

Technical Assistance to the Kingdom of Cambodia  
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*Livelihoods Component*

**INFLUENCE OF BUILT STRUCTURES  
ON LOCAL LIVELIHOODS**

**Case studies of road development,  
irrigation and fishing lots**

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## ANNEXES

## KEY TERMS USED IN THIS REPORT

**Buffer zone.** A zone that usually surrounds or adjoins core areas and is used for cooperative activities compatible with sound ecological practices, including environmental education, recreation, ecotourism, and research. In the Tonle Sap Biosphere Reserve, a buffer zone of about 5,400 square kilometers (km<sup>2</sup>) surrounds the core areas up to the outer limit of the flooded forest.

**Commune council.** In Cambodia, an elected body that governs commune administration. In addition to fulfilling their administrative tasks, commune councils participate in informal dispute resolution, plan and implement development projects, do some agency functions for the central and provincial governments, and conduct advocacy. Development activities consist mainly of small-scale infrastructure and public goods projects.

**Community management.** The community-based management of local natural resources, including certain designated fishing areas, with support from relevant authorities, institutions and organizations. Examples relevant to this report include community fisheries committees, road committees as well as farmers' water user groups.

**Core areas.** Securely protected sites for conserving biodiversity, monitoring minimally disturbed ecosystems, and undertaking research and other low-impact uses such as education. In the Tonle Sap Biosphere Reserve, core areas are in Prek Toal (213 km<sup>2</sup>), Battambang; Boeng Tonle Chhmar (Moat Kla) (145.6 km<sup>2</sup>), Kampong Thom; and Stung Sen (63.5 km<sup>2</sup>), Kampong Thom.

**Chronic poverty.** Describes the condition of households who remain poor over time. In this study, the “**chronic poor**” describes those households that remained poor between the period prior to the change in built structure studied and the current period, as defined by household surveys. Those “**vulnerable to chronic poverty**” were previously in the non-poor group but then fell below the poverty line; those who moved “**out of poverty**” were previously in the poor group but then managed to move above the poverty line. The “**non-chronic poor**” includes these two latter groups plus those who were above the poverty line during both time periods. See also ‘Poverty’.

**Flooded forest.** A descriptive term for the natural vegetation that originally covered most of the Tonle Sap's floodplains. It is now characterised by low forest and shrubs that contribute to the fisheries productivity of the Tonle Sap.

**Gini coefficient.** A measure used to describe income inequality. In this study, it is used to describe income inequality among households within a village. The coefficient is provided as a fraction between 0 and 1, where a higher number indicates greater inequality. Here, 0 corresponds to perfect income equality (i.e. everyone has the same income) and 1 corresponds to perfect income inequality (i.e. one person has all the income, while everyone else has zero income).

**Livelihood.** The capabilities, assets, and activities required for a means of living. A livelihood is sustainable when it can cope with stresses and shocks and maintain or enhance itself in the present and in the future without undermining the natural resource base.

**Livelihood approach.** A way of thinking about the objectives, scope, and priorities for development. It reinforces positive aspects and militates against constraints or

negative influences. Its core principles are that poverty-focused development should be people centered, responsive, and participatory; multilevel; conducted in partnership; sustainable; and dynamic. It puts people at the center of development.

**Poverty.** The state of being deprived of the essentials of well-being such as adequate housing, food, sufficient income, employment, access to required social services and social status. Poverty is usually measured with reference to a **poverty line**; if a household earns an income lower than a set amount, that household and its members are deemed to be living in poverty. In this study, the measure of poverty includes cash income as well as a dollar-value equivalent for household production (such as rice or fish catch) consumed by the family. See also 'Chronic poverty'.

**Social capital.** The networks of relationships among persons, firms, and institutions in a society, together with associated norms of behavior, trust, cooperation, etc., that enable a society to function effectively. It is measured by the degree to which a community collaborates and cooperates to achieve mutual benefits.

