the study site may be addressed, as follows:

- A mediation mechanism and/or formal negotiation framework should be established in order for formal agreements to be reached between the developers, the local authorities and local communities
- A full Environmental Impact Assessment should be conducted
- In order to strengthen community participation and good governance, the proposed Environmental Management Planning process should be adopted, and
- The use of an Integrated Coastal Management (ICM) approach should be considered.

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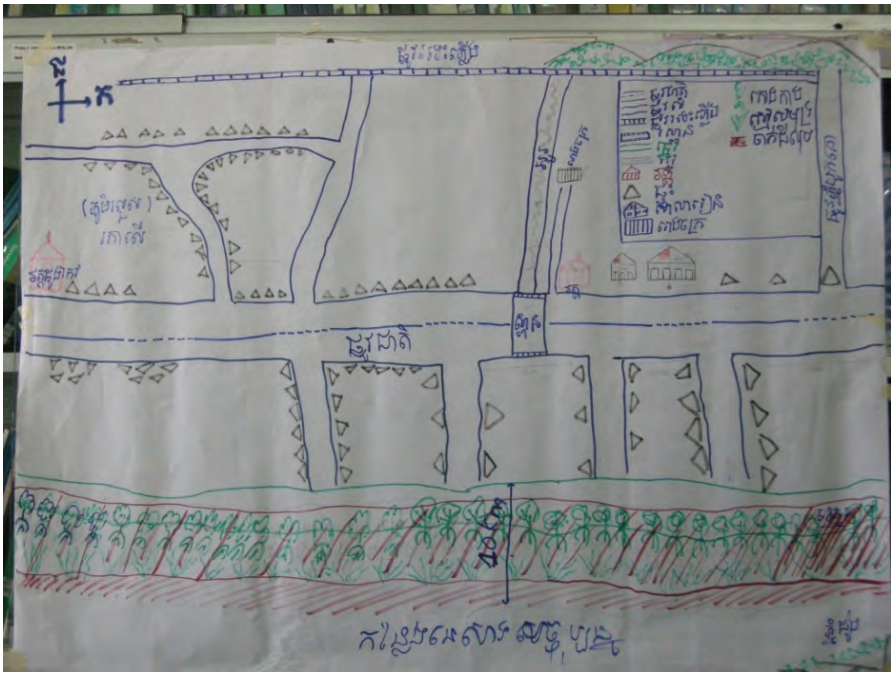
**Appendix 1: Research Team Activities**

Key Informant Interview Held
at the Commune Council

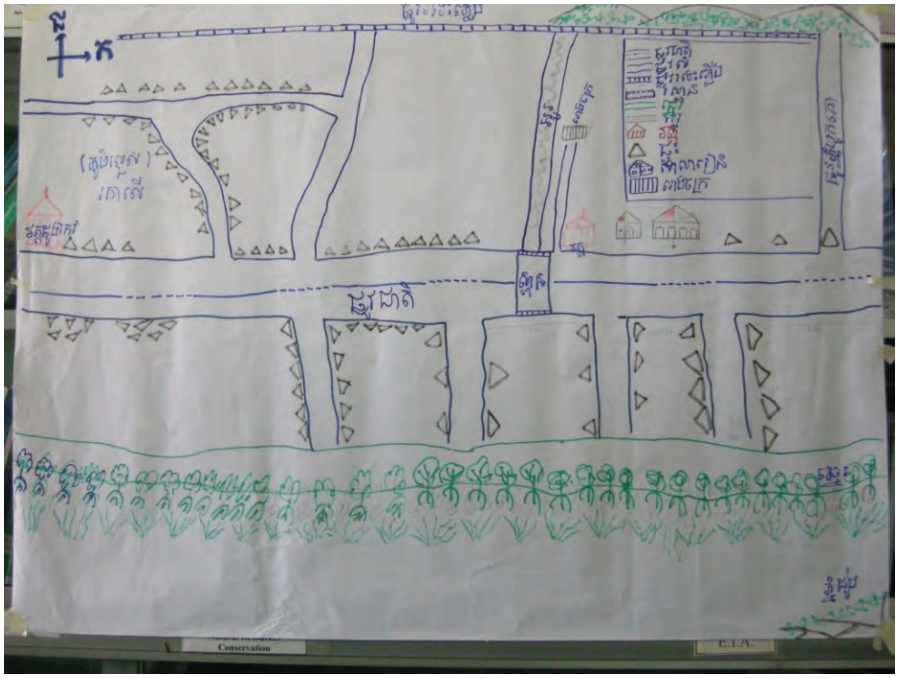
Focus Group Discussion
in Rolous Villages

Focus Group Discussion and Mapping
Exercise in Kep Thmey Village

**Appendix 2: Social Mapping in Rolous Village**



Landscape before the SEZ in Rolous Village



Current Landscape in Rolous Village

# Analysis of Information Flows from Yali Hydropower Dam Operations and Implications for Local People's Livelihoods along the Sesan River in Cambodia

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I would also like to acknowledge all our colleagues at the Department of Natural Resource Management and Development and some of the students there, for their contribution and help during the fieldwork. Special thanks must also go to Dr. Seak Sophat for his coordination of the research program, for providing comments and editing the manuscript. We would also like to express our gratitude to Mr. Lor Rasmey, Ms. Theng Keoviotey, and Tep Vichet for their patient assistance during the intensive field research work in the remote villages of Ratanakiri Province.

## Abstract

Large-scale hydropower developments are well known for causing serious environmental and social impacts across the globe. The situation becomes even more complex when a hydroelectric project is located in one country, but most of its impacts are felt in another. The construction of the 720 MW Yali Falls dam began on the Sesan River in Gia Lai Province, Vietnam, in November 1993, approximately 70 kilometres upstream from the international border with Cambodia. Since that time, unusual and dramatic fluctuations in river levels along the Sesan River have had major downstream environmental and socio-economic impacts in Cambodia, and these impacts have been especially serious for the many indigenous peoples living along the Sesan River in Ratanakiri Province. As a result, three villages in Sesan Commune, Ou Ya Dav District in Ratanakiri Province were selected as study sites, in order to assess the effectiveness of the warning system used as part of Yali dam's operations, and its impact on people's livelihoods (particularly when it does not operate in line with the

operating guidelines). The specific objectives of this research study were to assess the Yali dam warning system, assess the impact of its operations on people's livelihoods, and to study people's adaptive capacities in terms of its impact.

In order to assess the effectiveness of the Yali dam warning system and its impact on people's livelihoods, as well as the adaptive capacity of the local people, both qualitative and quantitative data collection methods and analyses were used. When gathering primary data, two qualitative approaches were employed: (a) ethnographic-type fieldwork, and in particular participant observation at the selected study sites, and (b) semi-structured interviews and group interviews with those who live and work in the affected areas.

Our results show that two types of information flow after water is released from the Yali Falls dam: official information and unofficial information. Official information refers to a letter which is sent out regarding the water release process by the Vietnam National Mekong Committee (VNMC) to the Cambodia National Mekong Committee (CNMC), which is located in the Ministry of Water Resources and Meteorology in Phnom Penh. Two types of letter are sent; a 'normal situation' and an 'emergency situation' letter. After receiving the emergency letter from the VNMC, the CNMC transfers it to the affected areas immediately. When the official letter arrives at the Ratanakiri Provincial Department of Water Resources and Meteorology, the water level of the Sesan River is estimated by analyzing the volume of water released from the dam and the existing level of water in the river, before the information is shared with the affected people. If the predicted water level in the Sesan River is not considered an emergency, the information is always retained within the Department (it is not sent to the relevant villages). In an emergency situation; however, the letter is transferred to the Sesan district governor and the affected villages. However, affected people always complain that the notification sent to them is often late and not accurate, with bureaucracy, technical problems and geographical location being the main causes of the delay. As a result, the unofficial notifications play an important part in helping to share water release and/or dam operation information with the affected villages. This information is usually provided to the villagers by soldiers stationed at the border post, and as a result is more reliable and reaches the affected communities faster than the official information.

The impacts of flood events on local people in the study area have become severe in recent years, because the notification system is weak and unreliable. In addition, the adaptive capacity of those affected is limited. Sharing information regarding the release of water from the dam is the only way in which affected communities can cope with these potentially unforeseen flooding events.

**Key Words:** Hydropower operations, information flows, rural livelihoods, natural resource governance

## Introduction

Large-scale hydropower developments are well known for causing serious environmental and social impacts the world over (Goldsmith and Hildyard, 1984; McCully, 1996), and while assessing the impacts of hydroelectric dams is already complicated enough when a large dam is located within the same country, the situation becomes even more complex

when the dam is located in one country, but most of its impacts are felt in another (Barrow, 1998).

In November 1993, construction of the 720 MW Yali Falls dam began on the Sesan River in Gia Lai Province, Vietnam (Vietnam News, 1998), approximately 70 kilometres up-river from the international border with Cambodia (TERRA, 1999). Unusual and dramatic fluctuations in river levels along the Sesan River have since had serious downstream environmental and socio-economic impacts in Cambodia, the impacts being especially serious for the many indigenous peoples living along the Sesan River in Ratanakiri Province.

People from all communities situated along the Sesan River in Ratanakiri Province have reported that the river's hydrological regime has been very irregular since October and November 1996, when a massive flood hit them, inundating a large amount of agricultural land and causing a large amount of damage. It is believed that the large and rapid floods that occurred at that time (the water rose many meters over just a few hours) were the result of water being released from a diversion dam built to facilitate the construction of the main Yali Falls dam, or from the main dam itself. However, the headman of a village in Andong Meas District reported that the dam broke because the high quality Japanese cement which was meant to be used, had been replaced with lower quality Vietnamese cement by the dam construction manager, cement apparently not strong enough to hold the dam together. Government officials in Ratanakiri Province believed, at the time of the flooding, that it had resulted from water being released from the Yali Falls dam itself (Himel and Nhem, 1997). It can thus be concluded that either (i) Vietnam did not warn Cambodia at all, (ii) warnings were given but did not reach people living along the river, or (iii) warnings were given but did not reach the people in time.

The operation of Yali dam has subsequently had a negative impact on the local ecosystems and on local people who live along the Sesan River, with late delivery of the early warning system being one of the main causes of the damage caused. As a result, assessing the effectiveness of the early warning system and its impact on local people will be useful; as it will raise awareness among all stakeholders and concerned agencies of the impacts of the process, and so help them implement policies and processes to aid those people affected.

In this paper, I will: 1) assess the effectiveness of the Yali hydropower dam warning system, 2) assess the impacts on people's livelihoods of the late delivery of warnings from the system, and 3) explore the capacity of the study riparian communities to adapt to the impacts of the dam's operations and its notification system.

## Methodology

### *Study Site*

Ratanakiri Province was selected as the case study area, in order to obtain information and data related to dam projects on the Sesan River; with Ou Ya Dav District, and in particular three villages in Sesan Commune, chosen as the study sites (see Figure 1). The villages chosen were Ka Tang and Phi, from where villagers' experiences in relation to the impacts of the hydropower project were drawn. The reason why I chose these villages is because they

are located near to the Cambodia-Vietnam border and along the Sesan River. Also, the villages are located in a remote area, in which the availability of information regarding the hydropower dam is still limited, and also where the level of vulnerability to the hydropower dam's impacts is high. As a result, villagers in the study villages have suffered some serious impacts from the dam's operations over the last few years.

Ou Ya Dav District consists of seven communes and 29 villages, and the total population is 13,979. Sesan Commune encompasses three villages - Phi, Ka Tang and Padal, which have a combined, total population of 1024, of which 620 are women. One can reach Sesan Commune via two main transportation routes: 1) by a small, wooden boat on the Sesan River, especially in the wet season when the water level in the river is high. In the dry season this route is more difficult, as the water level is low and there are many rocks, and 2) via national road 13A from Banlung town to Ou Ya Dav District, from where another road leads to the commune and then dirt roads lead to the study villages, both in the wet and dry seasons. By road it is still more convenient to access these villages in the dry season, as during the wet season the road becomes very muddy and slippery. To the east of Sesan Commune is the Cambodia-Vietnam border, and to the west and north is Andong Meas District. To the south of the Commune is Kok Gneng Commune.

Our interviews with the villagers in 2012 showed that a mix of ethnicities have lived in the villages for several decades. The Jarai are indigenous to the area, while a few Khmer people have, over the last few years, migrated to the area to farm and grow crops. For day-to-day communication among themselves and with relatives in Vietnam, the Jarai people use a Jarai dialect; however, the younger Jarai and village headmen speak Khmer, a language the Jarai

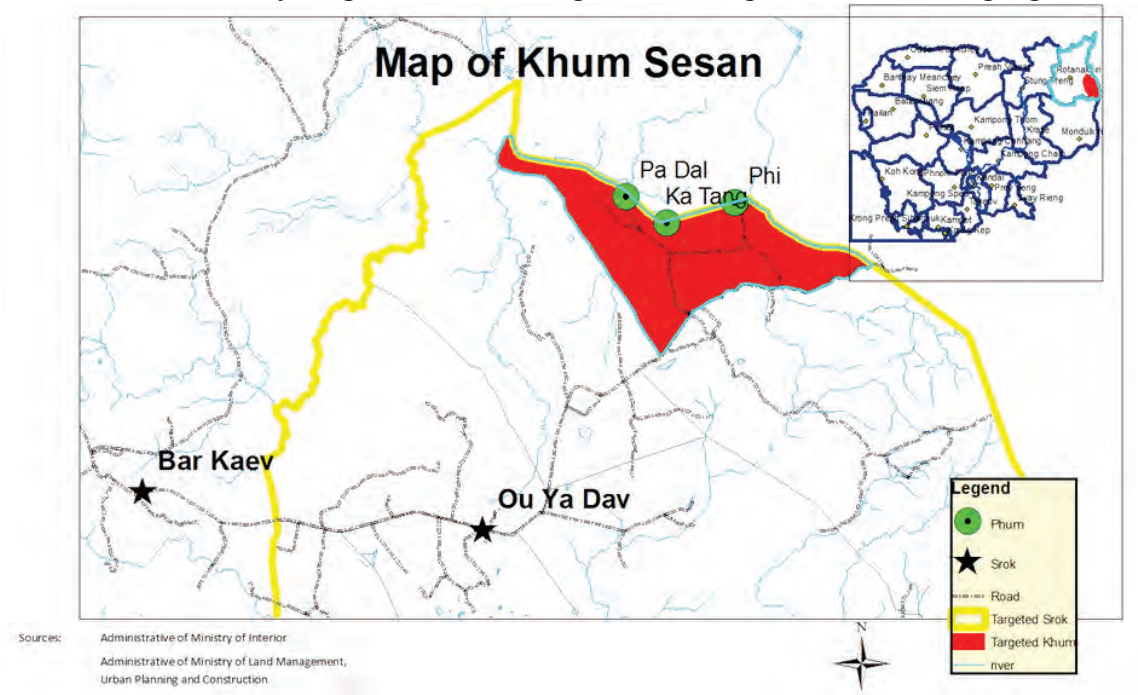


Figure 1: Map of the Study Site

### *Data Collection Methods*

This research project is an exploratory research project which used both qualitative and quantitative data collection and analysis methods, and two types of data were collected—primary and secondary data. The secondary data sources included documents, books and research papers, while the primary data was absolutely critical to the study and was acquired using key informant interviews and interviews with the local people. The relevant secondary data included socio-economic, demographic, geographical and hydrological data for the area, which were used to analyze the current planning, management and intervention activities of the concerned government agencies and civil society groups.

Secondary Data Collection

Secondary data was mainly focused on existing data collected from a number of sources at the national, provincial and local levels, based on annual reports, meetings and field or project reports. National sources of information included the Ministry of Environment, the Ministry of Industry, Mines and Energy, and the Ministry of Water Resources and Meteorology, among others. At the provincial level, sources included provincial departments and annual reports from local and international organizations such as 3SPN, CEPA, NTFPs, HA and CARE (see Abbreviations for full names). At the local level, factual statistical records, hand-written maps, pictures and figures were taken directly from the study villages, communes and district. In addition, the archives of regional bodies like the Mekong River Commission (MRC) were used as additional sources of relevant information. These archives included:

- Some relevant research papers and publications, as well as national, annual reports and textbooks, and
- Provincial annual reports, community databases and reports, plus the reports of governmental agencies and non-governmental organizations.

Primary Data Collection

Primary data was collected from the field using different research techniques and tools/methods, and included data on the culture, population and livelihoods of the study villagers, as well as their perspectives on the hydropower dam and its impacts in relation to local people's livelihoods.

Interviews were held with selected local people who became the 'respondents', and they provided key information for the research team. In order to hold interviews with people in the local communities, the most important issue was to 'build trust', for with trust, the researchers were able to access key information. As well as building trust, the research team used a range of interview styles and other techniques to obtain reliable data. When gathering the primary data, two qualitative approaches were employed: (a) ethnographic-type fieldwork, in particular, participant observation at the selected study sites, and (b) semi-structured interviews and group interviews with those who work and live in the study areas.

Ethnographic Research Method

Employing ethnographic participant observation allows for a fuller appreciation of human behaviour in relation to localized space and local practices, much of which, in my view,

remains little understood at the relevant policy-making levels. While I do not claim to fully comprehend all "the inner workings" of the communities I researched, without spending the appropriate amount of time with people in the study area and making an effort to get to know them through the many observations we performed, the research would have been empirically much poorer, and this would also have handicapped my efforts to link the grounded realities with the broader conceptual concerns and issues related to resource governance.

The ethnographic method was used to obtain the primary data, and the principle of ethnographic fieldwork is to build trust and a relationship between the researcher and the research community – and particularly in the sense of the reflexive aspects of the qualitative research, the length of time spent at the research site and the familiarity developed by joining-in with everyday activities. In this research study I used observation, met with key informants, conducted focus group discussions, and validated the findings made with other sources.

The research supporting this study was conducted between April and June 2012, with two data collection stages carried out in order to obtain the data required to meet the research objectives, as follows:

*The First Stage:*

The first stage of the research was conducted at the research site from 18 to 24 April 2012, in order to understand more about the site, determine the general information sharing process used by the hydropower dam operator, understand the impacts of the dam on the local area and general issues regarding the site, and also learn more about people's livelihoods there. To obtain such information, focus group discussions, semi-structured interviews and observations were undertaken.

Focus Group Discussions: During the first research stage, three focus group discussions were held in three different villages in Sesan Commune. Discussions were held between the research team and the 3SPN, in order to plan and facilitate the field work before visiting the research sites. During the first field work phase, focus group discussions were arranged by the research team, with the cooperation of staff from 3SPN. Some Participatory Rapid Appraisal (PRA) tools, such as a checklist questionnaire, a seasonal calendar and participatory/ resources mapping were used during the group discussion. By using these tools, the research team was able to obtain answers which represented the views of the whole group. In each meeting, local people were asked to join, with the number of attendees varying slightly from one village to another, due to the villagers' availability. In Pa Dal village, twelve people joined the group discussion, including five women and seven men. In Tang village, only five women, four men and a few younger people joined the group discussion, as at that time most of the men in the village were out in their *chomkar* fields (home gardens). In Phi village, 22 people joined the discussions, including six women and sixteen men. Most people in the group could not speak Khmer very well but could understand it, so there were one or two local villagers who helped translate the local language into Khmer.

Semi-structured interviews: These were conducted in the villages during the first research stage and included local people who could understand and speak Khmer. These interviews were held when people were not working and during meals.

Observations**:** This method was also employed during the field visits. The research team spent two nights and three days in the villages, in order to understand more about the living conditions there as well as people's livelihoods.

*The Second Stage:*

The second and last research stage was conducted between 4 and 9 June 2012. This second field work stage was employed to obtain more detailed information about the notification process, the challenges and constraints faced by the process, gain an in-depth understanding of the impacts of and responses to the process, and to obtain any other data missing thus far. During this stage, no focus group discussions were held; however, to obtain the required data, key informant interviews and in-depth interviews were carried out.

Key informant interviews: A set of questionnaires was developed for the second field visit, for which nine key informants were chosen to respond: at the local level the village chiefs (of the three villages), a commune chief, a deputy district governor, a chief at the Department of Water Resources and Meteorology in Ratanakiri, a director of the provincial governor's administration office in Ratanakiri, and the director of community radio in the Department of Information, also in Ratanakiri. At the national level, a chief of the project network in CNMC was also chosen to respond to the questionnaire. These informants are directly and indirectly involved in the notification sharing process, and so understand the challenges and constraints faced.

In-depth interviews: A set of in-depth interview questionnaires was prepared for this last stage of the field work. Due to time constraints, six households in the three villages were been chosen for the in-depth interviews. These interviews mainly focused on the life of the respondents' families in terms of the information sharing process and the dam operations, the impact of the dams on their livelihoods, as well as their response to these impacts, and also their livelihoods in general. Among these six households, those giving the best three responses were chosen for inclusion in the final report.

## Results and Discussion

### *History of Yali Dam*

Before the 1990s, the significant hydropower potential of the Sesan River had already been targeted for development, in fact plans to develop a large dam at Yali Falls had existed since the French colonial period, with a French entrepreneur granted a concession to construct a hydroelectric dam at Yali Falls in 1929. At that time, the investor was unable to develop the project as planned, and so the French authorities ultimately revoked the concession in 1931, before any construction could begin. A plan to develop hydropower on the Sesan River was then reconsidered in the 1970s.

When construction of the Yali Falls dam began, Vietnam had only just passed its environmental law, which for the first time required an Environmental Impact Assessment (EIA) to be prepared for major investment projects, including the construction of large-scale hydroelectric dams. However, this environmental law and its associated regulations did little to define

what constitutes a trans-boundary EIA, and even now, Vietnam still lacks detailed regulations or guidelines regarding trans-boundary EIAs, though the country has access to donor-supported technical assistance in relation to EIA development (Wyatt and Baird, 2007).

### *Construction Period for Yali Dam*

Construction started on Yali Falls dam in November 1993, with a number of optimization studies carried out by the Swedish International Development Agency (SIDA) and the Asian Development Bank (ADB), together with Electricity of Vietnam (EVN), having refined the choices down to six locations on the upper Sesan River. The Vietnamese government eventually prioritized the 260MW Sesan 3 dam, located approximately twenty kilometers downstream of the 720MW Yali Falls dam, which is estimated to have cost one billion US Dollars to build. Yali Falls dam then began to modify the river's hydrology and water quality in mid-1996 (Wyatt and Baird, 2007).

### *Impact of Yali Falls Dam on the Sesan River*

The villagers and communities in this area have long-depended on the Sesan River for their livelihoods and food sources, and the adverse impacts of the dam include the loss of life, livelihoods and property, as well as a decline in food supplies. Many people have changed their behaviour since the dam was built, acting in different ways to previously (Rutkow et al., 2005). In 2000, the Fisheries Office reported that due to an extreme rainfall event in 1996, excess water had to be released from the dam to prevent Kon Tum town in Vietnam from flooding (Fisheries Office and NTFP, 2000). According to an interview conducted by Thim in 2010, villagers from the riverbank villagers downstream of the dam in Cambodia believe that the first impacts of the dam were felt in 1996, after several intense floods had hit their villages (Thim, 2010).

By May 2000, when the first two of four turbines were commissioned and put into operation, the dam had already had large-scale environmental, social and economic impacts on communities living along the Sesan River, communities consisting mostly of indigenous people and with a total population of approximately 50,000 (Hirsch and Wyatt, 2004).

### *Notification System History*

Since Yali Falls dam in Vietnam was constructed in November 1993, at an estimated cost of one billion US Dollars, communities living downstream from the dam have suffered negative effects. Most of these impacted communities are inhabited by indigenous people, and in Ratanakiri Province, nine different ethnic groups have been affected, including the Lao, Jarai, Kachok, Tampuan, Brao, Kreung, Khmer, Kavet and Chinese (Fisheries Office and NTFP, 2000).

In order to reduce the negative impacts, communities downstream of the dam and NGOs asked the Cambodian government to raise their problems with the Vietnamese government, and as a result, a letter of concern was sent to the Vietnam VNMC by the CNMC.

The resulting Sesan negotiations then reached the highest political levels on both sides of the

border, and at the third meeting of the Joint Committee in November 2003, the Vietnamese Prime Minister released a directive consisting of five 'solutions', as developed by Electricity of Vietnam (EVN), in response to the concerns raised by the Cambodian government (Thim, 2010). The key solutions among these served to formalize in writing the earlier commitments made by EVN, these being: (i) to provide advance warnings of water releases under normal and emergency flood conditions, (ii) to control the rate of discharge from the dam so that "people along the Sesan River can recognize changes in water levels and take precautions accordingly", and (iii) to provide that "…environmental mitigation studies, if needed, will be discussed…with the participation of the Mekong River Commission". The last solution revealed ambivalence on the part of the Vietnamese government towards the need for further impact and mitigation studies, which seemingly reflected an attempt to advance Vietnamese interests while disregarding Cambodian concerns (Wyatt and Baird, 2007).

The Cambodia-Vietnam Joint Committee for the Management of the Sesan River was established at the MRC's 7th Council Meeting in October 2000. The Committee was established to be responsible for the implementation of these solutions; however, in 2004 the Joint Committee was disbanded and reformed as the 'Standing Committee on the Management of Dams and Canals along the Cambodian Vietnam Border', but to date this new committee has not yet convened to discuss developments along the Sesan River, despite these issues being within its mandate (Wyatt and Baird, 2007). According to an officer of the Committee, a lack of finance is the main reason why it has failed to meet and take responsibility for its work. Usually, the water release letters are sent to the Committee, but due to a lack of financial support, the Committee then transfers the letters to the CNMC – which is expected to take charge and share this information with local agencies.

### *General Situation in the Study Area*

The histories of Phi and Ka Tang villages, both located in Sesan Commune, were discussed during interviews with the villagers. They stated that the villages had been founded several decades previously by an indigenous group known as the Jarai. In the past, they lived in small groups, with four to five households located in a particular forest area along the river. Eventually, each group expanded and they merged together to form villages, which are now located alongside the Sesan River, close to the border. Phi village is located in the upper reaches of the Sesan River, very near to the border between Cambodia and Vietnam, while Ka Tang village is further downstream. According to the interviewed villagers, both villages have been established for a long time ago and so can be considered old (*villager in Phi village, 2012*).

Those now living in the villages include the majority Jarai and some Tampouen indigenous people, as well as a few Khmer families who recently migrated from lowland provinces to farm and do business. In terms of communications, the Jarai indigenous people tend to use their own language among themselves in the villages, but when outsiders come to visit the villages they speak Khmer. In addition, the Jarai are able to communicate in the Jarai-Vietnam language with the Jarai who live in Vietnamese territory. During my interviews with the villagers in Phi and Ka Tang villages, the Jarai people understood questions asked in the Khmer language, but when they responded in Khmer, it was hard to catch their meaning, as most of them cannot read the language. However, some young people and the

heads of the villages, who are studying or studied at primary school up to grades three, four and five, are able to read Khmer.

Traditional customs and beliefs predominate among the indigenous people in the area, and these are closely linked to the local, natural resources, which are strongly believed to be governed by spirits (known as *arachs);* for instance, *arachs touek* and *arachs trey* are the spirits of the water and forest respectively. These spirits are linked to sacred elements of nature and help guide the actions of the villagers during their daily lives. The spirit ceremonies involve prayers by elders, and these link to natural resources protection and also reflect the perception of villagers that spirits help with their well-being and livelihoods. For instance, the spirits can help bring rain for crops, more fish to the rivers and are thanked for bringing a substantial harvest (field survey, 2012). Noticeably, the elders are normally the most respected people in the villages, as they organize the spirit ceremonies and deal with internal conflicts, in order to bring harmony and build strong and true relations.

### *Overview of Phi and Ka Tang Villages*

The history and landscape of Phi village shows that the name 'Phi' was given by the Jarai, and refers to a small steam located in a dense forest, or *ya phi.* Later, the name was shortened by the Jarai community to Phi. Phi village is located adjacent to the Vietnamese border and is also located at the headwaters of the Sesan River in Cambodia, which runs west from the border. To the west is located Ka Tang village and to the south is the national road which connects to the provincial and district township of Ratanakiri. This road also goes to the Vietnamese border, and to the north is a forest in which villagers go to collect non-timber forest products (NTFPs) for their livelihoods - to generate an income.

According to our informal group discussions and interviews with elders in the village, the village has been established since before they were born. Being located by the Sesan River, recently the villagers divided the village into two parts; north and south of the river. Most of the villagers live in the northern half as this was the location of the original village, though some villagers have settled their houses temporarily to the south of the river, to develop their c*hamkar* land.

The house settings and characteristics in Phi and Ka Tang villages are quite similar to the other villages in Oyadav District. Following informal discussions in the villages about the house constructions, the residents indicated that in the past villagers built their houses using forest products; the houses were of a small size and were set on the ground. However, in recent years the changing weather has resulted in regular floods, so the villagers have gradually changed their house designs. Now the houses are set on wooden poles rising two to three metres from the ground and the houses are a bit larger, though still small when compared to some villages in nearby districts. Those houses built along the Sesan River are parallel with the main road, though they are set apart from each other and each household in Phi village has a backyard containing a home-garden.

Phi Village

Phi village is rich in terms of natural resources, having forest land and fertile red soils with

cash crop plantation potential. The Sesan River flows through the village, and supports a lot of fish, aquatic resources and vegetation in the river and along its banks, those the villagers depend on for their livelihoods.

The population of the village is 540 and there are 124 families living there, most from the Jarai group. When comparing Phi and Ka Tang villages, in Phi village the houses are bigger and constructed of wood, and the living conditions are better than in Ka Tang village, because Phi village is closer to the border with Vietnam and villagers there have easier access to the market in order to sell their domestic products. There is a primary school in the village, but no regular teaching hours or teachers. In terms of access to health care, villagers can go to a hospital and health care centre in Vietnam, across the border (FGD, 2012).

Ka Tang Village

Ka Tang village is also located along the Sesan River, but to the east of Phi village, and the people living here are also from the Jarai indigenous group. It is very difficult to access this village from Phi village and Sesan Commune, as the dirt road is in a very bad condition and is very muddy in the wet season. This village is also rich in natural resources, and local villagers go to collect NTFPs for their daily food requirements and to generate an income. From one focus group discussion (FGD, April 2012), it was clear that the villagers here have a lower level of education than in Phi, as there are no regular classes and no teachers or students in the school. Also, cultural constraints mean young girls hardly ever go to school, as they marry early and help their family with the house work and farming activities. The interviews showed that the Jarai here have maintained their cultural traditions and spiritual beliefs, those related to the spirit forest and the water. The different geographical spaces in the village include villagers' residences, farming areas, the river, the forest and spiritual locations. Unlike in Phi village, the villagers here have set up their houses in a circle, as they like to live close to each other, meaning they can help each other and work together. This also makes it easier to communicate, share information and hold social events; for instance, whenever flooding occurs, the villagers can help each other easily. Ta Kang has a population of 349 people, with 85 families.

### *Literacy and Education in Phi and Ka Tang Villages*

Access to education in general in most of the local villages is low and most of the villagers are illiterate. There is a one primary school located in each village, and both hold classes from grades one to six; however, the schools lack teaching materials and there are no regular classes or teachers. Most of the students help their families to obtain food and earn an income, so schooling is not a priority. According to a training needs assessment report by 3SPN (2011), literacy rates in Ratanakiri are still limited (especially in those villages made up of indigenous people and located along the Sesan River); below those in the lowland provinces.

The low levels of literacy and education are a challenge to Phi and Ta Kang villages. According to the results of my interviews with the villagers, literacy and education is still at a low level because most children and young people study only three or four classes in primary school, while some drop-out as the schools are located far away from their homes and parents cannot afford to buy meals for them. In addition, most of the parents and their

children work in the fields, resulting in late school enrollment – at the ages of ten to thirteen years, and these children feel ashamed to start at primary level with the others. The causes of a high drop-out rate among students in both villages are the lack of teaching materials, the fact that there is no appropriate place to stay in the local villages, and the need for teachers to travel back and forth to the schools. Also, the teaching schedules are irregular. Another key cause is that the schools sometimes flood due to the dam releases, meaning operations close down when students and their families are evacuated to higher ground.

## *Livelihoods in the Study Villages*

The livelihood activities of the villagers vary, and include agricultural work, livestock rearing, collecting NTFPs and mining. In terms of agricultural work, the main source of income is rice farming, both in the wet and dry seasons. In the wet season, villagers cultivate rice on small plots of wet-land between the river and the upper areas, and in the dry season on plots near the forest. At the same time, a variety of crops (including plantation crops) and home-garden vegetables are grown in the villages along the river banks. In the dry season, some crops are planted in home-gardens alongside the Sesan River and around the houses. In addition, some cash crops are grown around the houses, such as fruit trees (bananas, coconuts, mangoes and papayas). Paddy fields can be found on land near the forests; however, most villagers make their living by collecting NTFPs from the forest and from around their homes, and from farming. The villagers in Phi and Ka Tang have to rely on the one to two hectares of rice-fields they own, so the main sources of income for the villagers are fishing and forest products, though they also rear livestock and mine for gold sometimes. Another significant livelihood activity is agriculture, with the villagers growing one rice crop per season per year. The paddy rice is rain-fed and so depends on the annual rains; during the dry season they do not grow rice as there is no irrigation system in place. Villagers grow paddy rice using their own labor and animals, and the cultivation process depends totally on the annual rainfall; however, this results in an unpredictable yield. If a year has sufficient rainfall and the yield is good, the villagers are able to support their livelihoods, as they are able to use this rice all-year-round.

During the non-rice growing months, the villagers supplement their incomes by growing crops such as corn and cassava, and vegetables such as morning glory, soy beans and salad crops, which are grown along the river. The interviewed villagers said that they worry a lot about the Sesan River, as the water level has fluctuated a lot in recent years, bringing more sediment and algae. As a result, most villagers have given up growing vegetables due to the water surges and riverbank erosion, which have led to a decline in riverbank vegetation.

The villagers also catch fish for their subsistence and for sale to middlemen, who come to the villages from outside. Fish production is important for the villagers' food consumption activities, because it contributes a lot towards their dietary requirements and incomes, helping to sustain their livelihoods. The interviewed villagers said they have noticed a decline in the fish yield from the Sesan River over the last few decades, as many of the deep-water pools used for fish breeding and reproduction have become shallow, destroying the fish's habitats.

*"Regarding fish habitat loss, most of the villagers in the past did not catch fish in the deep pools because there were too many big fish and crocodiles, but today it is changing; we can fish there and no large fish or crocodiles come anymore. Due to this and the gradual decline in fish stocks in the Sesan River, we have changed our livelihood's strategies. Instead of obtaining our income from fishing, now we encroach on the forests and collect NTFPs, or migrate out of the area at great risk to generate an income (villager in Phi village, 2011)."*

Table 1: List of Activities/Seasonal Calendar in Phi and Ta Kang Villages

| **Activity** | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice/Cultivation and Farming | | | | | | | | | | | | |
| Fishing | | | | | | | | | | | | |
| Cropping ( Cashews ) | | | | | | | | | | | | |
| Gold-mining ( may involve migration) | | | | | | | | | | | | |
| **NTFPs** | | | | | | | | | | | | |

Source: Field survey, 2012

Table 1 shows a list of income earning and livelihood activities carried out throughout the year in Phi and Ta Kang villages, such as rice cultivation, fishing, cropping, collecting NTFPs and gold mining, most of which sustain the villagers daily lives. Another important activity, family-fishing, occurs year-round in the villages, though the peak fishing season in the Sesan River is meant to start in May and run to July; however, with the level of the water in the Sesan River currently being high, this has recently changed to early in the wet season. The other months of the year have a normal fish catch, with only a small amount of fish available for consumption. Villagers added that fish constitute their main protein source, but that the fish catch has gradually declined due to water fluctuations and the destruction of the fish habitats.

Besides fishing, villagers utilize forest resources year-round, such as different types of NTFP, timber and others. The NTFPs include mushrooms, tree resin, wild animals, traditional herbs and vegetables. In the wet season, villagers collect bamboo, mushrooms and leaves, as well as hunt other types of wild animal for consumption purposes, and also for sale, while in the dry season, they collect fire wood, dry resin and traditional herbs, both for domestic use and for trade at the border market - or middlemen come to buy these products in the villages.

Wet season rice cultivation runs from early June to October - including the harvesting period, and from early December through to February, villagers plant dry-rice in small plots in the forest - a well-known rice-rotation activity. Dry-rice gives a higher yield, but the yield is often eaten and/or destroyed by wild animals (pigs). Gold mining occurs some months of the year when villagers have spare time, because this activity is risky and it is hard to find the gold. Villagers who mine gold go to a particular area every year near the border between O'yadav and Borkeo districts.

### *Natural Resources Availability in the Study Villages*

There are different kinds of resource in and around the study villages that villagers can access, such as the forest itself, non-forest products and wild animals. According to the villagers, they depend totally on these natural resources for their food intake, for medicines, for their house construction materials and for income generation purposes. Wild vegetables and fruit are important supplementary food items during rice shortage periods in the dry season. Villagers also collect wood for firewood and for constructing houses, and also to make handicrafts. Resin is also gathered in order seal boat hulls and as a source of light for torches. Villagers said the Sesan's riverbank is a habitat for a number of wild animals and fish, and also serves as garden-land, to grow vegetables. A number of different species of wild animal can be found around the villages, such as wild pigs, deer, birds and aquatic species; however, the hunting of wild animals and birds is strictly prohibited by the law. During our interviews, villagers said they are concerned by the number of major threats to the wildlife, to fish and birds nowadays, due to their habitats having been destroyed; for instance, the inundated forests along the Sesan's river bank are nesting grounds for birds, yet these grounds have been lost, resulting in a reduction of their food sources, mainly due to the water level fluctuations and floods.

### *Culture Related to Natural Resources Management*

In our interviews, the villagers indicated that the Jarai's livelihoods, culture and lifestyle alongside the Sesan River depend totally on the utilization and availability of natural resources along the river. Most villagers recognize the significance of aquatic resources in the river - that they support their lives and culture. One female Jarai villager said: *"If the Sesan dies, the Jarai people will disappear and die also." Ms. Thou - a Jarai woman in Phi village, April 2012.*

In addition, most villagers believe that the Sesan River contributes many resources in support of their lives, such as water for drinking, washing and for watering the animals, plus to cultivate rice. The villagers also strongly believe in river and forest spirits; for example, when they face natural disasters, such as floods, drought or sickness - especially among the children, they pray to the spirits to take care of and help them to avoid harm. When they go fishing in the river, they always offer something to the water spirits in order to secure an abundant catch, something connected to the specific fishing gear used. The spirits are a key part of the villagers' beliefs, beliefs they have held for many generations and that offer protection and support their well-being.

The spirits also enhance and protect natural resources in the area; for instance, the spirit forests cannot be cut down because these forests help protect the people. If these forests were to be chopped down, sickness and disaster would befall the villages.

### *Non-timber Forest Products (NTFPs)*

A variety of potential natural resources are still available in and around the villages. NTFPs are the main livelihood source for the Jarai people, as they help generate an income, provide construction materials for their houses, can be used as medicines and also to make fishing gear, and the villagers collect NTFPs every day throughout the year. Resin from trees,

rattan, bamboo and vines are collected for use and also for sale at the market. The hunting of wildlife has decreased in recent years, due to the promulgation of wildlife laws which prohibit it; however, villagers still use traditional traps to catch wildlife for food and for sale also.

### *Customary Land Use*

Customary land use in the villages reflects traditions with regard to land ownership and utilization rights. Land is divided-up by household or individual within the village, based on the decisions of the traditional leaders (traditional leaders refers to village heads or respected elders who deal with village issues and conflicts). At present, traditional land use and management in the villages is based on beliefs and customs, as villagers are totally dependent on natural resource usage for their livelihoods. As a result, nature and the spirits are associated with a particular place. As spirits are a key part of the villagers' lives, before clearing any land for cultivation or other activities, ceremonies are held for them, for villagers firmly believe in spirit forests; they are an integral part of the Jarai group's traditions. At their spirit ceremonies, villagers offer animals such as pigs, chickens and buffaloes, plus vines, and play traditional music for the spirits, so that the spirits will protect the land before the villagers use it.

### *Health Issues Related to Drinking Water*

Generally, finding clean drinking water is a key issue and a great challenge for the villagers, even though drinking water campaigns have been undertaken by state and non-state organizations in the villages recently. Changing the behaviour of the villagers from the use of unsafe drinking water to clean water is not easy, due to the lack of sufficient water filters, a lack of pumps for the wells, low education levels regarding water-borne diseases, and the river's poor water quality.

Most of the villagers we spoke to said that the most common household water source in the villages is the Sesan River itself, plus rainwater. Only a few have wells – as constructed by SEILA between 2004 and 2006, but some of these wells are not used due to the muddy water that they produce or due to problems pumping the water out. Most villagers do not drink boiled water because they are used to drinking the river water and find it easier to take water from the river than from the well (commune headman, 2012). The interviewed villagers and commune chiefs estimated that approximately 10% of the population in the villages boils its drinking water; the remainder does not use boiled water, leading to regular bouts of diarrhea, which occurs particularly during the wet season. This rarely or never leads to death, because chlorine tablets are provided by the District Health Center, which are used to clean drinking water during extreme flood events. Another common health problem villagers experience is itchy skin during the wet season, and the villagers said that this skin disease is caused by bacteria (a parasite) that lives in the muddy water. The villagers said that this skin problem has become more prevalent in recent years.

### *Changes and Damage caused by Hydropower Developments*

During our field survey, we detailed those changes in the villagers' statuses that have

occurred since the hydropower project was introduced. The results from a focus group discussion (FGD) show that significant changes have occurred to the villagers' livelihoods, plus that natural resources have been lost due to the dam being built upstream in Vietnam. In fact, most villagers complained that since the dam was built, the ecology of the river has changed dramatically; for example, fish yields have declined every year. The villagers said they used to catch more fish in May and June, when the river was high, but that now during these months they hardly catch any fish due to water fluctuations and the irregular flow, both of which damage their fishing gear. They said that especially at night the water flows very fast, meaning they cannot use their fishing nets to catch fish - the water moves the nets out of position and sometimes even the boats.

In addition, in recent years the villagers have observed that the river water has changed color, becoming dark-brown; making it hard to drink. The villagers used to drink, cook and wash using the river water, which was very clean and did not have many algae. Now, the villagers suffer from skin-diseases and the water is muddy and dark-brown in color, particularly near the river banks where people use the water most. In response to this situation, a rural community development project has been introduced to fix the drinking water issue, with a pumped-well project recently implemented by the European Union (EU) and the Commune Development Fund.

Cropping patterns have also changed in recent years due to the changes in water flow and the frequent flooding. The villagers used to grow many varieties of cash crops and vegetable along the river bank for their own consumption and for sale, but more recently they have had to grow these crops on more elevated plots away from their homes, which have a limited water source. The table below presents a summary of the villagers' livelihoods before and since the dams were built.

Table 2: Summary of Village Livelihoods Before and Since the Dams were Built

| Since | Before |
|---|---|
| • Change to river's ecology leading to fish catch decline due to water fluctuations. Loss of fish species and main source of protein for villagers.<br>• Villagers fear water flow variations; children are afraid to swim and bathe in the river.<br>• Quality of the water is of concern; some villagers suffer from itchiness and skin diseases.<br>• Change in crop patterns on the river banks due to soil erosion and regular water fluctuations. Now grow vegetables on higher land; far away from their homes and providing low yields.<br>• Villagers are migrating in search of alternative work outside the villages. | • Sesan River rich in natural resources, including aquatic species, fish and other animals, plus widespread vegetation along the river banks.<br>• Sesan River provides good soil fertility, allowing for a variety of crops to be grown. The river banks allow local villagers to grow crops and vegetables for their own consumption and to share with others.<br>• Low flooding risk; little damage.<br>• Good fish stocks in the Sesan River, leading to larger catches. Enough for subsistence and to share with other villages.<br>• Water flows naturally and slowly; providing nutrients for agriculture and farming.<br>• No migration out of the villages. |

Source: Field survey, 2012.

Photo by San Vibol

**Case Study: Villagers Historical Experiences of the Sesan River**

We held an interview with Mr. Seng Ang, a 50 year-old Jarai man living in Phi village. He said that before the dams were built upstream on the Sesan River in Vietnam, the river was home to a wide variety of fish species and other aquatic resources. For instance, he said he used to catch about 50 to 60 kilograms of fish a day during the 1980s, with many white fish species caught, such as *trey pava muk muy and pava muk phi,* fetching a good price at the market. However, since the dams were built he has noticed that some of the fish species and other aquatic resources have declined in number from year to year. He said he now only catches a few kilograms of fish a day, and some fish species caught for sale he catches only very rarely.

The Jarai usually use water taken from the Sesan River for drinking, cooking and bathing, but in recent years the river has become muddier and the water of a lower quality, particularly since 2005. In light of this, some wells were installed using funds from the EU, for the villagers to utilize instead of taking water from the river and so prevent skin-diseases and other illnesses from developing.