**Transition zone.** An area in which stakeholders work together in a variety of economic and other activities to manage and sustainably develop a biosphere reserve's natural resources. In the Tonle Sap Biosphere Reserve, a transition area of about 9,000 km<sup>2</sup> lies between the outer boundary of the buffer zone and Highways No. 5 and No. 6.

## VILLAGE NAMES AND DESCRIPTIVE NAMES USED IN THIS REPORT

### 1. Road development case study, Pursat province:

Chong Khlong	Cham village near the road
Ou Ta Prok Main	Khmer village near the road
Ou Ta Prok Up	Khmer village far from the road

### 2. Irrigation case study, Kampong Thom province:

Snao	Head-user village
Sa'ang	End-user village

### 3. Fishing lot case study, Battambang province:

Thvang	Village far from Tonle Sap Lake
Prek Toal	Village near Tonle Sap Lake

## ACRONYMS USED IN THIS REPORT

ADB	Asian Development Bank
CF	Community fishery
CFA	Community fishery area(s)
NGO	Non-governmental organization
TSL	Tonle Sap Lake
SLF	Sustainable Livelihoods Framework

## EXECUTIVE SUMMARY

1. This report documents the results from an assessment of the influence of built structures on the livelihoods of Tonle Sap communities, as part of the livelihoods component of the “Study of the Influence of Built Structures on the Fisheries of the Tonle Sap”. The livelihoods component aims to identify the links between built structures and socioeconomic change with a specific emphasis on fisheries, and aims to ensure that the analysis and recommendations regarding the influence of built structures incorporate the knowledge, perspectives and insights of people living in the immediate surroundings of the built structures.
2. This study examines cases involving three different types of built structures: road development in Pursat province, irrigation development in Kampong Thom province, and fishing structures along with associated management systems, in Battambang province.
3. Two field research approaches were employed simultaneously, namely quantitative analysis using household surveys (using semi-structured questionnaires with open-ended questions as well as ranking and rating questions) and qualitative analysis using a combination of key-informant interviews and group discussions and exercises (participatory village survey methods). These two approaches were selected to enable direct assessment of key observable and perceived influences of the built structures as well as to gauge communities’ understanding of the interconnectivity between their livelihoods, environment, aquatic ecosystems and built structures.
4. The type of built structure clearly influences how direct benefits are distributed. The case studies illustrate that different types of built structures (roads, irrigation schemes, fishing gears) have different degrees of openness or exclusion in terms of the ability of poor households to access the livelihood opportunities enabled by the structures. Overall, roads are most open as they provide public access with no direct exclusion. Irrigation is meant to bring livelihood benefits by increasing the seasonal availability of water, but still to a limited group, i.e. for landholders within the irrigation scheme and possibly for laborers and marketers nearby. In addition, the irrigation reservoir creates a new open access resource for fishing, although the access to the reservoir may be limited by different kinds of regulation and management practices. Fishing structures of the lots are clearly most exclusive as they funnel benefits to a small group and exclude the majority from the fishing area.
5. Yet there is also much we can say that applies across different types of built structures in different social and ecological settings. Institutions matter quite significantly, in ways that enable positive livelihood strategies (for example, through effective participation and consultation in project planning), and that disenable opportunities for the poor (for example, through mechanisms that reinforce inequitable access to aquatic resources and their livelihood benefits). Scale also matters, as many of the factors that either threaten local livelihoods or open new opportunities are not within the direct influence of local communities. The cross-scale factors that emerged as significant in the case studies include such issues as seasonal migrants making use of community fishing grounds, markets that develop to provide for a demand for local products (e.g. pig rearing), and, of course, environmental factors, including the relationship between hydrological change, habitat, and fisheries productivity.