Another significant issue raised by Mr. Send Ang is that most of the villagers (him included) have had to change their cropping patterns, giving up the growing of vegetables along the river bank and clearing the natural forest in order to farm – further away from their homes (interview with Mr. Seng Ang in Phi village, 2012).

Mr. Kla Hen is a 70 year-old Jarai man who lives in Phi village. During our visits to the village we interviewed him and he said that when he was young, the Sesan River supported many natural resources, such as fish, water birds and vegetables, which grew along the river bank, along with wildlife in the forests. Villagers earned their incomes and took their food consumption from these natural resources on a daily basis; however; he said that since the hydropower dam built was built in Vietnam, villagers have had to deal with a number of natural disasters; for instance, in 2000 there was a severe drought in the river, leading to a loss of fish and other species. In recent years, there have been severe floods and changes to the water flow in the Sesan River, with the floods destroying villagers' property, animals and farming activities; for instance, fishermen have lost their fishing gear, boats and other equipment. He has also noticed that recently the water flow and seasonality of the river have

changed; sometimes floods occur in the dry season, such as in March 2011 when a flood destroyed his entire corn crop.

He said: *"In the past, the river's natural flow helped my family and other villagers - giving a lot of fish and watering the crops, but now the water in the river, with flash floods and rapid fluctuations, is destroying our crops/farming and damaging our fishing gear and boats, plus killing animals."* He has also noticed that the social relationships between Phi village upstream and Ka Tang downstream have broken down. There is now less trust among the villages because of the flooding; for example, in the past - before the dam was built, when boats or fishing gear in Phi village broke loose and ran downstream, the villagers in Ka Tang would return them to the upstream villagers. However, recently, the villagers downstream have stopped doing this (interview in Phi village, 2012).

### *Loss of Village Assets*

Our household survey and a report from the district, as shown in Figure 2 below, revealed the number of buffaloes, cows and pigs lost due to heavy floods, as caused by the poor

performance of the dam notification process. In 2009, a heavy flood occurred in all the study villages downstream of the Sesan River dam. This incident occurred as the result of water being released from the dam in Vietnam without any notification letter having been sent to the villagers - to give them time to leave the area and prepare for the severe flooding to come. Most of the households we interviewed said they did not receive a notification letter or news to inform them of the impending release of water from the dam.

Figure 2 shows the livestock losses in the three affected villages: Phi, Ka Tang and Padal, referring to buffaloes, cows and horses – those used for transportation and to plough the land, as well as pigs and chickens (kept for food). Actually, the figures represent the loss of domestic livestock, such as buffaloes, cows and pigs. It can be noticed that buffaloes and cows are used as draught labor for the villagers' agriculture, farming and transportation activities, and without these animals, the villagers face difficulties trying to cultivate their crops, leading to food shortages.

Figure 2 shows that 72 cows were lost in Katang village alone during the floods of 2006, a loss which had a huge impact on the productivity of the villagers' farms and crops, while only ten cows were killed. In addition, Phi village lost 30 buffaloes, as compared to nine buffaloes in Ka Tang. In Padal village, 70 pigs were lost, while in Phi just over a half its pigs disappeared. The graph also shows that one person died during the floods - in Padal village, which is not one of our research sites, but is located nearby. In conclusion, in 2009, due to the lack of any notification being received, the release of water from the dam resulted in a huge amount of damage occurring in the study villages, with property lost and the environment damaged.

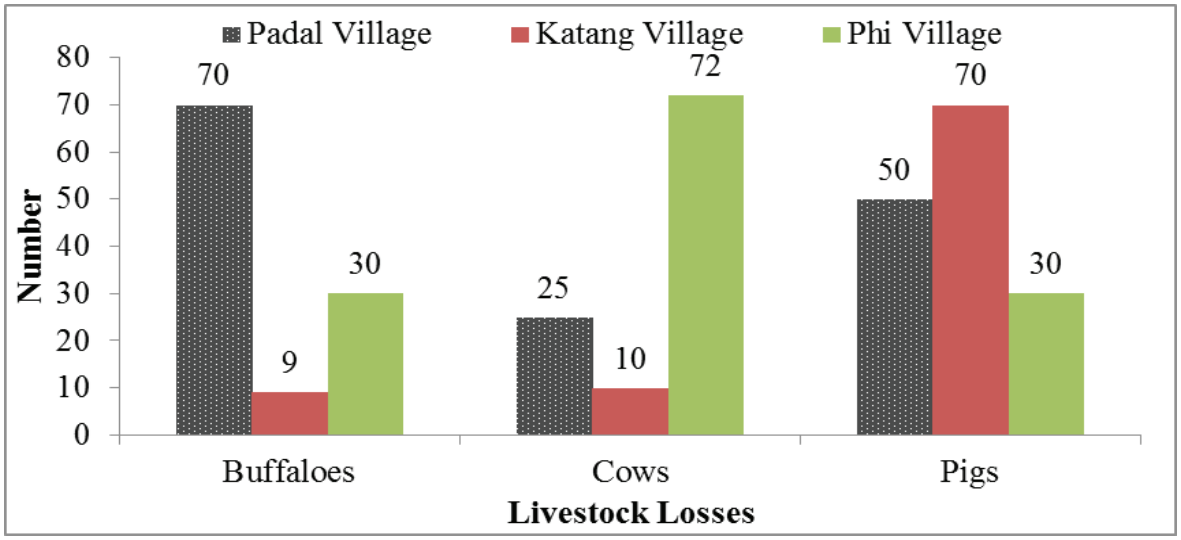


Figure 2: Livestock Losses in the Study Villages
Source: District report on damage to villagers' property, 2009.

### *Damage to Property*

In 2009, another heavy flood occurred in Phi and Ka Tang villages, and particularly in O'yadav District, which is further downstream. This flood was also the result of water being released from the dam in Vietnam, with again no notification letter sent to the villagers, to give them time to prepare and escape from the area. The interviews and focus group discussions held showed that the villagers did not receive any notification letter or news regarding the flooding event from any governmental agencies. Figure 3 below shows clearly the significant losses suffered in the village due to the flooding.

The village's assets referred to in the figure include houses, bicycles, boats, rice-stocks and electrical equipment (such as batteries, boat engines and rice-mills). The figure shows that 63 residential houses in Phi village were damaged by the flood, while 31 households were submerged by water in Ka Tang village. The second biggest loss for the villagers was motorbikes, with ten motorbikes lost in Phi village, but only eight found downstream in Ka Tang village. Motorbikes are the main form of transportation for the villagers, helping them to carry agricultural products to the local market for sale. To buy a motorbike, the villagers have to save a lot and/or borrow money from a money lender at a high interest rate. As a result, those families who lost their motorbikes found themselves in debt. In summary, all the villages' assets were damaged by the floods, leading to a loss of rice stocks, bicycles and motorbikes.

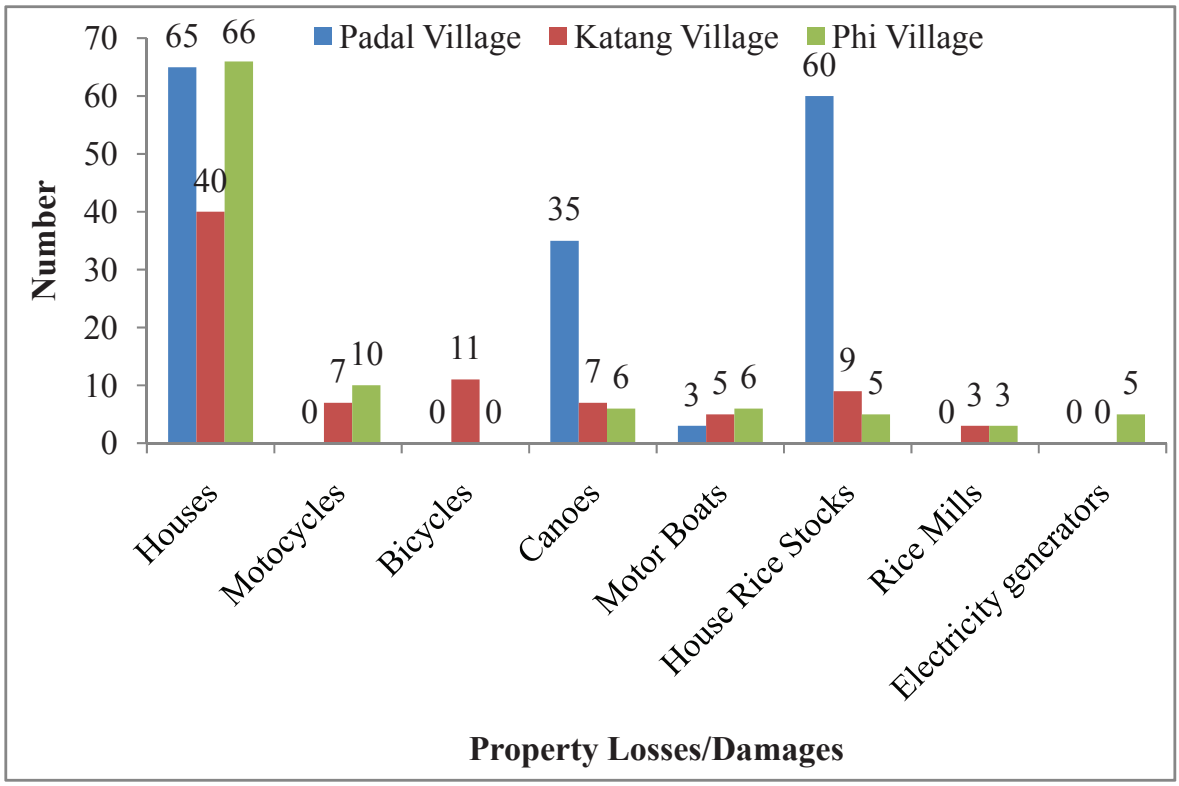


Figure 3: Village Property Losses and Damage
Source: CNMC, 2012

**Damage to the Commune's Property**

Since the hydropower dam was constructed upstream, downstream communities have not received any compensation from the dam owner for the losses and damage caused (FGD, 2012). However, the negative impacts of the dam have forced most of the villagers to change their livelihood strategies, including their cropping patterns and seasonal collection of NTFPs – their main sources of income, as well as to migrate. The villagers we interviewed indicated that these disasters are a result of the dam's operations; for example, sometimes heavy rains or droughts occur suddenly, forcing the villagers to live in constant fear of environmental shock. In 2006, there was a severe drought in some parts of the Sesan River, and this harmed its ecological biodiversity, with a loss of fish and aquatic resources occurring in the deep pools within which the fish breed. Vegetation and riverbank soil was also eroded away. Added to that, in 2009 severe flooding occurred in the commune due to the opening of the dam's gates, which the operator ordered in order to reduce the amount of water inside the dam and maintain its operations (FGD, 2012).

Figure 4 shows the amount of property and number of items lost and/or damaged at these times, the losses including some domestic animals and field materials/tools, plus the death of a villager (due to the flash flood of 2009). Overall, the highest losses have occurred among livestock, such as cows, buffaloes and chickens in each village, while during the flooding events about 155 houses have been significantly damaged. Also, important assets such as motorbikes, traditional farming equipment, rice mills and other electrical machinery

(about ten to twenty items) have also been lost in each village. Sadly, one villager living in Padal village passed away during on eof the flash floods because he and his son tried to move their boat away from the house, but were carried away by the strong currents. The father disappeared at night; therefore; no one could save him (interview with the deceased man's wife, 2012).

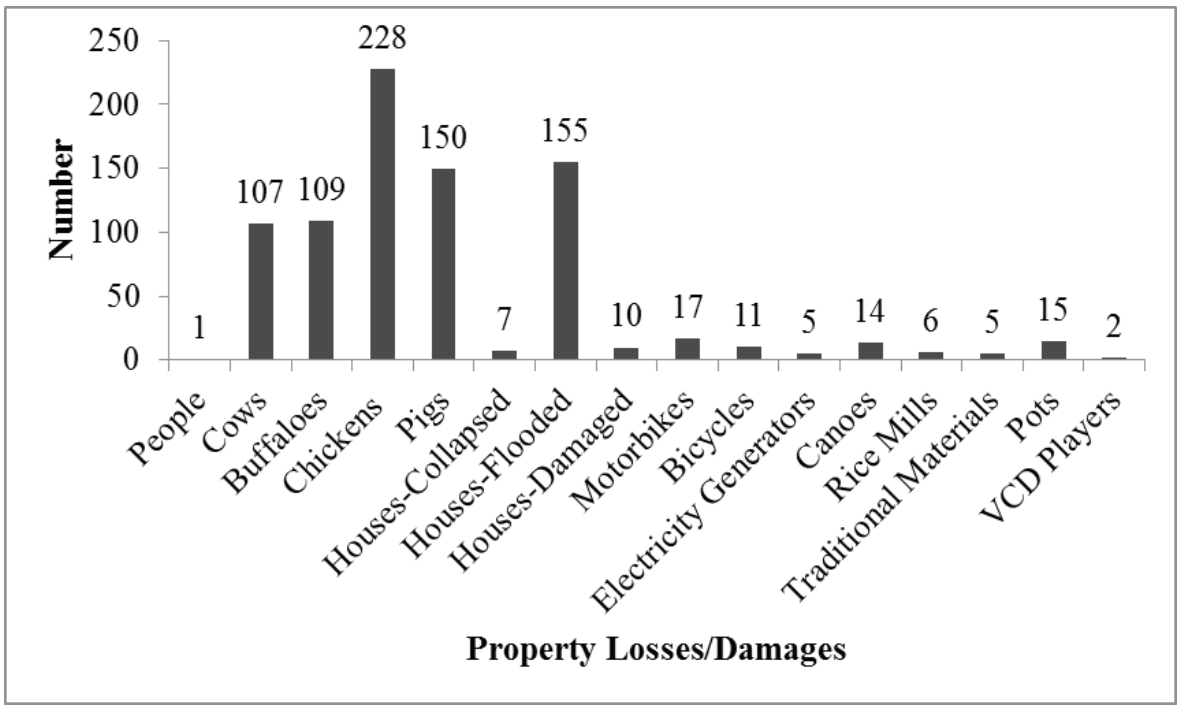


Figure 4: Damage to Sesan Commune Property caused by the Dam
Source: District report, 2009

**Timeline of Events in the Study Area**

The timeline of events in the study area shows that since the early 1980s, many changes, plus social and environmental events such as political elections, social changes and natural disasters (droughts and floods), have occurred in villages along the Sesan River. Villagers have noticed that the state of natural resources in the area – from which they make a living - has changed dramatically over recent years. Our interviews and focus group discussions revealed the experiences the villagers have had in relation to these changes and events, as shown in Table 2, which covers the last 30 years within the study communities:

Table 3: Timeline of Events in the Study Area

| Timetable | Events |
|---|---|
| Early 1980s | More fish in the river,<br>Crops grown on small islands in the river<br>Use of river water for drinking and bathing<br>No mobile phone access |
| From 1993 | Hydropower dams constructed in the Sesan River; upstream in Vietnam |
| Up to 1996 | Downstream communities on the Sesan River suffer severe floods and damage; caused by water being released from the dam with no notice and/or early warnings given<br>Changing crop patterns; some small islands disappear and crops abandoned due to changes in the water flow/current |
| 1997-99 | Floods occur for longer periods of time and cause severe damage |
| June, 2000 | Severe floods and droughts occur, causing severe destruction and loss of some lives<br>Cambodia National Mekong Committees (CNMC) writes official request letter to the VNMC re: impacts of the dam's operations on community livelihoods and physical infrastructures<br>VNMC creates research team to investigate problems in the Sesan River (in cooperation with the MRC |
| From 2004 | Start to use wells rather than river water for consumption<br>River water muddy; occasional skin-diseases<br>Committees in charge of management of the Sesan River cease operations |
| 2009 | Receive more information on water release plans from dam operators/others using mobile phones<br>Number of mobile phones used by villagers increases |
| | Flash flood occurs due to heavy storm (Ketsana)<br>High water levels and strong currents in river<br>Change in crop patterns and cropping strategies; from use of river banks to the upland, forest areas - those far away from residents<br>Still limited news on flooding events |
| | Interventions and help offered by outside organizations (border police, disaster committees and local NGOs)<br>Severe floods caused by dams; villagers receive foodstuffs (tinned fish and basic materials/gifts) from Vietnamese helicopters |
| 2011-present | Fish catch declines significantly<br>District office receives early warning on water release from the dam. |

Source: Field survey, 2012

### *Notifications - Information Flows*

According to our study, the flow of water release information from Yali Falls Dam can be divided into two types: (1) official information flows and (2) unofficial information flows.

Official Information Flows

*A) National level*

Letters regarding water release events and dam operations are sent by the VNMC to the CNMC, which is situated within the Ministry of Water Resources and Meteorology. These letters are sent by fax. There are two types of letter sent: normal situation letters and emergency situation letters. The emergency situation letter is sent at short notice, saying; for example, 'water will be released in the next two or three days; a large amount of water ranging from 1,000 cubic meters ($m^3$) to 5,000 $m^3$, which may cause severe flooding'. After receiving the emergency letter from the VNMC, the CNMC transfers it to the affected areas immediately.

Regarding the normal situation letter, water is usually released within one week of the letter being sent by the VNMC, and in these situations the volume of water being discharged will be of a medium amount. Usually, the normal situation letter goes to the Administration Department (who register its receipt), and then it is sent to the Department of Projects – which adds an enclosure seeking approval from the H.E. Secretariat of the CNMC. When the Secretariat has approved it, the letter is sent to the affected areas. It should be noted that the letter sent by the VNMC is in Vietnamese and English; therefore, the letter prepared by the CNMC needs to be translated into Cambodian, to make it easy for local people to understand.

According to Mr. Chhieng Hong, Deputy Director of the Department of Projects and a coordinator at the National Navigation Programme, the letter is sent to relevant stakeholders, such as the Ratanakiri Municipality, the Standing Committee on the Management of Dams and Canals along the Cambodia-Vietnam border, and the Provincial Department of Water Resources and Meteorology. The letters are sent by e-mail, fax and post. Usually, the letters are not sent by post because this route takes around one or two weeks to reach the target area and costs a lot of money.

*B) Provincial level*

According to our key informant interviews at the provincial level, Ratanakiri Provincial Municipality and the Provincial Department of Water Resources and Meteorology work together on the communication issue. The Department of Water Resources and Meteorology analyzes the information received from the CNMC and the data related to water levels in the Sesan River, in order to calculate the level of the water when released from the dam. In cases where the water level is high enough to flood the communities, the Department of Water Resources and Meteorology sends the information immediately to the provincial governor for immediate action, after which it is transferred to the four districts located along the Sesan River, including O Yadao, Andong Meas, Ta Veng and Veun Sai. Usually, the most effective way to share the information is by mobile phone or 'icom' radio, with an official letter sent later.

*C) District level*

After receiving the dam operations' and water release information from the provincial level via phone or icom radio, the O Yadao District governor takes immediate action, transferring the information to Sesan Commune, the only affected area located along the Sesan River. The information is always sent to the commune by phone or icom radio, but as Sesan Commune is in a remote area, it is sometimes difficult to communicate by phone. When the information cannot be sent by phone, a district chief always assigns an officer to go to the commune to share the information directly. Here, it is important to note that the district officers told us the information is sometimes not accurate and is late, making it difficult for them to transfer it to the target commune on time.

*D) Communal level*

According to our interviews with the Commune chief, the Commune did not receive any information related to the dam's operation and water releases between 2000 and 2009. In 2009, information on Typhoon Ketsana was sent to the Commune via phone, but it came through as just a normal weather report. When the typhoon hit Vietnam in 2009, water was released from the dam, leading to severe flooding in the downstream communities.

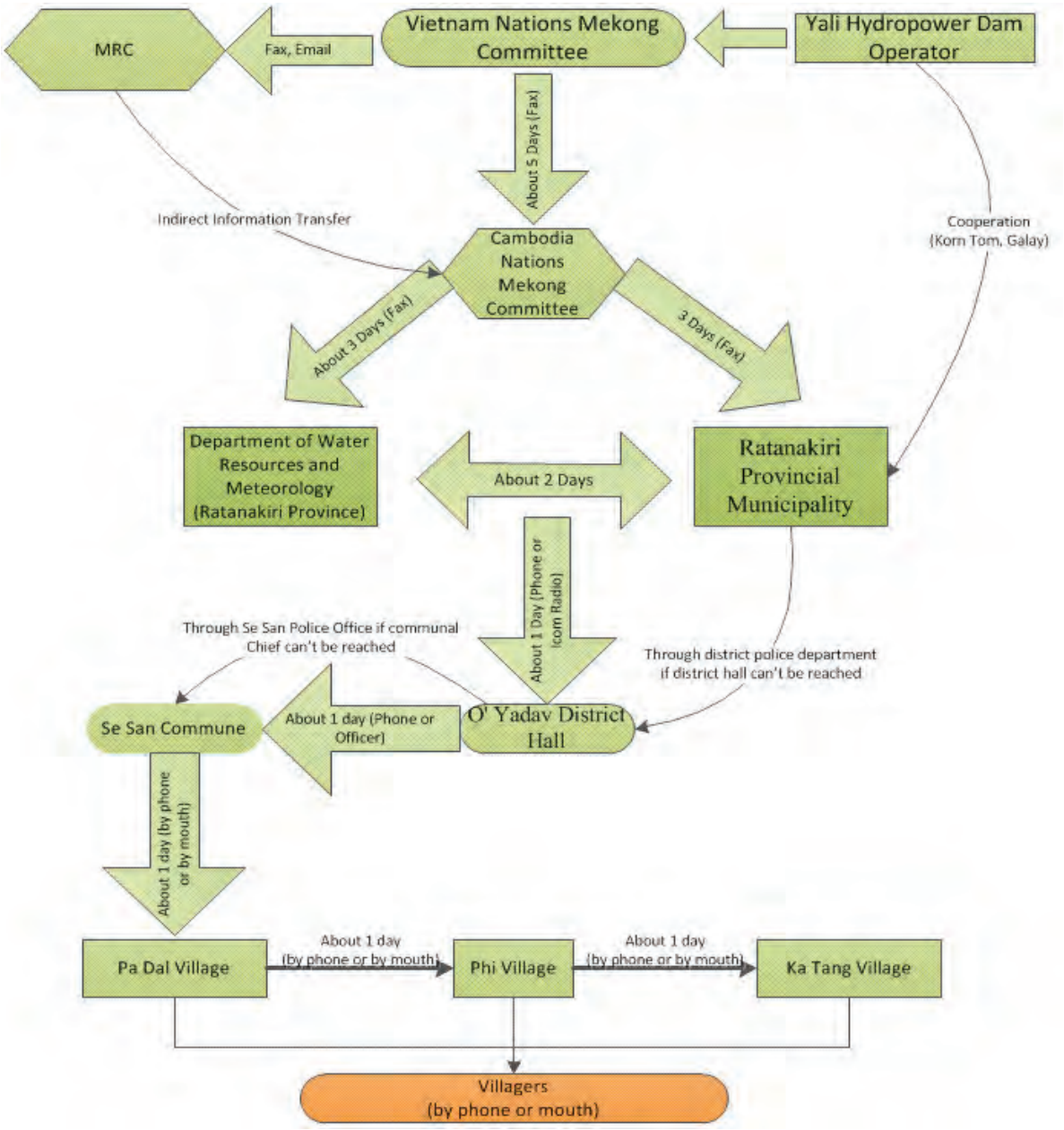


Figure 5: Official Information Flows
Source: Field Survey, 2012

### *Unofficial Information Flows*

According to the results of our study, unofficial information flows are the most common way in which local people in the study area receive information about the dam operations; from other people in their community by word of mouth. Since the severe flooding event of 2009, people in the affected community have been constantly worried about such an event happening again; therefore, unofficial information about the dam's operations helps them prepare, mentally and physically.