6. Built structures – by definition, purposeful modifications to the physical environment – clearly do affect livelihood outcomes, but they are by no means a “magic bullet.” This study examined the influence of changes in both directions, namely interventions to introduce new (or improved) structures as with roads and irrigation, and interventions to remove structures (large fishing gears associated with the fishing lot). In all cases, the changes were justified on the grounds of poverty reduction.
7. Progress in poverty reduction has been modest, and inequality remains high. While it will be some years before the outcomes in these particular cases can be measured conclusively, the results already raise a justifiable concern. The ability of individual households to take advantage of changes depends very clearly on other assets, especially education. In certain contexts, other assets such as livestock holding may be key, and smaller family size may be an advantage. These observations signal the need to pay close attention to the livelihood context in which changes are being introduced, and the ways in which different households may or may not be able to benefit. In essence, it means considering infrastructure as one element in a broad array of useful investments to encourage pro-poor rural development.

### **Recommendations**

8. **Link planning of new structures to decentralised natural resources management.** Planning, construction, and operation of built structures cannot operate in a vacuum, but must have strong connections both to long-term management of the Tonle Sap’s natural resources and to local development planning. The case studies indicate that the best way to ensure community involvement and ownership is to link planning of built structures to on-going processes of decentralised rural development and natural resources management. In advance of the physical infrastructure, it is often necessary to strengthen local institutional capacity to address the new challenges for collective decision-making.
9. **Strengthen institutional mechanisms to integrate decision-making across sectors and geographic scales.** Social, economic, and ecological trade-offs stemming from alternative scenarios of infrastructure and water resources development need to be explicitly evaluated and publicly debated. Government policies and strategies should clearly prioritize the relative importance of different social and economic benefits derived from the fisheries of the Tonle Sap Lake. Efforts are also needed to overcome the communication gaps between different sectoral ministries.
10. **Adopt processes of consultation and participation in project planning that recognise the differences among local households.** More attention must be paid to participation and ownership from the very initial stages of project planning. At the planning stage, it is important to analyze sensitively how the anticipated benefits and costs of a project are likely to be distributed among different social groups, taking into account the role of local institutions and differences in household assets. Special provisions also need to be made so that the poorest groups can indeed participate effectively.
11. **Target built structure investments with an understanding of how the poorest groups can benefit.** Even when the net benefits of infrastructure

developments in terms of average household income appear to be positive, the poorest groups can be left behind. Addressing these distributional issues requires reconsidering priorities in terms of the links between infrastructure development and changes in livelihood opportunities, as well as types of infrastructure and their scale and complexity of operations. It means favoring investments in structures with high degrees of openness in terms of social groups that can access the benefits. And it means, where feasible, favoring smaller-scale projects that are more easily adapted to local needs, more easily managed locally, and less attractive for elite capture.

12. **Plan complementary investments to address the asset gaps of poorer groups.** Many households fail to take advantage of the livelihood opportunities offered by built structures because they lack other essential assets. Alongside infrastructure improvements, investments in basic education, training and technical support services, and credit may be needed, as well as support to community organizing capacity.