Local people do not really rely on the official information flows; instead they gather information from a variety of unofficial sources. Usually, people receive information from

their relatives, such as Cambodian soldiers based at the border. Mr. Siev Ang, a villager in Phi Village, told us he has not received official information since the disaster in 2009, but instead receives information from his relatives who work at the border by phone, after which he sends it on to other villages in Sesan Commune. He also mentioned that his relatives receive notifications from the Vietnamese soldiers posted at the border. Generally, information is shared whenever there is a change in weather conditions, in the water level of the river, or when the situation at the dam changes. Unofficial information is important for the affected people, even though sometimes it is not correct, and in fact people normally receive the unofficial information before they receive any official notice.

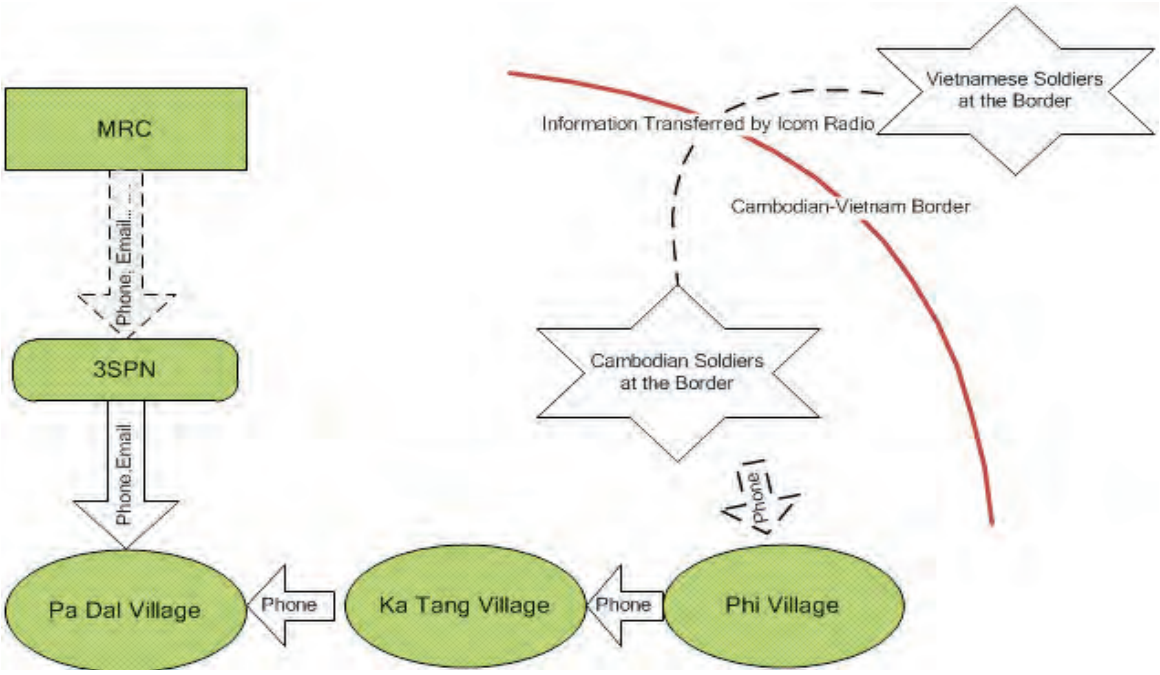


Figure 6: Unofficial Information Flows
Source: Field Survey, 2012

### *Capacity to Cope with Flood Events*

The coping capacity of the local people with regard to flooding events will be discussed here; to understand to what extent the affected communities have the ability to cope with changing conditions in the river system. The extreme flood event that occurred in 2009 (caused by Typhoon Ketsana) will be used as a case study.

Prior to the Flood Event

Most people in Phi and Katang villages told us they did not receive a water release notification prior to the flood event in 2009, either from the village chief or from local government agencies. In contrast, people in Padal village said that information pertaining to Ketsana and the danger of flooding was delivered to them via the Sesan Commune chief, who received it from the provincial governor by phone – though it was delivered to them very late. In addition, the Sesan Commune chief said that the information was a warning about the impending storm, not about the dam operations. As the information they received was not

clear, so they did not believe it, and as a result, local people did not pay attention to the notification and did not prepare themselves for such an extreme event.

During the Flood Event

During the flood event of 2009, which was caused by water being released from the dam, those in the affected villages suffered a lot, as they did not expect such severe flooding to occur – such an extreme flooding event had not occurred before. The affected people attempted to move to the hills or to higher ground near their villages in search of temporary shelter. Boats were mostly used to evacuate family members and property; however, because the water was rising so fast, those affected could not take foodstuffs or other materials; their rice stocks were washed away and their animals drowned. As the result, they suffered shortages of food and drinking water, plus lacked proper shelter.

Having had to evacuate with little time to prepare, they lacked food and clean water, plus proper shelter, and this caused them serious problems while staying on higher ground near the village. To deal with this situation, those affected tried to phone for emergency relief from the provincial government agencies and NGOs. Phoning was the best way to communicate with people outside the area, because they were surrounded by water and transportation was impossible. Eventually, emergency relief was delivered by provincial government agencies, NGOs and the Vietnamese government.

After the Flood Event

After three days of flooding, the affected households decided to return to their homes; to clean-up and repair their damaged houses, as they were aware that the dam upstream had caused serious flooding. Emergency relief was delivered after the flooding event by the provincial governor, by provincial government agencies, the Cambodian Red Cross, Oyadao District office, 3SPN, Care Organization, JIK and a representative from a Danish organization. This emergency relief included food and some other items/facilities.

To cope with future, unforeseen floods, people in the villages affected previously now share relevant information by phone and using other forms of communication. Here it is necessary to note that people in Phi village always receive information on the dam's operations prior to the other villages, because they have relatives working at the border who are able to share information with them.

## Conclusion and Recommendations

### *Conclusion*

Communities along the Sesan River have long depended on the river for their livelihoods and food sources; however, water flows in the river have changed in recent years due to the construction of the dam upstream. The change in water flows that has resulted from the building of the dam has led to unusual flooding events, water level fluctuations, bank-erosion and increased dry season flows, but until recently scientific research findings have indicated these changes were natural. In fact, the floods that occurred in 2006, 2009 and 2010 caused

significant losses among the villagers in terms of their livelihoods, assets and property, as well as environmental damage such as river bank erosion.

Since the damage caused by hydropower dams can be considered a man-made disaster, a lot of effort has been put in by local and international NGOs to develop the appropriate compensation and environmental mitigation measures, plus restore the flow regime of the Sesan River and the livelihoods of villagers living alongside it, and such measures should be taken into account by dam builders in the future. Other efforts have been organized by local and international NGOs, those mainly based in the area, who have worked with Sesan community to build an advocacy network. The aim of this network is to seek greater cooperation from the government and the dam builders; to develop more effective river basin management policies and processes, and to address the adverse consequences of trans-border hydropower projects. Since late 2001, this community network has been strengthened through the provision of capacity building initiatives.

Advocacy-based local NGOs, such as the 3SPN, have played an important facilitation role and initiated a number of activities, such as supporting community-based research and community consultation on environmental awareness and protection programs. As a result, local communities have spoken to policymakers at the national and international levels about the impacts of the dam on local livelihoods; taking their actions to all political levels. In addition, the River Coalition Network (RCC) is the social network arm of an NGO coalition, and has been established to encourage local and international NGOs to express their concerns and seek policy reform regarding river basin management, as well as social justice for the affected communities.

As a result of these efforts, Vietnam has realized and accepted the fact that Yali-Falls dam impacts upon the livelihoods of downstream communities in Cambodia, and having understood the issues, has begun to address community concerns. For example, the Vietnamese government has constructed the Sesan 4A re-regulatory reservoir near the Cambodian border - to stabilize water flows, and has conducted an environmental impact assessment along the Cambodian part of the Sesan River, to assess and mitigate the negative social impacts of the dam. Recently, significant efforts have been made to improve information flows, and concerned voices among the affected communities have been acknowledged, plus a joint environmental mitigation plan has been put in place by the two governments and the dam builders. However, challenges and constraints remain; for example, resettlement plans, appropriate compensation packages and environmental plans are still limited in scope and have not yet been considered fully.

### *Recommendations*

This working paper makes practical recommendations for improving public participation, as well as information sharing and awareness of the environmental and social impacts of the hydropower projects among downstream communities along the Sesan River, and below are our key suggestions and recommendations in this regard:

- A notification issued by the dam operator in Vietnam should be sent directly to the communities and local authorities in Ratanakiri Province, Cambodia, to help affected

villagers prepare for flooding events.
- Existing civil society, NGO and community networks should be strengthened, in order to improve public participation levels.
- A permanent water recording system should be installed, in order to make local people aware of and be able to prepare for flooding events, so they can move to safety and prevent losses and damage to their property.
- As far as possible, the potential environmental impacts of the dam's operations should be mitigated against, and
- Appropriate compensation packages should be put in place for when a disaster has already occurred.

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# The Implications of Hydrology Change on Local People's Livelihoods around Tonle Sap Lake: A case study in Chhnok Tru, Kampong Chhnang Province

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## Abstract

A stable hydrological regime brings natural, social and economic benefits, but if it is unpredictable and varies a lot, instead can have negative impacts. The Tonle Sap Basin is a unique water resource, both for Cambodia and for South East Asia, as it plays an important hydrology management role for the upper and lower Mekong River. It is also hosts a huge number of fish and other ecosystems which support local livelihoods and the economy of Cambodia as a whole. However, this unique asset is being adversely affected by a number of factors, including hydrology regime change - which is impacting upon the whole area's ecosystem.

This study explores evidence as to how the hydrology of the area is changing and the impact this is having on the livelihoods of local people who live in and around Tonle Sap Lake. It has three objectives: (i) to understand how the hydrological regime has changed in the study area over recent years, (ii) to identify the impacts of this change, and (iii) to explore the existing adaptive capacities of local people; those used to avoid hardship. To achieve these three objectives, secondary data was obtained from relevant stakeholders, such as ministries,

NGOs and libraries, as was primary data, for which participant observation, focus group discussions and household interviews were used to investigate the impacts of hydrological regime change on local people and the adaptation strategies practiced by them. Hydrology change at the study site was analyzed based on water levels and timing, with twenty year's worth of data taken (1991-2010) from Preakdam hydrological station, and this was compared with local people's perceptions of the changes that have taken place.

The results show that water levels and the timing of the water flows in and out of the area have changed over the period, according to the technical database held at Prekdam hydrological station, which is run by the Ministry of Water Resource and Meteorology (MOWRAM). The water level has become much lower in recent years, a phenomenon which has grown more significant over time. In addition, the timing of the water flows into and out of the area has also changed; in some years, water flows in have started in May, while in others they have been delayed until June. However, the annual total water flows did not vary so much over the twenty year study period, and if observing the historical data on technical grounds, the hydrological regime has changed only slightly when compared to the past overall, but has changed more in recent years.

These findings are not so different from local people's perceptions, for they believe the hydrological regime has changed - based on their lived experiences – and this has had both a direct and indirect negative impact on their lives. Fish numbers have declined significantly, meaning local people now earn a lower income from their fishing activities than they did in the past. In addition, due to the decline in fish numbers in the area, local people now spend a lot of money traveling to other areas to fish, spend more time fishing and also use illegal fishing equipment, activities that are placing a lot of pressure on the local fish species. Although people now earn a lower income, they have to spend a lot of money moving their houses to safe locations during the wet season, maintaining their houses and buying new fishing equipment - hardships they face every day. This shows that people have had to adapt in order to lessen the negative impacts of these changes on their livelihoods, such as using more modern fishing equipment, expanding their fishing areas and diversifying their income sources. However, their capacity to adapt is limited and sometimes insufficient; therefore, the government, international NGOs, local NGOs, the local communities and other stakeholders, should pay more attention to hydrological change and its causes and impacts in the study area. Tonle Sap Lake is not only a key water reservoir, but hosts a range of ecosystems, plus provides food and economic growth opportunities. As a result, further technical studies and systematic interventions should be encouraged and carried out.

**Keywords:** Hydrology change, impact of hydrology change, livelihoods, Tonle Sap Lake, Fisheries

## Introduction

Tonle Sap Lake is the largest lake in Southeast Asia and contains diverse ecosystems, plus supports a wide variety of social, economic and cultural activities. The lake is seen as the backbone of economic development in Cambodia, and directly or indirectly provides employment to approximately two million people living in its environs (Kummu et al., 2013; Hap, 2006). As a consequence, over recent decades the lake's resources have been degraded

significantly, having a serious impact on the livelihood activities of people living there. According to reports, the decline in resources has been caused by a variety of factors, such as unclear property rights, overfishing, deforestation and pollution (Serrat, 2005). In addition to these detrimental factors, hydrology changes have also contributed towards the decline in resources around Tonle Sap Lake. Previous studies suggest that the changes that have occurred include changes in the flood patterns, changes to the hydrological regime - including the water in-flows and out-flows to and from the lake - and changes in the water level of the lake, upon which a large proportion of the fish resources are dependent (Paula et al., 2010). Naturally, a stable hydrological regime is highly important for maintaining biodiversity, natural habitats and soil fertility levels (to support cropping systems) (Baranand and Myschowoda, 2009; Kite, 2001; Kummu et al., 2013); moreover, this stability helps create vast areas of wetland and flooded forest, which have high fish productivity levels, are rich in biodiversity and have diverse ecosystems (FAO, 2011).

In particular, the hydrology of the Tonle Sap is changing rapidly (Benger, 2007; MRCS/ WUP-FIN, 2005), as identified through the following flood indicators: timings, periods, levels, speed and scope (Kummuand and Sarkkula, 2008). The flow of water from the Mekong River to Tonle Sap Lake each year gives an indication of the lake's sustainability, for this flow creates a large breeding ground for fish. Every year, thousands of tons of fish are caught by fishermen around the Mekong and Tonle Sap areas, helping to boost economic growth and provide food and jobs for people and relevant stakeholders. Around 1.2 million people who live in the Tonle Sap area depend on its resources for their survival (Heikinheimo, 2011), though fishers earn on average only 127 US Dollars per person per year (Hap, 2006). This shows that the Tonle Sap helps maintain both household incomes and the country's gross domestic product (GDP).

Unfortunately, these benefits are no longer as stable as they once were (Laberts, 2008; MoE and UNDP-Cambodia, 2011), particularly as the construction of hydropower dams, water reservoirs and irrigation schemes, plus land use changes and climate change, have led to major hydrological changes to take place (Kummu and Sarkkula, 2008; Smith, 2012), and these changes have had an impact on the ecosystems and socio-economic structure of the area. It is not only the fishers who rely on the aquatic resources to be found in Tonle Sap who have suffered negative impacts; other workers, such as farmers, laborers, boat and general services workers have also suffered (Keskinen, 2003; Nuorteva et al., 2010), though it is the farmers and fishermen who dominate in the area who are the most vulnerable (Nuorteva et al., 2010).

In order to improve their livelihoods, people have started to adapt to the hydrological changes; however, in order to develop appropriate solutions and strategies, the exact nature of the problems faced, plus their impacts and the existing local initiatives in place, need to be understood. As a result, this study will identify those issues requiring further technical study, plus will share experiences and policy recommendations.

This paper will examine how hydrological changes have impacted on people's livelihoods in the Tonle Sap area and how people have adapted to the hardships they face. The aims of this paper are to: 1) explore and determine the historical changes to have taken place to Tonle Sap Lake's hydrology, in order to develop a thorough understanding of the study area's

hydrological patterns and regimes, 2) identify the possible impacts of any changes on the hydrology of the study area, and 3) explore the existing coping and adaptive capacities used by the local communities in order to deal with the impacts of these hydrological changes.

### *Scope and Limitations of the Study*

We selected one village named Chhnok Tru for the study - a floating village in Chhnok Tru Commune, Boribor District, Kampong Chhang Province. The aims of the study were to identify historical changes in the hydrology of the area, including water level and water flow changes, as measured by Prek Kdam station, and also to capture people's perspectives and perceptions regarding the changes to have taken place, including the impacts on their households and livelihoods. Though the distance from Prek Kdam station to Chhnok Tru village is quite far, an official from MOWRAM confirmed it would be a good site to use for the study. In addition, historical data was used to understand the perceptions of local people, with the impacts of the changes on fisheries used as the main livelihood measure, as most people at the study site are fishermen. In fact, only fishermen who have a permanent house located at the study site were chosen to be participants in the research.

## Methods

### *Study Site Selection*

Chhnok Tru is one of three floating villages located in Chhnok Tru Commune, and shares a border with Phat Sanday Commune in Kampong Svay District, Kampong Thom Province to the north, Kar Chab Commune to the west, Ponley Commune and Boribou District to the south, and Kampong Phrash village in Chhnok Tru Commune to the east.

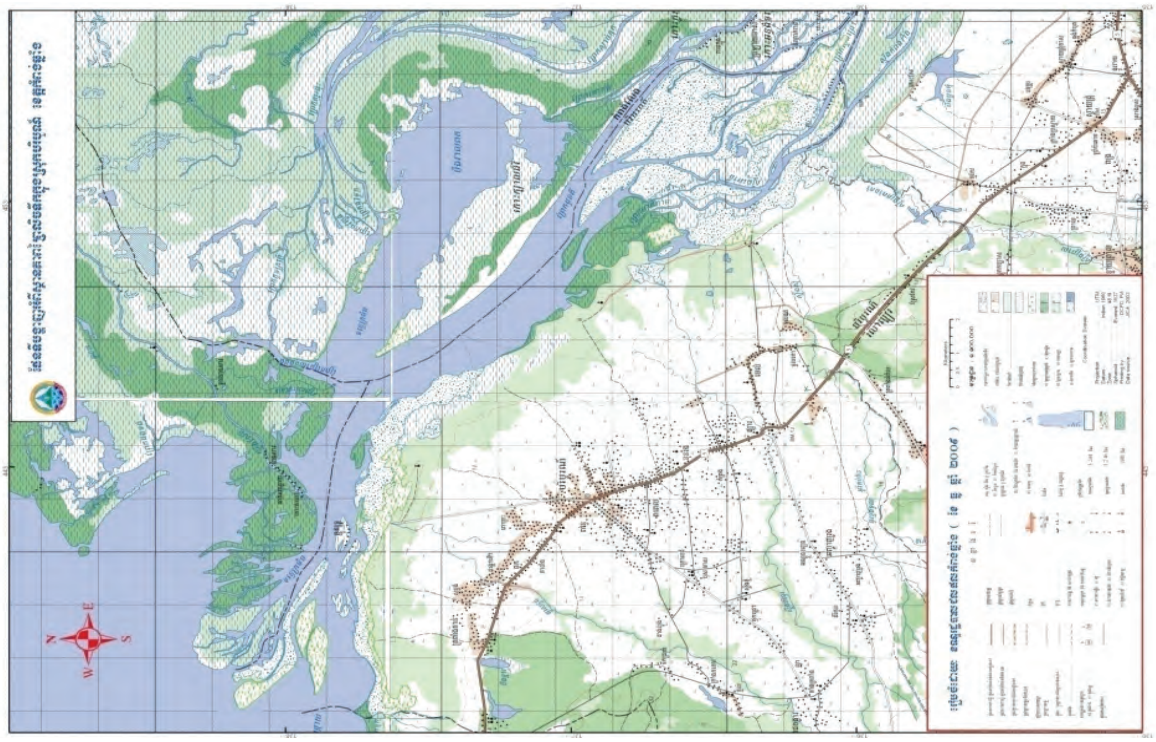


Figure 1: Flooded Forest in the Chhnok Tru Area
Source: Fisheries Administration, 2009

Most parts of the study site are covered by water, but land is also available for crop cultivation activities in some areas during the dry season. The village has two small islands within its boundaries, namely Chhnok Tru and Mo No, which local people use to grow crops such as rice, potatoes, pumpkins, musk melons, mandrels and water melons in the dry season. The area also has many kinds of flooded forest tree species, such as *Barringtoniaacutangula, Coccocerasanisopsdum, Diospyroscf.bejaudii, Combretumtrifoliatum, Terminalia cambodiana* and *Ficusheterophylla.* The flooded forest in Chhnok Tru provides an essential habitat for fish, including *Puntioplitesproctozysrom, Henicorhynchussiamensis, Hypsibarbuslagleri, Thynnichthysthynnoides,* and *Hypsibarbuslagleri,* and also helps to protect local people's houses from storms and waves. In fact, all ecosystems within Tonle Sap Lake and the Tonle Sap River area act as the main livelihoods source for local people, offering benefits in the form of significant biodiversity levels, especially among fish species. Tonle Sap Lake is well known as having among the highest fish densities in the world, and it is this which has attracted people to live on and around its waters over time. Living in a floating house on the water is just like living among the fish and among your own personal food source.

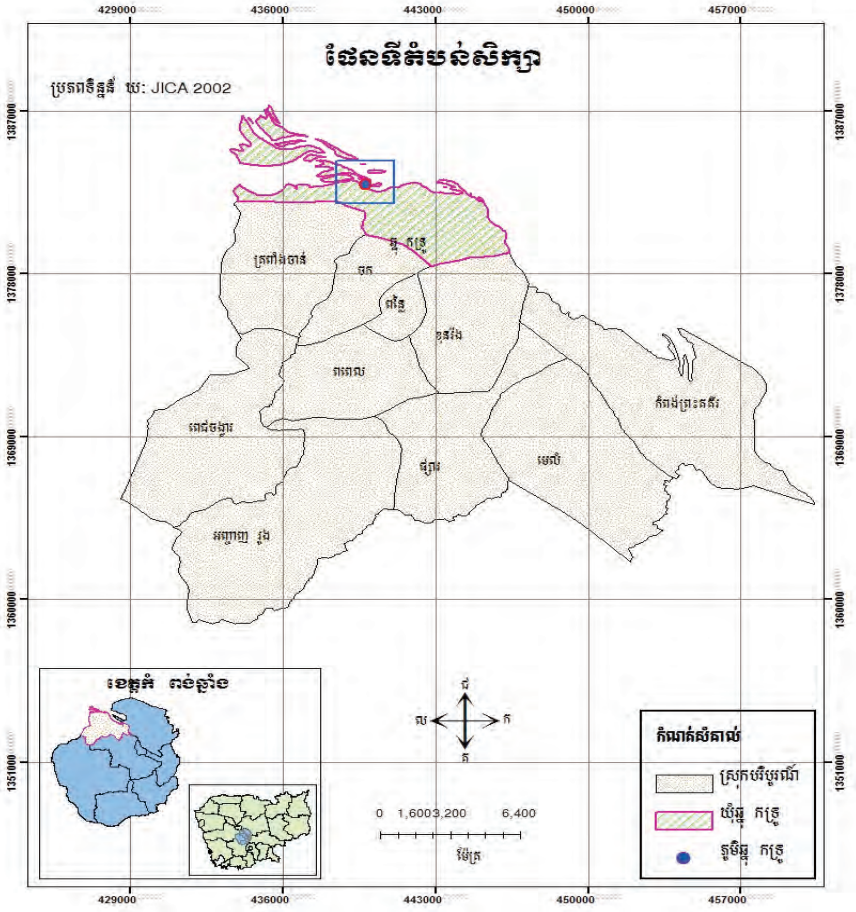



Figure 2: Chhnok Tru Village Map

A floating village in Kampong Chhnang was selected as the study site, due to its special characteristics. Up to a decade ago it was considered to have among the highest fish densities in the area, but over the last decade the number of fish has decreased rapidly. As a consequence,

people's livelihoods have been seriously impacted. People's living standards have also suffered, forcing some households to use illegal fishing gear in order to catch fish. Other households have decided to stop sending their children to school; instead, having them work at home to help with their families' survival, while others still have decided to send members away in search of work, either to other areas of the country or abroad. So, one can see that recognizing the difficulties they face, people have started to adapt, making it the right time to conduct a research study in the area.

Generally, people in the study village live close to each other, as a big community - living inside the red circle shown in Figure 2, and it was this area that was used for our household interviews and group discussions. Furthermore, observations were conducted outside this area, to the left and right of the circle, because these areas participate heavily in fishing activities also.

### *Data Collection and Analysis*

**Sample Selection:** Only fishing households with a permanent house located in the study area were selected as interviewees, and only household heads (whether the wife or husband) - those who make decisions in the family - were asked to join the group discussions and take part in the questionnaire surveys. Regarding the size of the sample, this was based on the 47 small groups classified by the local authorities, in which each group has around eleven to thirteen households living near to each other and with similar occupations. This classification made it very easy to select randomly one participant or representative from each group, meaning a total of 47 samples joined the interviews. However, this total did not include those households invited to join the group discussions.

**Secondary Data Collection:** As much secondary data as possible was collected from relevant institutions, such as the Royal University of Phnom Penh, MOWRAM, the Ministry of Agriculture Forestry and Fishery (MAFF), the Ministry of Environment (MOE), the Cambodia National Mekong Committee (CNMC), the National Committee for Disaster Management (NCDM), the Mekong River Commission (MRC) and the Cambodia Development Resource Institute (CDRI), as well as NGO forums, the Fisheries Action Coalition Team (FACT), and a variety of social and economic reports published by the local authorities. These resources provided very useful background information on the study site, plus its existing problems and some of the solutions to be found. Historical data on the hydrology of the area and fish populations was obtained from these sources also, as were relevant policy documents.

**Primary Data Collection:** Primary data was collected from various sources in support of the study's objectives. Focus group discussions and Participatory Rural Appraisal (PRA) were the main tools used to collect the primary data, and seven to twelve fishermen joined the discussion groups, these being the tools used to find out more about the problems being experienced and the existing livelihood strategies used by the local people. In addition, these methods were used to explore historical aspects of the area's hydrology regime and fishing resources. Mapping is a tool used within PRA, and this was used to identify the boundaries of the village and of the fishing, crop cultivation and protected areas. A seasonal calendar tool was also used to understand the livelihood strategies of the villagers, based on the

different activities carried out over the course of the seasons. Using this tool, all livelihood activities in support of the households' food security and income generating requirements were recorded in a table which covered all the months of the year, and with a timeline drawn to show the hydrology, fishing activities and background of the villages over time. In addition, questionnaire, semi-structured and in-depth interviews were used to obtain more detailed information, based on villagers' illustrations and descriptions of the events to have occurred; for further analysis. Field observations were also used to assess the geographical setting and the activities of local people at the study site.

**Data Analysis:** All the qualitative data was interpreted in a descriptive and narrative way, while data from the household questionnaires was entered into an SPSS spreadsheet. All the data was then analyzed using means and cross-tabs to obtain the central parameters, with simple descriptions created in relation to average incomes and expenditures, as well as the perceptions of the fishers in relation to the hydrological changes that have taken place.

## Results

### *Demographic Profile and Culture*

There are 591 households in Chhnok Tru, which has a population of 2,854 people. The average age of those who participated in the study was 44 years-old at the time, with most from the Khmer ethnic group. All are Buddhists. More than 70% of the respondents have only a primary school education, while 6.4% went on to secondary school. The illiteracy rate among the respondents is 17%, meaning that overall the education level of the respondents is very low. Most of the households interviewed have fishing-based livelihoods, while the rest run businesses or services to generate an income.

Table 1: Socio-economic Statuses of the Respondents

| Components | Mean-Frequency |
|---|---|
| Number of respondents | 47 |
| Male respondents | 38.30% |
| Percentage of female-headed households | 10.64% |
| Average age of respondents | 44 years-old |
| Education level of respondents | Primary school (74.47%); secondary school (6.41%); high school (2.10%); did not attend school (17.02%) |
| Fishing as the main occupation | 65.96% |
| Buddhists | 93.60% |
| Khmer | 93.60% |
| Married | 89.36% |
| Average household size | Six people in a household, with three working |

Source: Field survey, 2012

Local people in the study village live on the water and do not own any land upon which to build houses or carry out farming activities. Though some households cultivate crops on islands located in the village and in nearby villages, they do not own this land, but have permission from the appropriate authorities to do so. However, these islands can only be cultivated during the dry season, as during the wet season the water is too high and contains strong currents. To adapt to such wet season conditions, local people move their houses and moor them in safe locations within the flooded forest or close to land - in shallow water located close to the two small inlands in the Tonle Sap area. Throughout the year, they are continually moving their floating houses in this way.

Among the village population, the level of education is a big concern. Around 74.5% of the respondents only completed primary school, while 17% did not attend school at all. Added to this, only a few respondents were able to continue to secondary school or high school levels.

Figure 3: Floating Village in Chnuk Tru
Photo: Author

As this shows, the overall level of education in the village is very low, due mainly to low formal school enrollments as a result of insecure family conditions and safety issues. Living in a floating village means sending their children to school is very expensive for the households, plus the children are needed to help their parents with the fishing and farming activities, to sustain household food security and incomes. Also, traveling by rowing boat or motor boat to school every day is not so safe, especially in the wet season, during which time strong currents and waves are a key feature. These are some of the obstacles to and constraints placed on the local people when wishing to send their children to school.

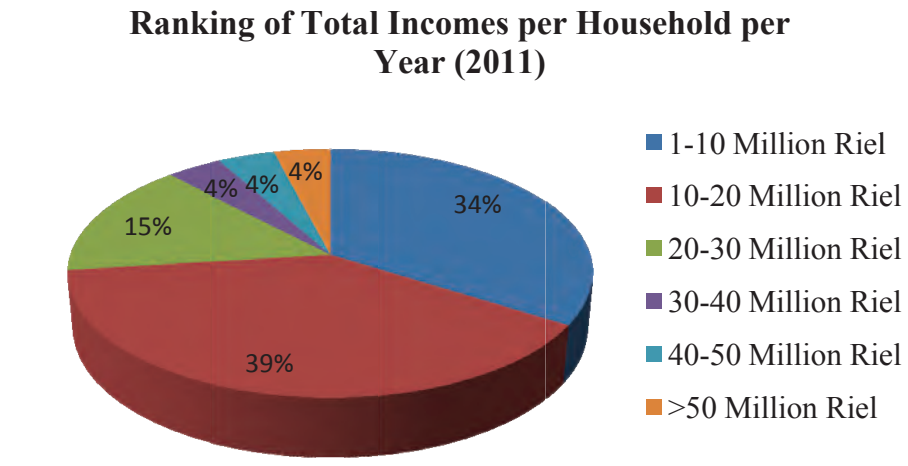
Regarding ethnicity, there are three ethno-religious groups within the study village; the Khmer, the Khmer-Muslims (Muslims have been living in Cambodia for a number of centuries) and the Vietnamese. The Vietnamese and Muslims migrated to Chhnok Tru village to find work and make a living some time ago. These three ethnic groups have different

cultures, but are on good terms and communicate with each other in terms of their fishing plots, product exchange and trade activities.

The local people also cooperate well with the local authorities, including the commune councils, the village headmen, the Fisheries Department, the Environment Department and the police. More than half (60%) of the respondents said they used to participate in village meetings to discuss healthcare, the local environment, fishing gear, security and other issues.

### *Economic Status/Occupations*

Fishing is the primary source of food security and also the main income source in the study village, and more than 82% of the respondents generate an income from fishing activities. In general, local people travel to the fishing area near Kampong Thom Province in the early morning and return to the village in the evening. Around three members of each family are involved in fishing activities, catching between one and twenty kilograms of fish per day. Besides fishing, local people also farm on three small islands located in the village, on which rice and other mixed crops are grown extensively during the dry season only. Many kinds of crop are grown, including chilies, tomatoes, corn, sesame, water-melons, beans, winter melons and musk melons. Winter melons and musk melons are the key cash crops for local people, and seasonally a mixture of crops is grown twice a year. The first growing period is between January and March, and the second period lasts from May until June, ahead of the flooding season. Some local people also run small businesses and work in other employment activities, such as selling petroleum, vegetables and meat, plus ice processing and food storage.




| Average total income | Min | Max | Std.D |
|---|---|---|---|
| 16925851 | 1260000 | 64375000 | 14147087 |

Figer 4 Income Ranges of Respondents

Based on the income sources in 2012 the respondents earned an average income of around seventeen million Riel per household per year. Regarding the income ranking of the households, they on average generate incomes of around sixteen million Riel per year (4000 US Dollars ) .

The highest ranked households; meanwhile, earn between twenty and 65 million Riel per year (5000 and 16000 US Dollars), though there is a very small number of these. With this amount of total income, local people are not able to save for future investments and household welfare improvements, because they need to cover their daily expenditures on food, fishing gear, house maintenance activities, clothes and social activities. However, even though their food security is generally assured, their livelihood situations in terms of extra income, the children's education, healthcare and households assets, are still highly constrained.

### *Hydrology and Changed Identifications*

Hydrology and hydrological regimes play a very important role in stabilizing ecosystems, for if the hydrology of an area changes, ecosystems will also change and with them, local livelihoods. Biodiversity can also be impacted, including habitats, food sources and migration patterns, particularly for fish species in the study area. Decreased biodiversity has a negative impact on food security and income generation activities, because local people's main income sources in and around the Tonle Sap Lake come from fishing.

However, to know whether the hydrology has changed at the study site or not, technical evidence regarding water levels and water flows in and out is regularly collected by MOWRAM, at Preak Kdam hydrology station. This data will be used here to identify the hydrological changes taking place at the study site, because this station is the nearest and most accurate station in terms of recording the flow of water from the Mekong River to Tonle Sap Lake every year. Taken together with the perceptions of local people, this evidence will be used to assess the hydrological changes that have taken place in the study area over recent decades.

### *Hydrological Changes Measured by MOWRAM at Prek Kdam Station*

Water level is one among a number of hydrology indicators used to identify significant changes in hydrological regimes. With regard to fish species, some require deep water to live and to find food, while other species can live near the surface. This makes it genetically very difficult for species to adapt to sudden water level changes, plus changes in oxygen, heat and food levels. If the water level changes rapidly and suddenly, some fish species become endangered or even extinct, meaning fish numbers decrease, and this can have a negative impact on other aquatic species, as well as those fishermen whose livelihoods depend on such species. This is particularly true in the case of Cambodia, and the graphs below clearly show the hydrology changes that have taken place in the study area over the last twenty years in terms of water levels and flow timings.

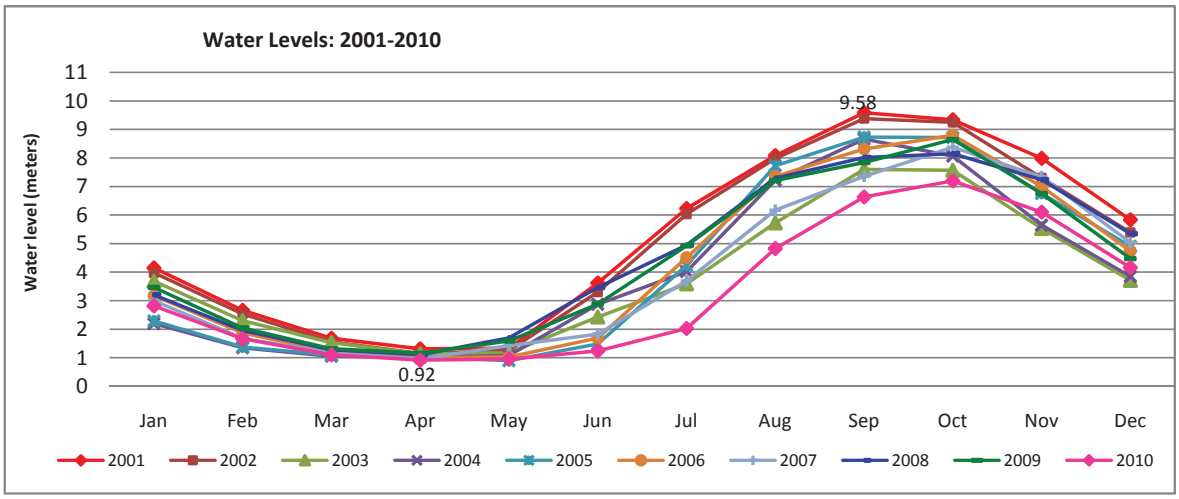



Figure 5: Water Levels between 2001 and 2010
Source: MOWRAM; based on hydrological data from Preak Kdam station

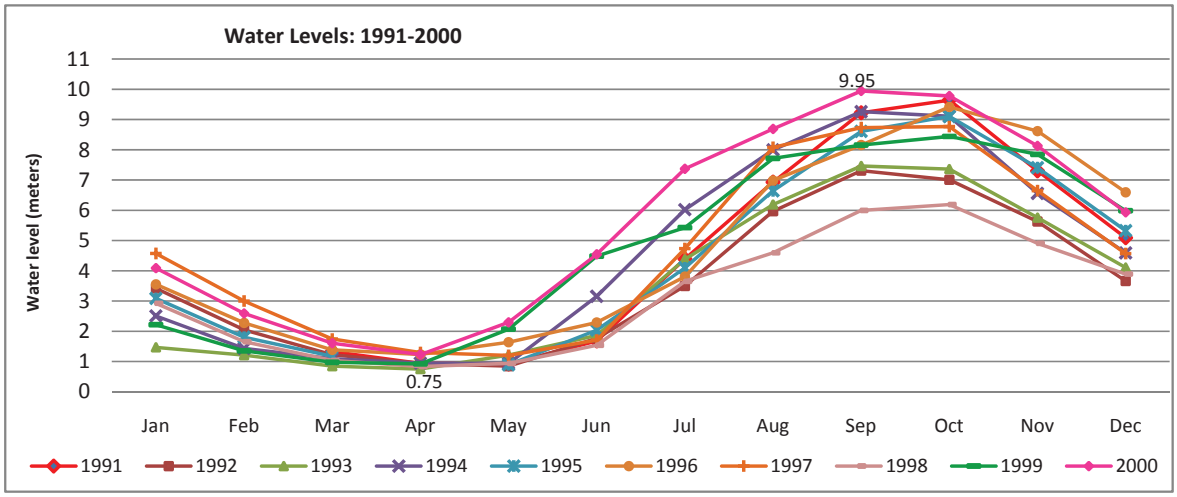



Figure 6: Water Levels between 1991 and 2000
Source: MOWRAM; based on hydrological data from Preak Kdam station

Regarding the water level changes that have occurred over the last twenty years, the lowest water levels, those reached at the end of the dry season, have not differed significantly from year to year; however, the high water level marks have varied a lot. For instance, between 1992 and 1995, the lowest water level recorded was around 0.75m, and varied a little in 1996 and 1997, ending up at around 1.30m. After that, the low level mark returned to lower values for 1998 and 1999. Indeed, between the years 2000 and 2010, the low water marks reached at the end of the dry season stabilized at around 1.30m.

As the wet season starts, so water starts to flow back towards and fill Tonle Sap Lake. As both graphs above illustrate, the interval between the low and high water levels has varied over the years. Natural conditions have not always brought the same water level rises for a given rainfall density over different years. In theory, these conditions should not have been so variable, meaning aquatic species will have found it hard to adapt. However, taking the peak water level as an example, when comparing over a number of years, one can explore

the differentiations seen. According to the decade's worth of data shown in Figure 4 (water levels from 2001 to 2010), the highest level reached was in 2001 (9.58m), and this level decreased every year up to 2010 (finishing at around 7.0m only). In 2001 and 2002, the peak water levels were very close to each other, at around 9.5m, but in 2003 the peak water level decreased dramatically to around 7.5m. Then, from 2004 until 2009, the peak water level rose back to previous values, at around 8.5m, and then stabilized until 2010, when the peak water level surprisingly decreased again, to around 7.0m. Observing Figure 6, the same situation in terms of water levels also occurred between 1991 and 2000. This unstable hydrological situation will have had a negative impact on some fish species, especially those less able to cope with changes in climate, food sources and habitats.

Regarding the timing of the flows into and out of the Tonle Sap, this varied by about one month over the study period. The water flows into and out can easily be recognized by when the wet and dry seasons start each year, and Figures 5 and 6 above show the monthly water level data over the last twenty years. However, as the Figures show, between 1991 and 2000, the water flows-in started during May, except in 1997 when they were delayed until June. In addition, between 2001 and 2010, flows into the lake started around June, except in 2007, 2008 and 2009, when they started in May. This data shows the level of variability in the start of the water flows into Tonle Sap Lake; for instance, from 1991 to 1996, this start period was stable, then varied in 1997 as the wet season came late, meaning water did not start flowing into Tonle Sap Lake until around June. After that, from 1998 until 2000, the inflows moved back to May, then from 2001 to 2006, reverted to June.

Water normally starts to flow out from the lake again during a specific period – normally from October or November. Over the last twenty years, the beginning of this outflow period has not varied so much - just a little between 1991 and 2000. However, differences in the timings of the water flows out of the lake are not so much of a problem for local people.

### *Hydrology Changes as Perceived by Local People*

All the people living in Chhnouk Tru are highly dependent on water resources for their livelihoods, both for generating an income and for food processing, for domestic use and for house maintenance. Therefore, even though the education level of local people is low, the recent changes to the hydrology and natural resources of the area have been clearly identified and understood by the local people based on their everyday experiences.

Regarding the hydrological regime, local people have noticed changes to flows into the area from the Mekong River. If these flows from the Mekong River did not take place, local flooding would not occur, and Tonle Sap Lake and other water sources such as streams and lakes would eventually disappear. In addition, the cycle of in-flows and out-flows is exactly what is measured by the Prek Kdam station. Water starts flowing into the Tonle Sap around May or June, and after filling the surrounding lake areas, water starts to flow out in November, with the lowest water levels being reached in April or May.

The results of our household interviews show that 65% of the respondents agree that the hydrology has changed in the area over the twenty years, with, in particular, water levels and the timing of in-flows and out-flows changing rapidly since 2000. Furthermore, from the two

focus group discussions (FGDs) held with local people, the research team found that the water levels have been changing, not only during the wet season, but also in the dry season. This view is consistent with the results of the household interviews, in which 70% of respondents said that the water level has changed significantly during the wet season and 52% also said it has changed during the dry season. Added to this, 68% of respondents said that the timing of in-flows has changed dramatically, while only 32% said that the timing of out-flows has changed also. This shows that many people take notice of the timing of the in-flow period during their daily lives, and as a result, have noticed the change, for although they do not measure specifically how deep the water is each year, they can tell based upon their experience. For instance, during 2012, water started to flow into the lake in July, which was late when compared to other years.

When comparing the perceptions of local people against the technical measurements, the results are remarkably consistent, showing that the local people pay close attention to hydrological changes in their area. It is also a sign that people have a good understanding of problems related to hydrology and its impact on livelihoods. However, some of the perceptions of local people were in contrast to the measured water levels from Prek Kdam station, so further interventions regarding the broadcasting of information and the use of personal observations are needed.

### *Perceptions on the Causes of Hydrology Change*

There is still no robust scientific evidence to illustrate how and why the local hydrology has changed in recent years; however, literature on the topic and the perceptions of local people point to some possible causes. Natural and man-made phenomena are the two most likely causes of hydrological change. In terms of natural phenomena, climate change has been cited as a possible cause, as it is expected to result in modifications to weather patterns in the Lower Mekong Basin, including rainfall levels, wind and temperature patterns, resulting in, not only an increased intensity, but also a greater duration and frequency of extreme weather events. Naturally, Tonle Sap Lake is connected to the Mekong River, so that when the wet season begins around June, the Mekong River and other water sources flow into the Tonle Sap to form an enormous lake, and when the dry season arrives, the Tonle Sap's waters drain back into the Mekong River (Vastila et al., 2010). This means that if temperatures and rainfall patterns change, it will impact on the Tonle Sap's entire hydrological system, starting first in the Mekong River. The Mekong River Commission (MRC, 2009) confirmed in a report that water storage problems, floods and drought may become more frequent and harder to predict in future years. Local people also claim that both the wet and dry seasons have become more unpredictable, which is a big problem, for if the wet season arrives late, so the Tonle Sap fills up late, having a negative impact on fishing activities. Hence, climate change is one factor impacting upon changes in both the water levels and the timing of water flows into and out of Tonle Sap Lake.