## I INTRODUCTION

13. This report documents the results from an assessment of the influence of built structures on the livelihoods of Tonle Sap communities, as part of the livelihoods component of the “Study of the Influence of Built Structures on the Fisheries of the Tonle Sap”<sup>1</sup>. The livelihoods component aims to identify the links between built structures and socioeconomic change with a specific emphasis on fisheries, and aims to ensure that the analysis and recommendations regarding the influence of built structures incorporate the knowledge, perspectives and insights of people living in the immediate surroundings of the built structures.
14. The present study assesses possible changes in people’s livelihood strategies and outputs, including those derived from fisheries, particularly in terms of changes in livelihood portfolios, vulnerability, resource access and income. It also summarises local people’s perceptions of the connections between their livelihoods, environment, aquatic ecosystems and built structures, as well as their viewpoints on best practices for built structures with a specific focus on institutional arrangements.
15. A variety of other research studies in Cambodia have highlighted the importance of natural resources for people’s livelihoods and people’s strong dependence on them. These studies also emphasise the diversity and seasonal change in livelihood sources of rural households. Of particular note is the TA supported by the ADB as part of the preparation of the Tonle Sap Sustainable Livelihoods project – Phase 1 (ADB 2004a). An extensive participatory rural appraisal (PRA) documented the importance of fishing not only to the livelihoods of those living in the core zone of the biosphere reserve, but also to those in the transition zone. It also showed that food insecurity (essentially rice deficit) is perennial for landless and land-poor households in the lowland areas, and that a key consequence of this is increased harvesting of fish, animals, reptiles, fuelwood, building materials, and non-timber products from the flooded forests. Finally, it documented an interest in livelihood diversification among residents of the core zone and buffer zone based on a perceived decline in the fisheries resource, and a high demand among villagers in the transition zone for irrigation improvements to reduce livelihood vulnerability. Such findings help explain why there is a strong push for infrastructure development around the lake, and why the potential influence of these built structures on fisheries resources and livelihoods merit attention.
16. Yet few studies in the country have looked specifically at livelihoods in the context of built structures, or the influence of built structures on livelihoods. The analysis presented in this report seeks therefore to complement existing studies by evaluating both quantitatively and qualitatively the role of built structures in sustaining the livelihoods of the people living close to the built structures. The study considers both enabling and disabling aspects of built structures, and consequently both positive and negative livelihood outcomes associated with them, with analysis based on the Sustainable Livelihoods Framework (SLF).
17. The study looks at the local influences of the selected built structures in their immediate surroundings. Consequently, the analysis of the livelihood outcomes, benefit and cost allocation and changes in vulnerability is done among the direct intended beneficiaries of different built structure projects. The study illustrates the complexities of the benefit allocation from the built structures, pointing out issues that should be taken into account when planning new structures and assessing their viability and contribution to poverty

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<sup>1</sup> Asian Development Bank TA 4669-CAM “The Study of the Influence of Built Structures on the Fisheries of the Tonle Sap”. Hereafter referred to as the Built Structures study.

reduction<sup>2</sup>. The focus on the local influences is, however, also a limitation, as the study does not address the issue of built structures' influence on fisheries (or other livelihood implications) outside the project areas. Thus, for example the downstream impacts on fisheries or the cumulative impacts on the livelihoods dependent on the natural resources of the Tonle Sap are not assessed within this study. Such influences at broader geographic scales are, however, addressed partly by the other project components. For example, the hydrology component looks at cumulative impacts of built structures on the Tonle Sap's flow regime, while the fisheries component includes a preliminary assessment of the influence on downstream and upstream fisheries. An upcoming synthesis report will employ findings from each of the component studies to characterise trade-offs associated with built structures in the Tonle Sap more comprehensively. This should also offer at least an indication of the livelihood implications in other areas not included in the present report.

## **II METHODOLOGY**

18. Two key field research approaches were employed simultaneously, namely quantitative analysis using household surveys (using semi-structured questionnaires with open-ended questions as well as ranking and rating questions) and qualitative analysis using a combination of key-informant interviews and group discussions and exercises (participatory village survey methods). These two approaches were selected to enable direct assessment of the key observable and perceived influences of the built structures as well as to gauge communities' understanding of the interconnectivity between their livelihoods, environment, aquatic ecosystems and built structures.
19. As the two approaches build on different kinds of research methods, they provide different types of information that complement each other. For both household and participatory village surveys, two or three villages were selected in each study area to cover villages with varying characteristics, in terms of livelihood assets and seasonal vulnerabilities, and in terms of the possible direct influences of the built structures, their locations, and the prominence of fishing as a livelihood strategy in the communities. The information was analysed to assess the possible influence of built structures on the livelihoods of the communities in the study areas, particularly in terms of activity patterns, resource access, and income. Qualitative analysis was focused on capturing local people's perceptions of the interconnectivity between livelihoods, environment, aquatic ecosystems and built structures, as well as their viewpoints on best practices for built structures. The findings were synthesised using the Sustainable Livelihoods Framework as an organizing tool to describe the often complex relationships between built structures and livelihood outcomes. Each of these elements of the research approach is summarised below.