Another cause of hydrological change is human activities, and particularly the building of hdropower dams which can also impact on water flows in and out of the lake, both in the dry and wet seasons. In the wet season, water flows may be delayed and/or reduced and in the dry season increased due to the release of water by the dams (ICEM, 2010). Dams on the Mekong River are also likely to have a significant effect on the Mekong Delta, which supports

large-scale agricultural production activities (Pearse-Smith, 2012). Many dams are now being built or are planned in the Upper Mekong and its tributaries.

As evidence of this, local people have confirmed the surprisingly low water levels that have been experienced since the year 2000, with water levels of seven to nine meters experienced in some villages - lower than before. Local people say that hydropower dams impact on, not only the amount of water flowing, but also the timings and durations of these water flows. In addition, local activities themselves have contributed a lot to hydrology change in terms of the water levels. In particular, the Tonle Sap in the area around Chhnok Tru has become much shallower, which has had a serious impact on transportation activities, fish habitats and the number of fish species living in the waters. Living permanently around Tonle Sap Lake, local people throw a lot of waste materials into the water, such as plastics, plus illegal fishing barricades can also be seen in many areas, made of tree branches. The plastic and the broken parts of the fishing barricades then gather at the bottom of the river, slowly forming into 'islands' and leading to a reduction in the water level.

### *Impacts of Hydrological Change on People's livelihoods*

Living solely on the Tonle Sap's resources, people are constantly concerned about the possibility of changes to the hydrology of the river and lake, changes that could impact upon, not only the area's ecosystems, but also on the local socio-economic situation. In terms of livelihoods, it is not only fishermen whose lives are based on the Tonle Sap's aquatic resources who have suffered the impacts of resource decline, but also farmers, workers, boat service and general services providers; hydrology change has impacted on many livelihood systems. However, the main impacts have been on the livelihoods of local fishers. Figure 7 below shows the relationship between the changes in hydrology and the household fish catch over recent years.

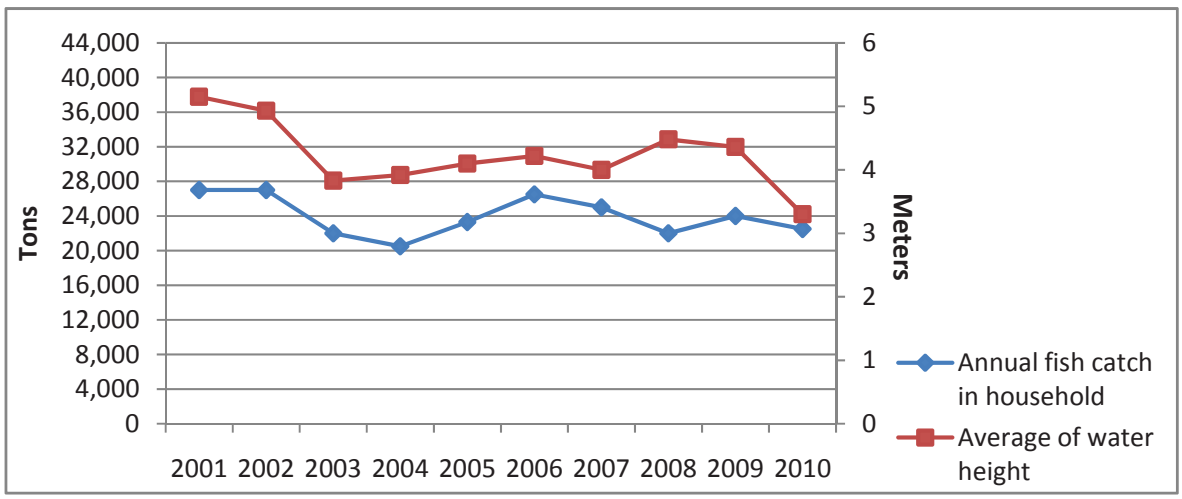



Figure 7: Water Levels and Fish Catches
Source: Fisheries Administration Report, 2001-2010

Figure 7 shows the annual fish catch as compared to the height of the water in the river over the period 2001 to 2010. One can see that as the water level declined, so did the fish catch, except in 2004 and 2008. These results are similar to those found by Baran (2009), who

concluded that the more water is present in a river, the larger the natural fish catch is likely to be. The graph of water flow timings and water levels from 1991 to 2010 shows that the water level has been lower in recent years, and this matches the perceptions of the local fishers, who have noticed the water becoming shallower and the fish catch declining over the same period. Fish habitats and feeding grounds can be lost when the water depth is too low, plus the increased temperature of the water can also have a serious impact on fish species. Furthermore, when the water is too low, local fishers cannot catch fish traveling from the Upper Mekong River to Tonle Sap Lake downstream, such as *Pangasianodongigas Datnioidesundecimradiatus* and *Catlocarpinosiamensis*. In fact, these fish species have become endangered in recent years and now face extinction due to habitat loss and a lack of sufficient nutrition and breeding grounds.

In addition, water level change has not only impacted upon the fish catch, but also had a negative influence on local people's livelihoods within both the dry and wet seasons. When the water level is low or there are unusual water flows in-season, the area of flooded forest, which is the main habitat for most fish species, decreases rapidly, and this has a serious impact on the fish catch. As the fish catch has declined, so fishermen have been forced to use illegal fishing equipment, such as fish barricades or narrow fishing nets, or travel further to catch fish in other areas. As a result, the fishermen are having to spend more time and money traveling.

So, natural pressures together with human activities have led to significant fish species decline, leading to lower incomes among the fishers and negative impacts on those who rely indirectly on fishing, such as transporters, vendors, fish processors and traders.

Moreover, local people now spend a lot of money on maintaining their houses due to the low water level and variable water flows; for example, strong winds and waves now regularly destroy the bamboo used to build the floating houses. In addition, the prices of food, equipment and other items has risen in recent years, and this, coupled with the lower fishing incomes and higher expenses, has dragged local people into poverty, even though they are living in the midst of a huge resources pool.

### *The Adaptation Capacities of Local People with Regard to Hydrology Changes*

To adapt to the recent hydrological changes, locals have applied certain methods to lessen the negative impacts, with changes to house designs and movements being one of the most common adaptive strategies used. During the dry season, local people's houses are located on Tonle Sap Lake, because it convenient for carrying out fishing activities. Some houses put bamboo stilts under the floors of their houses, and so float on the water's surface. The houses also tie themselves together for added stability, representing traditional practices applied over many generations. However, in recent years, people have adopted a new floating house design, by tying big 'jars' to the underside of their floors rather than bamboo. This is a cheaper method than using bamboo, because the jars can be used for many years, while bamboo has to be replaced after just one or two years. During the wet season, local people drag their houses, using boats, towards land, no matter whether the water rises late or early, and this new house design reduces damage, not only to their houses, but also their property, stored food and energy reserves – all of which are stored in the houses.

Changing the location of their fishing activities is another adaptive practice used to solve the decreasing number of fish in the study area. As the water has become shallower, so it has become harder for local people to catch fish. As a result, the fishers have decided to travel farther-afield, fishing near to the border of Kampong Thom Province and Koh Tabor. These locations are a long distance away; however, so fishermen have to spend a lot of money on traveling costs. It is this kind of pressure that has led some local people to use illegal fishing activities in order to catch more fish. In previous times, local people tried to protect their immediate vicinities from outsiders encroaching; however, in recent years they themselves have become the encroachers.

Income diversification is another popular adaptation strategy used among the local people. Because fish catches have decreased so rapidly in recent years, local people are no longer able to survive due to the attendant low incomes and lack of food security, so they have had to increase the number of jobs done by family members in order to survive. Working as hired labor or running small businesses in the village are additional occupations undertaken by the villagers in order to earn extra income in addition to their incomes from fishing activities. Also, some family members have decided to migrate to Kampong Chhang or Phnom Penh, the capital city, to work in garment factories, and some have even sent household members to work abroad in Malaysia and Korea. Even though they know migrating abroad is a risk, they have no other choice if they wish their whole family to survive.

Accessing micro-credit or using insurance companies are other options for the local people, who can borrow money from institutions such as ACLEDA Bank and PRASAC; some even borrow money from private lenders at high interest rates. The money borrowed is used to help maintain their houses, buy new fishing equipment or invest in new businesses. Actually, these loans are required in order to solve the many problems they currently face, but they are also a risk. If their investments fail, they may fall into debt and find it hard to recover.

Finally, strengthening social capital within their community is a traditional way of resolving problems, and has become particularly important due to the hydrological changes and natural disasters occurring in recent years. Pulling their houses to safe locations during the wet season, protecting them during the dry season, exchanging products, borrowing money and mutually identifying fish barricades are some of the activities based on local understandings and friendships that take place, and can be considered additional strategies used to reduce the impact of changes in the hydrology of the area.

Table 2: Water Regime Coping and Adaptation Strategies at the Household Level

| No. | Coping Strategies | Adaptation Strategies |
|---|---|---|
| 1 | Change location of fishing activities | Tanks used for floating the house |
| 2 | Access micro-credit | Income diversification |
| 3 | Strengthen social relationships | |
| 4 | Migration | |

Source: Field survey, 2012

## Discussion

As the findings above show, the recent hydrology changes within the study area have led to changes in both technical measurements and people's perceptions. Though the historical data does not indicate any significant historical change, it shows the potential for change to take place in the future. As indicated by Kumma and Sarkkula (2008), Zhang and Doll (2008), Zuo (2010), and Paul and Quan (2010), hydrological changes to the water levels and seasonal water flows around Tonle Sap Lake have been confirmed in recent studies, and recently, the water level in the Tonle Sap River has also become shallower. Results from technical measurements taken by MOWRAM, as well as the perceptions of local people, illustrate the changes in water level that have taken place. Even though seasonal flows into and out of the lake were not so different during the study period, this may change significantly in the near future due to uncertain rainfall levels and climate change. However, Kummu et al. have used an analytical framework to calculate the water balance in Tonle Sap Lake, taking into account the following components of the flood plain system: the Tonle Sap River, the Mekong River, Tonle Sap Lake's tributaries, rainfall, evaporation rates and overland flows via the floodplain. This is a very good model to use to show the changes in hydrology that have taken place; however, due to the limited data available from MOWRAM, as well as the short period over which the equipment has been installed, it is hard to come to a definitive conclusion across the whole system. The limited number of measuring stations installed in the Tonle Sap area is also another challenge.

In addition, many studies, such as those by UNFPA (2007), Zhang and Doll (2008) and Marko et al. (2010), have cited the hydrology issues as being caused by the construction of hydropower dams and irrigation systems, plus the expansion of agricultural land and climate change, but with the dams causing the most concern and putting the most pressure on water resources. Scott (2012), ICEM (2010), and Zhang and Doll (2008) mention that dam constructions change water flows across the seasons as well as in terms of the volumes. For example, hydropower dams can lead to dry season flooding events, because they sometimes release water downstream, and such events have been confirmed, both by previous studies and by local people, especially in the upper Mekong regions. The two other significant causes are due to the actions of local people; throwing waste such as plastics into the water, and the construction of illegal fishing barricades using a dense network of tree branches. As the years have passed, and with an increasing population in the area, more plastic and branches from the barricades has accumulated at the bottom of the river, blocking flows and reducing the water level.

As a consequence, the MRC (2009), Simon (2007), and Marko et al. (2011) claim that hydrology changes have had a serious and negative impact, not only on the local ecosystems but also on human livelihoods, and especially fishing activities. We have also found similar impacts to the previous studies, for the Tonle Sap around Chhnok Tru has become shallower, seriously impacting upon travel, fish habitats and fish species levels. The fish catch has declined significantly in the study area, and because fishing is the main occupation for the local people, the chances of them improving their livelihoods is very low, plus this change has led to societal problems developing, such as migration and local access conflicts.

To resolve these problems, Middelkoop et al. (2011) and Sarah et al. (2011) have made recommendations, such as improving water system management in order to protect the area from floods, storing more water, and educating local people on how to reduce the impacts. The current adaptations involve diversifying occupations, expanding the fishing areas and migrating elsewhere for their survival; however, I believe the current adaptation strategies used by local people are not sufficient to fully mitigate the impacts, so relevant institutions should work closely with the local people to design contingency plans; to mitigate for and adapt to the hydrological changes taking place.

## Conclusion and Recommendations

A stable hydrological regime is good for ecosystems and the livelihoods of local people, particularly in an area as dependent upon water as Chhnok Tru on Tonle Sap Lake. However, due to recent changes in the area, and the uncertainty surrounding natural phenomenon such as climate change, livelihood activities have become more uncertain in recent years, Added to this, local people throw waste into the water and use more electricity than in the past. Although some of the causes of these changes cannot be controlled at the local level, such as climate change, the negative impacts of such changes on the Tonle Sap Lake ecosystem can be reduced through changes in human behaviour.

To manage and reduce the impacts of hydrology change, we first need to identify the key causes of the problem, its impacts and the existing capacity of both nature and the local people. Technical data, together with the perceptions of local people on the recent changes, have provided supporting data and have allowed me to assess the impacts of these changes. However, even though this study has provided an insight into how the local hydrology has changed, as well as its causes and impacts, and the existing adaptive capacity of local people, scientific evidence is still lacking regarding the other hydrology characteristics and the economic livelihood costs of such changes. In order to allow further analysis, an analytical framework similar to that developed by Kummu et al. (2013) could be used to identify in more detail the scope and nature of the hydrology changes that have occurred, though this will require sufficient historical data to be available from the local measuring station (and over a longer period than for this study). An alternative would be to install new measuring equipment in order to capture all components of the water balance. In addition, a water budget calculation method could be used to identify the changes to the hydrological regime in the study area.

The causes of hydrology change need to be explored further in order to ascertain the root causes, plus the economic impacts analyzed in greater detail in order to understand the human costs of such change. However, this research needs to be carried out urgently, with participation from the community level all the way up to the national and international levels, in order to ensure the continuation of sustainable livelihoods and ecosystems in and around Tonle Sap Lake.

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# Status of Water Bird and Sandbar Bird Species on the Sekong River, Cambodia

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## Abstract

The Sekong River hosts a number of habitats critical for endangered wildlife species, including mammals, birds and fish; however, rubber plantations, paddy and other cash crop fields, and illegal logging and mining activities, as well as the creation of resettlement areas, have all had an adverse impact on wildlife biodiversity in the area. For the purpose of conservation and the protection of endangered waterbird species, an RUPP team carried out a biological survey of waterbird and sandbar bird species along the Sekong River, with its findings paving the way for the implementation of a bird protection project. This paper presents the status of waterbird and sandbar species in the study area, and also describes in detail a birds' nest conservation study carried out in the area, the intention being to pass-on any lessons learned to communities living on selected islands in the Sekong River IBA around Siem Pang District in Stung Treng Province.

## Introduction

Cambodia is rich in biodiversity and has a significant number of habitats and food sources which support globally-threatened wildlife species - some of which are on the verge of extinction, and in particular many water bird and sandbar bird species. The wetlands of the lower Mekong River support a number of globally-threatened species, and Tonle Sap Lake is home to the largest number of large water bird breeding colonies in Asia (Edwards, 2001). Among these species are the critically endangered Giant Ibis (*Pseudibis gigantea*), the endangered Greater Adjutant (*Leptoptilos dubius*), White-shouldered Ibis (*Pseudibis davisoni*), White-winged Duck (*Cairina scutulata*), Bengal Florican (*Eupodotis bengalensis*), and Nordmann's Greenshank (*Tringer guttifer*), plus the vulnerable Spot-billed Pelican (*Pelecanus philippensis*), Lesser Adjutant (*Leptoptilos javanicus*), Milky Stork (*Myteria*

*cinerea*) and Masked Finfoot (*Heliopais personata*). The three species of sandbar birds (Great Thick-knee, River Lapwing and River Tern) that feed and breed on the Sekong River in the dry season, use both the Mekong River and Tonle Sap Lake as habitats in the wet season (reports from local people, 2011). A survey conducted by Timmin and Pech (2002) recorded a number of water bird species on the Sekong and Sesan Rivers, including the River Tern (*Sterna aurantia*), River Lapwing (*Vanellus duvaucelii*), Great Thick-knee (*Esacus recurvirostris*), Small Pratincole (*Glareola lactea*), Woolly-necked Stork (*Ciconia episcopus)* and Mekong Wagtail (*Motacilla samveasnae*).

However, habitats and food availability are in decline due to the increasing demand for food among the local population, as well as the conversion of natural forest areas into agricultural land in remote areas (Birdlife International, 2006). If the human population continues to increase, it will put more pressure on these natural resources, due to activities such as the over-harvesting of NTFPs, land clearance, hunting and animal trading (Hugo *et al.*, 2009). Due to economic development and population expansion; therefore, the dry deciduous forests and lowlands of Cambodia are being increasingly exposed to the unsustainable exploitation of natural resources and also to infrastructure developments, both of which threaten wildlife ecosystems (Birdlife International, 2006). Due to habitat loss and human disturbance, and especially the conversion of forest land into agricultural land, plus illegal logging and mining activities on the sandbar islands, these water bird species are now under severe threat. Moreover, due to a lack of awareness and understanding among the local communities regarding the wildlife around their villages, they collect water bird eggs from the forest, to eat and trade (Clements, 2007). Another key threat to the bird population in the area comes from hunting, and in particular, the use of poisons in the streams, rivers, channels and ponds, and on agricultural land, the purpose being to kill for food and for trade (Hugo, 2009). It is for these reasons that the water birds' natural habitats and food supplies are in decline - threatening their survival (Clements, 2007). Also, because many of the water bird species lay their eggs on the ground of the sandbars and among rocky areas, they can be easily damaged by humans and/or eaten by other animals, which is why conservation activities need to be put in place to protect the nest colonies. If this does not happen, the sandbar bird population will decline even more, possibly leading to extinction in the near future.

Across Lao PDR, 31 of the 44 species classified as at risk are wetland birds. Species such as the Indian Skimmer (*Rhychops albicolis*) are globally endangered (Collar *et al*., 1994; IUCN 2000), while the Black-bellied Tern (*Sterna acuticauda*), Great Thick-knee (*Esacus magnirostris*) and Oriental Darter (*Anhinga melanogaster*) are globally *near*-threatened. Birds associated with sandbars on large rivers in Lao PDR, and elsewhere, have declined significantly, due, in part, to human disturbance of nesting sites. Added to this, the River Lapwing (*Vanellus duvaucelii*), Great Thick-knee, River Tern (*Sterna aurantia* ), Black-bellied Tern and Little Tern (*Sterna albifron*s) are also approaching extinction in Lao PDR, and of these, the Great Thick-knee, River Tern, Black-bellied Tern and Indian Skimmer are already extinct in Thailand (Lekagul and Round, 1991).

However, due to conservation activities carried out by government agencies and NGOs, the Sekong River is still rich in biodiversity, and has many habitats suitable for supporting a large number of wildlife species, and in particular sandbar bird species and their nest colonies

in the dry season, and these favorable habitats play a crucial role in providing these globally-threatened water bird and sandbar species with feeding and breeding sites.

Since a survey was carried out by Timmin and Pech on the Sekong River in 2002, there has been no work carried out to ascertain the status these water bird species, nor the conservation efforts being made in the area. In the absence of this information, it would be impossible to initiate protection and conservation activities; therefore, we undertook a sandbar bird survey along the Sekong River, from Koh Tbeng (UTM: 0634898-1527312) to Koh Chan Taban (UTM: 0644810-1593678) during May and June 2011. The aims of this paper are; therefore: 1) to assess the status of these threatened water birds, including the density and distribution of their population, and to identify potential nest colonies, those located on significant islands along the Sekong River, and also any threats to such colonies, and 2) to develop an appropriate conservation approach by assessing the perceptions of the local communities and other relevant institutions, the aim being to establish a sandbar birds' nest colony conservation group based on local community participation.

## Methods

The IBA situated along the Sekong River covers a stretch which runs from the international border with Laos to the river's confluence with the Mekong. Along this stretch of the river, there are many different habitats, many of which can be categorized as channel mosaics of rock and sand islands, with riverine scrub as the most common form of vegetation. There are no stretches dominated by extensive sandbars, and significant stretches are slow-moving and relatively featureless. For much of its length, the Sekong River is fringed by a belt of gallery forest, about 100 meters wide, which is significantly taller than the adjacent deciduous dipterocarp forest, and contains a high proportion of broadleaf evergreen trees. However, this has been degraded or cleared for cultivation in many areas. The IBA supports a suite of bird species restricted to wide, lowland rivers, including the River Lapwing, Small Pratincole, Great Thick-knee and River Tern. In addition, the IBA supports the Mekong Wagtail - a recently described species, which is thought to be endemic to the Mekong River and its major tributaries. Furthermore, at certain times of the year, the IBA may be important for a number of large water birds, including Giant Ibis.

### *Materials*

A variety of equipment and documentation was used during this survey of sandbar bird species and other significant water birds.

In terms of equipment, GPS tools, compasses, binoculars, telescopes, 1/50,000 maps and a rangefinder, plus data books and recording equipment, pens and pencils were used.

Also, a number of books and guides were used to identify the sandbar bird species, the significant water bird species and other mammals along the Sekong River, as follows:

- 'A Guide to the Mammals of Cambodia', written by Joe Walston, Men Soriyun, Soun Phalla and Sin Polin
- 'Birds of Southeast Asia in 2005', written by Craig Robson

- 'Cambodian Bird Book for Identification, 2003', written by Tan Setha and Colin Pool
- 'Bird Identification Techniques, 2003', written by Tan Setha and Frederic Goes

### *Methods*

Two survey methods were used to collect the key information needed to support a successful field research project.

Interviews

Interviews were conducted with local people, and in particular fishermen and other key informants - those living along the Sekong River and who have a good knowledge of the rare bird nesting sites, those belonging to the Great Thick-knee, River Lapwing and River Tern and those close to the interviewees' homes and fishing areas.

Field Observations

Two field observation methodologies were used to identify the individual species - direct observation and indirect observation - to record the number and location of sandbar bird species, significant water bird species and mammals.

In terms of indirect observation, the research teams recorded the songs of globally-threatened wildlife species during the research activities; plus recorded information using GPS equipment and compasses, while referring to mammal and bird identification books.

Direct observation was carried out in order to identify species sightings; especially of sandbar birds, water birds and other mammals; however, some additional observation methods were used for the sandbar birds and water bird species.

The accurate counting method was used when a number of conditions were met, these being

- The number of water birds was small; for example, less than twenty, so the birds could be counted individually
- The weather conditions were good; for example, no rain, good sunlight and a clear sky
- The birds had not been scared, and
- The observers could get close to the birds.

Estimates of the number of sandbar birds and water birds present were used when the following conditions were met:

- There was a large number of water birds present, making it difficult to count them individually
- The water birds are very active and nervous
- The weather conditions were not good enough to observe the birds accurately, and
- The birds were flying very fast and moving.

When the above conditions existed, binoculars or telescopes were used and the number of birds estimated based on the number of circles within a given area, and using the following formula:

Number of birds = bird numbers per one circle x number of circles

For example, if there were 34 water birds in each circle (when viewing through the binoculars there were 3.5 circles), the estimate of the water bird population was as follows:

Number of birds = (34 birds x 3.5 circles) = 119 birds

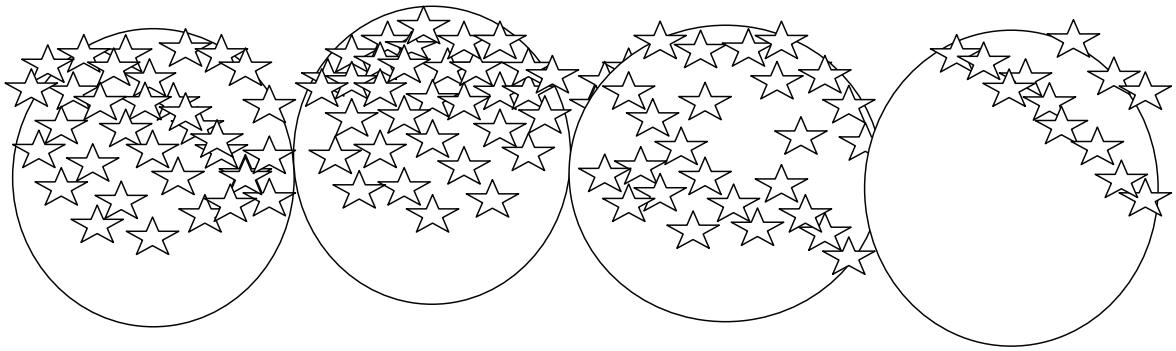

Figure 1: Formula for Calculating the Number of Birds by Counting

The height of the nests was calculated using a rangefinder - based on their distance from the observer, and then using a compass to indicate the bearing of the nests. Therefore, the formula used to calculate height of the bird nests was as follows:

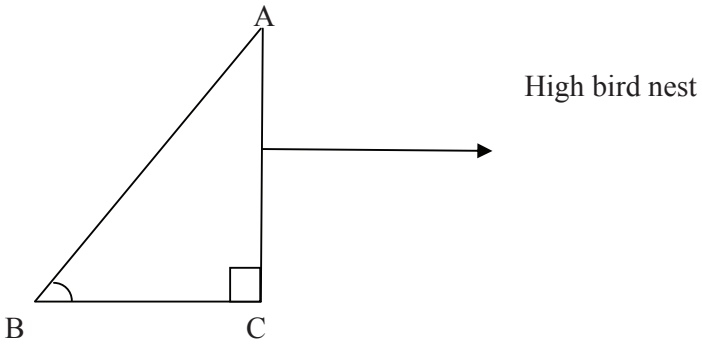


Figure 2: Diagram Used to Calculate the Height of the Birds' Nests

AC = BC [SIN (CBA)]

Where:
CA = Height of the bird's nest
BC = Distance from the observer to the nest
CBA = Angle

To record nests located on the ground, a transect line was used during observations along the Sekong River and on the islands, as follows:

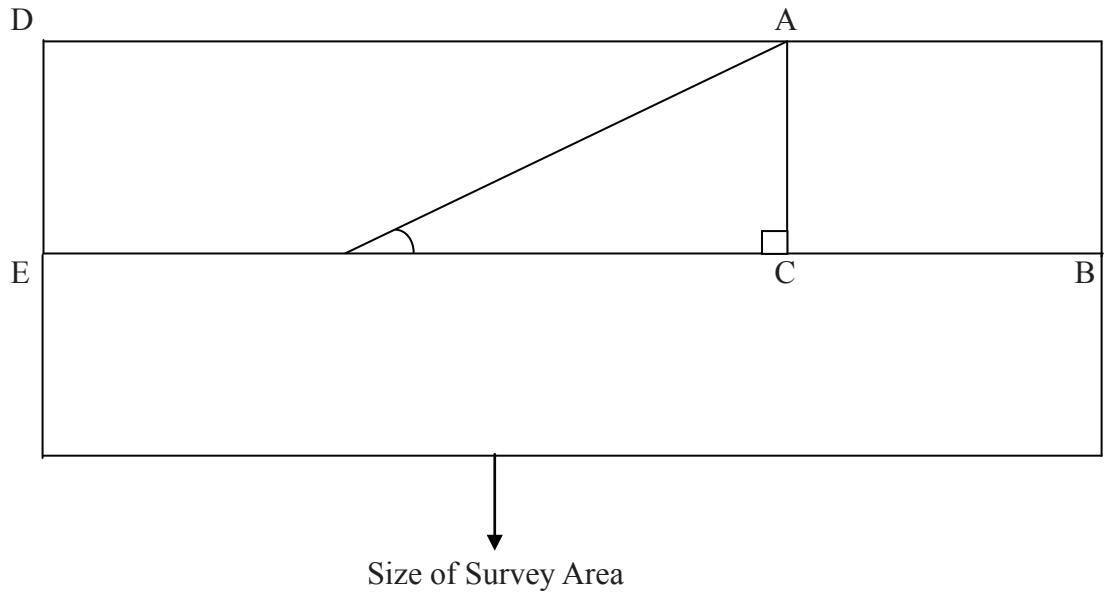


Figure 3: Diagram Used to Calculate the Size of the Survey Area

Where:
DE = Transect line
CA = Distance from the observer to the birds
BA = Distance from the transect line to the birds

Time Management

Time management disciplines play a significant role when surveying water birds and other wildlife, if one wishes to obtain good results from ground observations, especially early in the morning around 5:30 or 6 a.m., when the sun rises, because it is during that time that birds begin to call each other and are also actively searching for food. Another appropriate time to observe birds is in the evening around 4:30 to 6:30 p.m., because at this time the air starts to cool and birds venture out again in search of food, plus return to their roosting sites or their nests. However, during the heat of the day, and especially around mid-day, birds shelter in trees and stay quiet, making it difficult to observe them.

Survey Areas

Figure 4: Island Inhabited by the Target Species
Source: Field survey, May-June 2011

Some significant sites survey work was carried out from Koh Tbeng Island (UTM: 0634739-1526271), about 50 kilometres north of Stung Treng town, to Koh Chantaban (UTM: 0644810-1593678) close to the Cambodia-Laos border. Many islands were surveyed along the Sekong River between 27 May and 5 June 2011, such as Koh Hulaman, Koh Hat Hou Khun, Koh Kbal Khmoach, Koh Han Tum, Koh Kapha, Koh Chamheang, Koh Keang Phlao, Koh Dat Touch, Koh Dat Thom, Koh Keang Loung and Koh Tonsai. Furthermore, a sandbar and water bird survey was undertaken down river of Nhang Sum village (UTM: 0650581-1570191), including at Koh Chan, Koh Ke Nhaiy, Koh Smorng, Koh Tung and Koh Keat Moeung, and in southern An Chanh Toeuk village (UTM: 0640808-1547203), Koh Venou, Hat Venou, Koh Khmoach Loung and Koh Tbeng were surveyed.

Figure 5: The River Lapwing
Source: Field survey, May-June 2011

According to our survey carried out along the Sekong River, and especially the ground surveys and observations made of the islands, five islands can be considered suitable habitats for sandbar bird nesting sites, these being Koh Chan, Koh Dat Thom, Koh Tonsai, Koh Chamheang and Koh Tbeng, as they have a mix of sandy and rocky habitats, with short grass and shrubs being prominent. However, Koh Chantaban is a suitable feeding ground for both water birds and sandbar birds, especially the River Tern, due to its large stoney areas. It is here that some bird species wait for their food, such as fish. A map of the survey area is shown below.

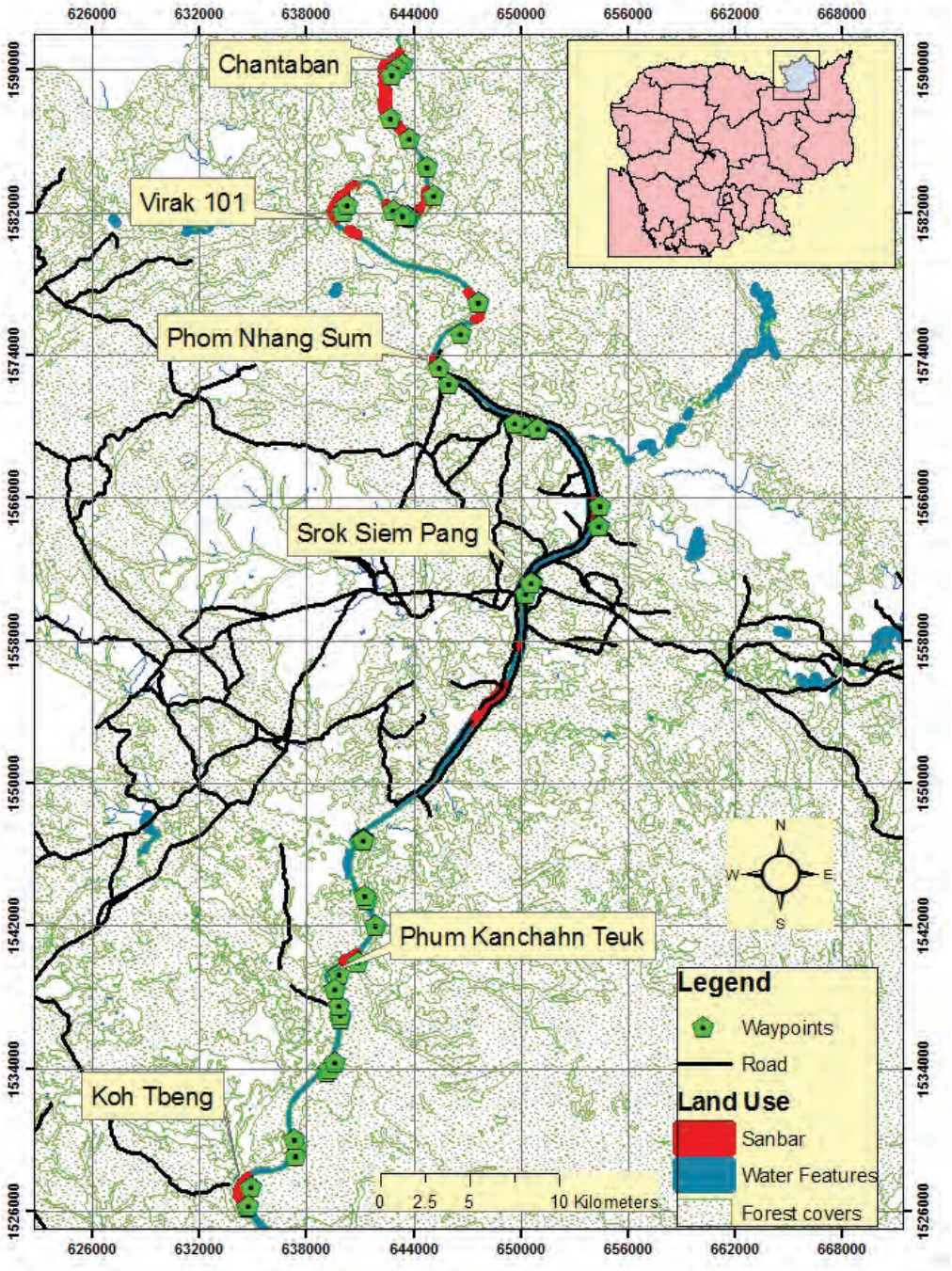


Figure 6: Map of Survey Sites along the Sekong River - from Koh Tbeng to Koh Chantaban Islands.

## Results

During the field observations carried out along the Sekong River and around sandbars, both globally-threatened water bird and sandbar dwelling bird species were seen, such as the River Tern, Great Thick-knee and River Lapwing, as described in detail in the following sections.

### *Sandbar Birds*

During the survey, sandbar dwelling species were found on islands with suitable habitats, as summarized in Table 1. The field survey showed that the most suitable habitat is on the upper stretches of the river near Nhang Sum village (UTM: 0651003-1569869), close to the Laotian border. However, further downstream, from Siem Pang town to Koh Tbeng, only one island (Koh Tbeng: UTM 0634476-1527633) was found to have a suitable habitat as it is covered by sand and rocky outcrops, with short grass and shrubs, and is also the largest island on the Sekong River. Therefore, due to its terrain and the relative lack of human activity, the upper Sekong River around Nhang Sum village has the most suitable habitats for sandbar dwelling bird species in the area.

Table 1: Target Species Observed and their Locations

| No. | Date | Species | Number Seen | Location | UTM E | UTM N |
|---|---|---|---|---|---|---|
| 1 | 29 May 2011 | River Lapwing | 2 | Hat Kapha | 0639457 | 1581598 |
| 2 | 29 May 2011 | River Lapwing | 17 | Koh Chamheang | 0639837 | 1582670 |
| 3 | 29 May 2011 | River Lapwing | 2 | Hat Nang | 0643935 | 1581852 |
| 4 | 29 May 2011 | River Lapwing | 16 | Koh Dat Thom | 0644695 | 1582505 |
| 5 | 29 May 2011 | Great Thick knee | 3 | Koh Dat Thom | 0644695 | 1582873 |
| 6 | 30 May 2011 | River Lapwing | 2 | Kantouy Ahong | 0643268 | 1586571 |
| 7 | 30 May 2011 | River Lapwing | 5 | Koh Keng Loung | 0642310 | 1587780 |
| 8 | 30 May 2011 | River Lapwing | 4 | Koh Tonsai | 0642518 | 1590209 |
| 9 | 30 May 2011 | River Lapwing | 3 | Koh Chantaban | 0644070 | 1593287 |
| 10 | 30 May 2011 | River Lapwing | 1 | Keat Moung | 0643809 | 1592909 |
| 11 | 30 May 2011 | River Lapwing | 7 | Koh Keang Phao | 0640434 | 1583338 |
| 12 | 30 May 2011 | Great Thick knee | 2 | Koh Chamheang | 0639538 | 1582187 |
| 13 | 30 May 2011 | Small Practicoles | 15 | Koh Chamheang | 0639473 | 1582121 |
| 14 | 30 May 2011 | River Lapwing | 2 | Koh Kapha | 0640603 | 1580959 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 30 May 2011 | River Lapwing | 2 | Hal O Tanel | 0645238 | 1573264 |
| 16 | 31 May 2011 | River Lapwing | 8 | Koh Chan | 0654087 | 1565580 |
| 17 | 1 June 2011 | River Lapwing | 15 | Koh Tbeng | 0634476 | 1527633 |
| 18 | 1 June 2011 | River Tern | 3 | Koh Tbeng | 0634381 | 1527437 |
| Total No.of River Lapwings | | | 89 | | | |
| Total No. of Great Thick-knees | | | 5 | | | |
| Total No. of River Terns | | | 3 | | | |
| Total No. of Small Pratincoles | | | 15 | | | |

Source: Field survey, May-June 2011

### *Water Birds*

A significant number of water birds were recorded during the field research activities carried out along the Sekong River, in both riverine and sandbar habitats, and as shown in Table 5 below.

Table 2: Other Species Observed and their Locations

| No | Date | Species | Number Seen | Location | UTM E | UTM N |
|---|---|---|---|---|---|---|
| 1 | 29 May 2011 | Oriental Darter | 1 | Koh Hulaman | 0645312 | 1573103 |
| 2 | 29 May 2011 | Oriental Darter | 5 | Hat Hou Khun | 0647226 | 1575956 |
| 3 | 29 May 2011 | Stork-billed Kingfisher | 1 | Chour Hat Hou Khun | 0646701 | 1575845 |
| 4 | 29 May 2011 | Stork-billed Kingfisher | 1 | Koh Kbal Khmaoch | 0647276 | 1577253 |
| 5 | 29 May 2011 | Grey Heron | 1 | Hat Nang | 0643698 | 1581922 |
| 6 | 29 May 2011 | Stork-billed Kingfisher | 1 | Koh Dat Thom | 0643852 | 1581834 |
| 7 | 30 May 2011 | Oriental Darter | 1 | Antouy Ahong | 0643077 | 1586549 |
| 8 | 30 May 2011 | Indian Cormorant | 1 | Koh Keang Loung | 0642290 | 1587793 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | 30 May 2011 | Oriental Darter | 1 | Koh Keang Loung | 0642290 | 1587793 |
| 10 | 30 May 2011 | Oriental Darter | 1 | Koh Tonsai | 0642346 | 1589090 |
| 11 | 30 May 2011 | Oriental Darter | 1 | Khear Koh Tonsai | 0642946 | 1590576 |
| 12 | 30 May 2011 | Oriental Darter | 3 | Koh Chantaban | 0644388 | 1593999 |
| 13 | 30 May 2011 | Lesser Whistling Duck | 20 | Koh Dat Thom | 0644480 | 1582321 |
| 14 | 30 May 2011 | Lesser Whistling Duck | 16 | Koh Dat Touch | 0642734 | 1582033 |
| 15 | 1 June 2011 | Oriental Darter | 1 | Koh Piroup | 0636899 | 1530030 |
| Total No. of Oriental Darters | | | 14 | | | |
| Total No. of Grey Herons | | | 1 | | | |
| Total No. of Stork-billed Kingfishers | | | 3 | | | |
| Total No. of Lesser Whistling Ducks | | | 36 | | | |
| Total No. of Indian Cormorants | | | 1 | | | |

Source: Field Survey, May-June 2011

### *Forest Birds*

Key Forest Birds

One species of vulnerable forest bird was found at two different sites during the ground surveys carried out along the Sekong River and its islands. Five Green Peafowl were recorded on 29 May 2011 at Koh Dat Thom (UTM: 0644680-1582404), while at Koh Tbeang (UTM: 0634476-1527633), one Green Peafowl was seen on the ground and then ran into the bamboo forest on 1 June 2011.

Figure 7: River lapwing and River Tern at Koh Tbeng
Source: Field survey, May-June, 2011

On 30 May 2011 at 5 a.m. around two Giant Ibis' were seen near their forest habitats on Koh Dat Touch Island (UTM: 0642734-1582033) about two kilometers with bearing 173 degree from the island.

Other Forest Birds

Other bird species were surveyed along the Sekong River in Stung Treng Province, as shown in Table 3 below.

Table 3: Other Species Observed

| No. | Species | Status During Survey | Observation Type | |
|---|---|---|---|---|
| 1 | Blossom-headed Parakeet | Uncommon | O | |
| 2 | Spotted Dove | Common | O | |
| 3 | Red Collared Dove | Uncommon | O | |
| 4 | Green Bee Eater | Very common | O | |
| 5 | Purple Sunbird | Uncommon | O | |
| 6 | Greater Racktailed Drongo | Common | O | |
| 7 | Black Drongo | Very Common | O | |
| 8 | Ashy Drongo | Uncommon | O | |
| 9 | Large-billed Crow | Common | O | |
| 10 | Rufous Treepie | Uncommon | O | |
| 11 | Oriental Magpie Robin | Uncommon | O | |
| 12 | Greater Coucal | Common | O | |
| 13 | Lesser Coucal | Very Common | O | |
| 14 | White-crested Laughing Thrush | Very Common | O | H |
| 15 | Striped Tit Barbbler | Common | | H |
| 16 | Black-hooded Oriole | Uncommon | | H |
| 17 | Black naped Oriole | Uncommon | O | |
| 18 | Yellow-vented Bulbul | Common | | H |
| 19 | Streak-eared Bulbul | Common | | H |
| 20 | Chinese Francolin | Uncommon | | H |
| 21 | Asian Koel | Uncommon | | H |
| 22 | Lineated Barbet | Common | | H |
| 23 | Indian Cuckoo | Uncommon | | H |
| 24 | Small Minivet | Common | O | |
| 25 | Dack-naped Tailorbird | Very common | | H |
| 26 | Great Slaty Woodpecker | Uncommon | | H |
| 27 | Grey-caped Pygmy Woodpecker | Uncommon | | H |
| 28 | Ochacus Bulbul | Common | | H |

| No. | Species | Status During Survey | Observation Type | |
|---|---|---|---|---|
| 29 | Large billed Crow | Common | O | |
| 30 | Green eared Barbet | Uncommon | O | |
| 31 | Large Cockoo Strike | Uncommon | O | |
| 32 | Scarlet Minivet | Common | O | |
| 33 | Bronzed Drongo | Uncommon | O | |
| 34 | White-crested Laughing Thrush | Very Common | O | |
| 35 | Red Jungle Fowl | Uncommon | O | |
| 36 | Red-billed Blue Magpie | Uncommon | O | |
| 37 | Blossom-headed Parakeet | Common | O | H |
| 38 | Red-breasted Parakeet | Common | O | H |
| 39 | Common Kingfisher | Uncommon | O | |
| 40 | Black-caped Kingfisher | Uncommon | O | |
| 41 | Giant Ibis | Uncommon | | H |
| 42 | Oriental Pie Hornbill | Common | O | H |
| 43 | Small Practicoles | Uncommon | O | |
| 44 | Rufous Treepie | Uncommon | O | |
| 45 | Crested Tree Wift | Common | O | |
| 46 | Orange-breasted Trogon | Uncommon | | H |
| 47 | White-rumped Vulture | Uncommon | O | |
| 48 | Crested Serpent Eagle | Uncommon | O | |
| 49 | River Tern | Uncommon | O | |
| 50 | Indian Roller | Common | O | |

Source: Field survey, May-June 2011

Notes:
O: Observed
H: Heard

### *Mammals*

Two mammal species were seen during the research, alongside the Sekong River within the bamboo forests and sandbar habitats, a Variable Squirrel close to Koh Kbal Khmoach on 29 May 2011 (UTM: 0646857-1577661), and four Long-tailed Macaques in bamboo trees at Thmor Dom on 30 May (UTM: 0644567-1583878).

In additon, on 30 May 2011 at 6 a.m., a group of Pileated Gibbons was heard about three kilometres from Koh Dat Touch (UTM: 0643267-1582118, at a bearing of 203).

### *Community Perceptions on Waterbird Biodiversity*

We interviewed Mr. Souy Thorng in Nhang Sum village, who said that he has seen water birds and sandbar dwelling birds on Koh Chamheang and Koh Dat Thom islands, due to the sandy terrain mixed with small rocks. He told us he has also seen three bird species - the Great Thick-knee, River Lapwing and River Tern - living in the area since 1990 when he moved there. He added that these three species of sandbar bird breed on Koh Chamheang and Koh Dat Thom during the dry season, between March and April. Some villagers collect the eggs of these birds for food in March, but never catch the birds. He said that people use poison to kill the birds in the ponds, channels and rice fields in the dry season. Also, carnivorous animals eat the eggs of the River Tern, Great Thick-knee and River Lapwing species, including the Monitor Lizard, snakes and Large-billed Crows. He concluded that since 2007, the number of water and sandbar birds in the area has declined.

Mr. Van lives in Nhang Sum village and said that three species - the Great Thick-knee, River Tern and River Lapwing - have nests on Koh Chamheang and Koh Dat Thom, and that they lay their eggs in March and April. He also said that people use poison to kill the birds and fishing hooks to catch them along the river. He added that some use poison with earthworms and fish to kill all the bird species in the area. As a result of these activities, the water bird population in the area has declined over the last three years. He added that local people would like NGOs to help with the water bird protection scheme in these areas, to raise their population to previous levels.

Mr. Deng Samporn, was born in the study village and he knows of three species nesting in the area: the Great Thick-knee, the River Tern and the River Lapwing, saying their nests are about a four-hour trip by boat. These species produce eggs in February but he said the last time he found any was in April. All the water and sandbar birds in the area arrive in March and April, following the food. He added that people collect their eggs in the dry season and also use poison to kill them, meaning the bird population is now in decline due to human expansion and habitat disturbance. He proposed using a fence to protect the nests of the sandbar birds in the dry season.

Mr. Kong Lear said that the River Lapwing, Great Thick-knee and River Tern mostly build their nests in April and that their eggs hatch at the end of the month. He said they lay their eggs on Koh Chamheang and Koh Dat Thom islands, about fifteen kilometres from his village. He said that the last time he saw their nests was in April 2010, adding that some people collect their eggs for food, as well as those of other bird species. He said that all the bird species in the area are poisoned in ponds, rice fields and rivers during the dry season, adding that in order to protect the wildlife, the use of poisons should be stopped and the birds protected. He concluded that the River Lapwing has now changed its nesting ground due to the many fishermen disturbing its habitat.

Mr. Heang Kon said that all three species of sandbar bird lay their eggs in April on islands such as Koh Chamheang and Koh Kbal Khmaoch; however, he added that their populations have decreased in recent years because people collect their eggs for food, plus poisons are being used in ponds, rice fields and in the river during the dry season. In addition, natural predators such as Monitor Lizards, snakes and Large-billed Crows also like to eat the eggs.

He concluded by saying that the most effective way of stopping this decline would be to protect the birds' nests, and that all the water bird and sandbar bird species are present in the above areas during April, as this is the breeding season.

Mr. Pang Pao, a fisherman at Dat Touch in Thmor Keo Commune, also said that the water and sandbar bird populations have declined due to the use of poisons along the river in the dry season, impacting upon the three sandbar species who breed there from February to April, particularly the River Terns.

Mr. E Kham, a fisherman on Koh Tung, said that there are many River Terns in the area during March and April, and that occasionally the Great Thick-knee can be heard at night at this time also. He added that he has not seen the two or three River Terns recently, either in the dry or wet seasons, as over the last three years there has been a decline in the water bird population due to the use of poisons, especially those used to kill termites.

Mr. Toun Chantha, a fisherman on Koh Vennou, said that in the past there were many water birds to be seen during March and April; he used to see eight to ten River Terns and between four and six River Lapwings. However, he said that now when it starts raining he never sees them and may have to stay on the island for around four or five months to do so. He did add that four River Terns can still be seen flying around the island.

Mr. Chan Boulorn, a fisherman on Hat Vennou, said that he never sees River Lapwings or River Terns during the wet season anymore, as many people come to the area to fish, so he has had to change his job also. During the dry season; however, there are not so many fishermen in the area, so in March and April he may see Great Thick-knees, four to six River Terns and ten River Lapwings on Koh Vennou.

Mr. Pi Thy, a fisherman on Koh Tbeng, comes from Hang Svat village (Siem Khouy Commune in Seasan District, Stung Treng Province) and said that River Terns had just left the area for the Mekong River (it was May). He added that 30 to 40 River Terns live in the area in March and April, and that ten River Lapwings live there each dry season. The River Terns and River Lapwings lay their eggs on Koh Tbeng in March. He said that he has lived in the area for ten years and has never seen a Great Thick-knee. He added that over the last two years, the water bird population has declined, though he is not sure of the reason for this but thinks it may be due to a decline in the fish yield in the Sekong River (as reported by him).

Mr. Sem Dan, a member of CEPA based in Nhang Sum village (Thmor Keo Commune in Siem Pang District, Stung Treng Province) said that the three sandbar bird species in the area have declined in recent years due to a lack of food as a result of illegal fishing activities in the dry season, with fishermen using electricity and small mesh nets.

According to my interview with Mr. Loun Bunpaeng, a ranger at Birdlife International in Western Siem Pang District, three River Tern chicks were seen on Koh Tonsai in 2006, while two to three Great Thick-knees have been seen every year on Koh Dat Thom, the last time being in 2010. He added that he regularly sees River Terns and River Lapwings as they migrate along the Sekong River.

Mr. Net Norin, a staff member at Birdlife International in Western Siem Pang District told me that there used to be a number of globally-endangered species in the area, such as two White-winged Ducks (last seen along the Sekong River at O'Kapha in 2006) but that in recent years they have not been seen. He said that the main threat to these species is not a lack of food, but habitat loss, and that due to the limited number of staff, instead of focusing on research, patrolling and other wildlife conservation activities, Birdlife focuses mostly on fauna and flora surveys in terms of forest habitats. Birdlife International has supported wildlife conservation and management activities in western Siem Pang district since 2003, and in cooperation with the Wildlife Conservation Society (WCS) and other NGOs has tried to increase the population of a number of globally-endangered species. For example, one birds' nest protection program has been implemented in the area, covering the White-shouldered Ibis and also Vultures. As a result, 29 White-shouldered Ibis nests and five Red-headed and Slender-billed Vulture nests have been found in the area, though they have not been able to check the eggs as yet.

### *Livelihoods of the Sekong River IBA Communities*

All the local communities in the study area rely on natural resources for their survival - around 90% of the people according to our survey, based on farming, fishing, logging, NTFP collection and hunting activities. Moreover, high population growth in the area has placed greater pressure on wildlife habitats, with people converting forest land into cultivation land, in addition to the expansion of shifting cultivation activities alongside the Sekong River. These human activities have led to habitat loss for the local sandbar bird species, with rain leading to extensive erosion of upland soils. However, many fishermen continue to live on the islands, and this has affected the birds living and breeding there. Added to this, fishing with electricity and small mesh nets in the dry season has affected the availability of food for sandbar birds and other water birds in this area (based on reports by Sem Dan). Furthermore, local people's livelihoods now rely more on the availability of cattle feed – to help with agriculture, and also the sale of products in support of their livelihoods. The biggest problem faced is cattle grazing in the dry season, as this also impacts upon the sandbar dwelling birds' nests, as cattle always graze along the river bank and on the islands, disturbing and damaging the birds' nests and also scaring the birds away.

### *Conservation Non-Governmental Organizations (NGOs)*

During an interview with Mr. Net Norin, a member of staff at Birdlife International in Western Siem Pang, he said that Birdlife International has been working with the Forestry Administration (FA) since 2003 – carrying out wildlife conservation activities focused on forest areas, including wildlife surveys and monitoring, and also the protection of globally-threatened birds, such as the White-shouldered Ibis. Other wildlife conservation activities are also carried out by the organization, such as awareness work and patrolling activities. However, these latter activities are still limited in scope due to too few staff being available to cover such a large conservation area. Another NGO operating in the area is CEPA, which is based in Nhang Sum village, where it focuses on the fishing and forestry communities. It also helps to monitor water quality in the area, such as the irrigation channels flowing from the Sekong River. CEPA has been established since 2006.

## *Threats to Waterbirds on the Sekong River*

### Human Activities

There are many direct and indirect threats to wildlife in the study area, and in particular alongside and in the Sekong River. The second biggest threat to the local bird species is from carnivorous animals, who eat the eggs of the River Tern, the Great thick-knee and the River Lapwing. However, the number one threat is from human activities, as humans compete with the three bird species' habitats during the breeding season in particular, because the birds lay their eggs on the ground, providing humans and carnivorous species with the opportunity to take them or eat them.

### Egg Collection Activities

Our interviews with the local people revealed that fishermen and herders collect the eggs of the River Tern, River Lapwing and Great Thick-knee from the local islands, for food, mostly in the dry season between March and early May. The local people also collect eggs to feed their pets and also to sell at the market. People also believe that some wildlife species are good for making traditional medicines; for example, the Lesser Cucoul is believed to help cure broken bones, while some people believe that the eggs of wild animals taste better and are cleaner than those taken from domestic animals.

### Hunting

Wildlife is threatened by hunting activities both within the forest areas and also in the rivers, where many illegal activities are carried out, including the army shooting wild animals at night. Other people use illegal fishing hooks along the river to catch water birds and also hunt a variety of animals using their dogs, in fact, hunting with dogs poses a threat to all species of wildlife in the area, because the dogs' owners take them to many different areas, sometimes by boat. For example, the villagers in Nhang Sum once caught a python using dogs, after it killed one dog, then sold it at the market. Also, one juvenile Sambar Deer in Koh Dat Touch was caught by local people after being hunted using dogs; forcing it to run into the river. In fact, a whole range of wildlife species are hunted using dogs, including wild pigs, the Red-Muntjac and Monitor Lizards; all of which are sold to traders from outside the area.

### Poisons

According to the interviews held with local fishermen in the study area, forest-dwelling birds and water birds are poisoned in the dry season using the same poison that is used to kill termites. For the water birds, poison mixed with fish or earthworms is used, then left on the islands or in ponds. For forest birds the same kind of poison is used, but mixed with rice or fruit. Each time the poison is used, around 30 to 40 birds will be killed. In the past three years, the water bird population has declined shapely due to the use of poison; however, poisons are not only killing the birds, but also impact adversely on humans and other carnivorous animals and wildlife. For example, up until 2010, around 30 vultures had been killed having eaten the carcasses of poisoned animals on the northern and eastern plains of

Cambodia, with four other birds poisoned but then cured and released back into their natural habitats (Hugo et al., 2010). The villagers in Nhang Sum also said that domestic animals are also sometimes killed due to eating the carcasses of poisoned animals.

Habitat Loss

The over-harvesting of natural resources in the Western Siem Pang area has led to a loss of both biodiversity and habitats, due to fishing, hunting and trapping activities – all for trade, and such activities are leading to habitat destruction and a decline in the amount of wildlife in the area. Furthermore, the introduction of forest conservation areas has conversely led to an expansion of agricultural land, impacting habitats alongside the Sekong River (Birdlife, 2006). Recent field observation work indicates that land clearance activities and the introduction of plantations along the Sekong River are having a negative impact on natural resources in the area. Illegal logging, especially of luxury wood species, is taking place, with the logs transported along the river to local markets. Another key threat along the Sekong River is the method used to capture the Long-tailed Macaque for market, in which the monkey is caught by cutting-down a hectare of vegetation from around its roosting area. Bank erosion along the course of the Sekong River has also impacted upon the sandbar-dwelling bird species, and many other illegal activities are taking place in this zone, such as deforestation (for the luxury wood market) and land clearing, because an armed forces base is located close to a number of significant wildlife habitats.

Figure 8: Temporary Shelters used by Fishermen and Loggers
Source: Field survey, May-June 2011

## Discussion

Birds who live around sandbars on the large rivers of Lao PDR and elsewhere have declined in number in recent years, due in part to humans disturbing the nesting sites. The River Lapwing (*Vanellus duvaucelii*), Great Thick-knee, River Tern (*Sterna aurantia*), Black-bellied Tern and Little Tern (*Sterna albifron*s) are approaching extinction across Lao PDR, and the Great Thick-knee, River Tern, Black-bellied Tern, and Indian Skimmer are already extinct in Thailand (Lekagul and Round, 1991). The Plain Martin (*Riparia paludicola*); meanwhile, nests in burrows on sandbars – a habit it probably shares with the extinct White-eyed River Martin, and is itself declining in numbers. A new species of river bird endemic to

the Lower Mekong basin – *Motacilla samveasnae*, or the Mekong Wagtail – was first described in 2001. This bird's habitat is restricted to wide, braided channels in lowland areas, those subject to seasonal flooding, and it lives and hunts along earthen banks and overhanging vegetation when water levels are high, and this limited distribution has made it vulnerable to habitat alteration, and any modification of flows and sedimentation patterns (caused by; for example, flow regulation regimes), would put the Mekong Wagtail at risk (Davidson *et al*., 2001). The wetlands of the Lower Mekong support a number of globally-threatened species, and Tonle Sap Lake is home to the largest breeding colonies of large water birds in Asia (Edwards, 2001). Among them are the critically endangered Giant Ibis (*Pseudibis gigantea*), the endangered Greater Adjutant (*Leptoptilos dubius*), White-shouldered Ibis (*Pseudibis davisoni*), White-winged Duck (*Cairina scutulata*), Bengal Florican (*Eupodotis bengalensis*), and Nordmann's Greenshank (*Tringer guttifer*), and the vulnerable Spot-billed Pelican (*Pelecanus philippensis*), Lesser Adjutant (*Leptoptilos javanicus*), Milky Stork (*Myteria cinerea*) and Masked Finfoot (*Heliopais personata).*

The diversity of sandbar birds to be found along the Mekong River is similar to that of the Sekong River, because the three bird species mentioned previously, as well as other water bird species, share their sites or change their locations during the wet season. According to our interviews with study community members, most of the water birds and sandbar dwelling birds move to the Mekong River in the wet season and come back to the Sekong River in the dry season for breeding, and especially the River Tern.

Because Western Siem Pang is very important from a wildlife perspective, research has been conducted in the area several times, and it was established as an Important Bird Area (IBA) in 2003. Western Siam Pang IBA is managed by Birdlife International, which cooperates with the Forest Administration (FA) and Siem Pang District authorities when undertaking its projects. However, the conservation and management area is very large, and the number of staff managing it small; therefore, illegal activities still take place in the area which have a detrimental impact on wildlife, such as land encroachment, land-grabbing, poisoning, poaching, animal trading, and the catching of wild animals to be used as as pets. However, some areas close to the Laos border are significant sandbar bird breeding areas, such as Koh Dat Thom, Koh Chambeang, Koh Tonsai and Koh Chantaban.

However, the bird populations in these areas have come under threat from fishermen settling on the islands. According to our interviews with the local villagers, then as well as fishing, the fishermen also hunt large water birds at night, plus use poison in the dry season – the main cause of bird population decline. As mentioned previously for other areas, sandbar bird nests are also threatened by egg collectors and carnivorous species such as Monitor Lizards, Large-billed Crows and Drago-monitor Lizards. In addition to these activities, dangers occur within the water, with birds sometimes killed by strong current and strong waves form passing motor boats. Heavy storms and fires lit in the dry season also threaten the birds' habitats, as do grazing cattle, as the cattle sometimes accidentally step on their eggs.

Figure 9: Island Habitats for the Target Species
Source: Field survey, May-June 2011

### *Birds' Nest Protection Scheme*

The birds' nest protection scheme has been the most successful project carried out along the Sekong River, and many such conservation schemes have been a success. Moreover, such schemes not only provide direct benefits to local people in terms of supporting their livelihoods, but also mean local people can be educated about their local species and their conservation. Once local people get involved with such protection schemes, they are more likely to share their experiences with other local communities, helping to minimize the negative impacts of egg stealing activities, plus they are more likely to join in with natural resource conservation activities in the area – helping to support the local bird populations. Moreover, NGOs and other related institutions are more likely to get hold of quality data from the local communities. As a result of such initiatives, the presence of such species and the threats they face are likely to be highlighted.

## Conclusion

In order to create conservation and management zones for sandbar bird species in the study area, one needs to prevent the cutting down of trees and the clearing of land for agriculture purposes along both banks of the Sekong River, particularly along its lower sections and on islands with sandbar bird breeding areas. During the dry season, the temporary fishing camps set up along certain sections of the river channel are a particular cause for concern, as they disturb the sandbar bird population and their seasonal breeding grounds, either due to direct persecution, hunting and egg collection activities, or through accidental disturbance of the nesting birds. However, the main threats to the sandbar birds' river habitats are egg collection activities and poisoning, and this applies to all bird species on the islands. In addition, other threats to the sandbar birds include the fishermen's camps on the islands and the dogs they use to hunt and catch animals. Another threat to the bird nests is the cattle, especially buffaloes, which graze on the islands and sometimes disturb the nests by chance.

A potential future threat to the IBA is the development of hydropower schemes upstream along the Sekong River or its tributaries, which may lead to changes in flow patterns and are likely to have a negative impact on riverine bird species. In addition, the use of poisons and egg collecting activities in the area pose a great threat, not only to the wildlife in the area, but also the local communities located in the conservation zones.

However, information is lacking about the threats to water bird and sandbar bird nests; because, due to their seasonal breeding patterns, there are not many birds to observe at all times of the year, and most of the nests are disturbed and birds poisoned during the dry season. The people interviewed said that some sandbar species migrate to the Mekong River, especially the River Terns, and as a result the survey team was able to find only three juvenile birds on Koh Tbeng and other islands, but did not see any River Terns. As a result, this study has limitations in terms of the number of bird sightings made, based on the amount of nformation received from the local communities.

## Recommendations

Education and awareness with regard to important bird species and areas, and especially sandbar bird nest protection sites, should be carried out in all villages and among the local authorities in the relevant areas, during which they should be asked to cooperate with conservation activities. Moreover, people in the local communities should be trained about water birds and sandbar birds, and exchange study tours carried out with other wildlife conservation projects related to birds' nest protection activities.

Other basic training on field work and data recording should be conducted, such as the use of data books, GPS, compasses, maps, binoculars and telescopes. This equipment serves a very important function; helping researchers to observe nests from afar so as not to scare the adult birds. If the adults fly away from their nests, predators may come to eat their eggs, especially the Large-billed Crows.

More effort should be made to protect sandbar-nesting birds while they are breeding in the dry season from March to April. For example, community agreements should be set up with individual villages so that nesting areas are not disturbed. Conservation of the Sekong River needs to take into account the entire river system, as focusing on just a small stretch in isolation might prove inadequate. The creation of new villages and agricultural developments along the river should be discouraged, and key stretches of riverine forest should be strictly protected from logging and shifting cultivation activities. Further monitoring and research also needs to be carried out every month, focused on identifying important stretches of riverine forest, smaller backwater rivers and streams, and better determining the numbers and breeding success rates of sandbar-nesting species.

In addition, those local communities responsible for sandbar bird nest protection activities should divide their areas into a core and buffer zone, in order to maximize the effectiveness of their activities and help with management of the nest colonies. The management of the islands upon which the birds breed is very important, as it may prevent local fishermen from setting-up their camps there. All important islands in terms of birds' nests should forbid fishermen from setting-up such camps; they should be restricted to the riverbanks - far from the roosting and nesting areas. Therefore, we believe that sandbar bird nest protection and conservation activities, those based on the participation of local communities, will play a crucial role in helping to maintain bird biodiversity in the Sekong River area.

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# Research Papers
# Natural Resource Governance in Cambodia

The Royal University of Phnom Penh (RUPP)

RUPP is Cambodia's oldest and largest university, located in the capital Phnom Penh. It hosts more than 18,000 students across a range of undergraduate and postgraduate programs. It offers degrees in fields of sciences, humanities and social sciences, as well as vocational courses in fields such as information of technology, electronics, psychology, natural resource management and tourism. RUPP has full membership in the ASEAN University Network (AUN).

Website: www.rupp.edu.kh

Wildlife Conservation Cambodia (WCC)

WCC is a local and non-profit NGO that has no political affiliation, race and religious discrimination. WCC was established in 2002 by a group of lecturers and students from the Royal University of Phnom Penh who have been working actively on the wildlife, natural resource and environmental issues in Cambodia. And it was officially registered with the Ministry of Interior (MoI) on 8 February 2006.

Website: www.wcc.org.kh

Inter-Church Organisation for Development Cooperation (ICCO)

ICCO is a donor organization based in the Netherlands that provides financial support and advice to local organisations and networks that work for better access to basic facilities, initiating sustainable economical development and enhancing peace and democracy. We also bring together enterprising people in the Netherlands and in developing countries. ICCO consists a number of members such as Edukans, Kerk in Actie and coPrisma. ICCO has been funding projects in Cambodia since 1974. Our support was interrupted during the Khmer Rouge and lasted until 1993. In that year we resume our program in a country that suffered from a post-war situation. ICCO focused its program on rehabilitation of the society. In 2000 we made a shift towards Conflict Transformation & Democratization.

Website: www.iccokia.org

Norwegian People's Aid

NPA has supported local organizations mobilizing the Cambodian Civil Society and increasing the participation of the population to the political debate. The social developments marking Cambodia during the last year period have confirmed the relevance of the thematic areas prioritised by NPA: land rights, democratization and creating an environment free of landmines and unexploded ordnance (UXO).

Website: www.npaid.org

The Department of Natural Resource Management and Development was established in2013 by the ministerial declaration under the Faculty of Development Studies, Royal University of Phnom Penh. It is the only department in Cambodia that has produced the competent human resources in the field of natural resource management, sustainable development and biodiversity conservation. In addition to training, the major goal of this department is to advance the research and outreach capacity in the area of natural resource management and conservation. The department has extensively networked and cooperated with local and international universities, government agencies, NGOs, private sector and local communities. The department possesses competent and specialized resource persons holding PhD and Master Degrees from the renowned universities in the region and the world. The department practically adapts the interdisciplinary approaches in teaching, research and consulting services. So far, we have had a focus of teaching, research and consulting services in the following areas:

- Land and natural resource management and assessment
- Land use and forest cover change assessment and evaluation
- Sustainable land management and evaluation
- Biodiversity conservation, monitoring, assessment, and management interventions
- Conflict management in natural resources
- Community forestry, fishery, and protected area
- Natural resource governance
- Natural resource economic valuation
- Payment of ecosystem services and assessment
- Climate change and natural resources
- Natural resource policy and regulations
- Hydropower development and natural resources
- Sustainable forest management and community livelihood
- REDD+ (Reducing Emission from Deforestation and Forest Degradation)
- Sustainable livelihoods with regard to natural resources

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