### **II.1 QUANTITATIVE ANALYSIS USING HOUSEHOLD SURVEYS**

20. The quantitative analysis focused on the impact of built structures on livelihood activities, income, income sources and income portfolios, vulnerability and food security and the role of asset endowments. Existing studies provide a rich basis of comparative information on the general socioeconomic characteristics of communities in the Tonle Sap Basin, including diversity of their livelihood portfolios and the range of assets that they have at hand (see for example, Rab *et al.* 2005). However, none of these measure the specific impact of built structures, which is the rationale for undertaking additional, focused

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<sup>2</sup> The results of the livelihoods component will thus be useful also to other projects designed to improve livelihoods opportunities for vulnerable communities in the Tonle Sap area, particularly the ADB-supported Tonle Sap Sustainable Livelihoods and Tonle Sap Lowland Stabilization projects.

surveys and analysis. Quantitative analysis focused on drawing inferences about the cause and effect relationship between built structures and livelihoods, food security and vulnerability. As such, it provides an important complement to the qualitative methods (described below), which focus on people's perceptions of past and potential future changes.

21. In brief, the quantitative analysis used household survey data to:
  - assess changes in affected communities in terms of:
    - activity/occupation patterns
    - income, income portfolio and distribution
    - number and distribution of vulnerable households
    - consumption patterns and food security
    - access to resources, infrastructure and markets
  - analyze the role of asset endowments on changes in income, income portfolio, vulnerability and activity patterns.
22. Sound quantitative analysis requires good information on rural livelihoods from a representative sample of households in the seven selected villages around the three built structure types. In order to generate information, the research team used a combination of data collection methods in a two-step approach:
  - Step 1: key-informant interviews to gather overview information on livelihood activities, population, infrastructure, problems, etc.
  - Step 2: household surveys to gather information on demographics and education, activities/occupation, access to resources, income, assets, housing and sanitation, access to credit and infrastructure, and perceptions about the influence of built structures on livelihood outcomes
23. To ensure that the information gathered was representative of the communities concerned, a *purposive stratified random sampling* approach was used. Households in the study villages were stratified, using information from Step 1, into four strata on the basis of their main income generating activity: 1) fishing, 2) farming, 3) fishing plus farming, 4) other (non-farm & non-fishing activities). These households were further stratified by wealth status into rich and middle, poor and very poor. From each stratum 5-15 households were selected. This resulted in a total sample of 80 households in Pursat (road development) and 90 each in Kampong Thom (irrigation project) and Battambang (fishing lot), thus comprising 260 households in total.
24. In analyzing the survey data, income was estimated based on all livelihood activities as a sum of both cash and in-kind income sources, including those sold and retained for household consumption. Comparative analysis examined the contribution to total income by activities and the percentage of households engaged in each activity by study site, by village, and by income group, and assessed the change between two time periods – before the change in built structure versus the present time. The period of comparison varied between 2 and 5 years, according to the case. Additional analysis examined changes in the number of households below the poverty line, the depth of the poverty gap, income distribution and changes in income and assets, and the strength of statistical correlation between various measures of household assets and chronic poverty.

## **II.2 QUALITATIVE ANALYSIS BASED ON LOCAL PERCEPTIONS**

25. The aim of the qualitative case studies was to study local perceptions and local knowledge about the built structures and their influence on livelihoods. The analysis also looked at institutional arrangements in connection with built structures and local

viewpoints on best practices related to them. The qualitative approach of the livelihoods component was based on different Rapid Rural Assessment (RRA) methods, but the approach also made use of methods commonly applied in Participatory Rural Appraisals (PRA).

26. The qualitative case studies focused on the village level, but also included key-informant interviews at the provincial and district levels, with key-informants from case study projects, line agencies and NGOs. Main methods used in the qualitative case studies consisted of key-informant interviews, group discussions and exercises, and in-depth individual interviews (Figure 1). The number of interviewees differed between the case studies, but on average the group of villagers included around 10 people, while the number of key-informants (both during pre-survey and the actual survey) was between 5 and 10 people.

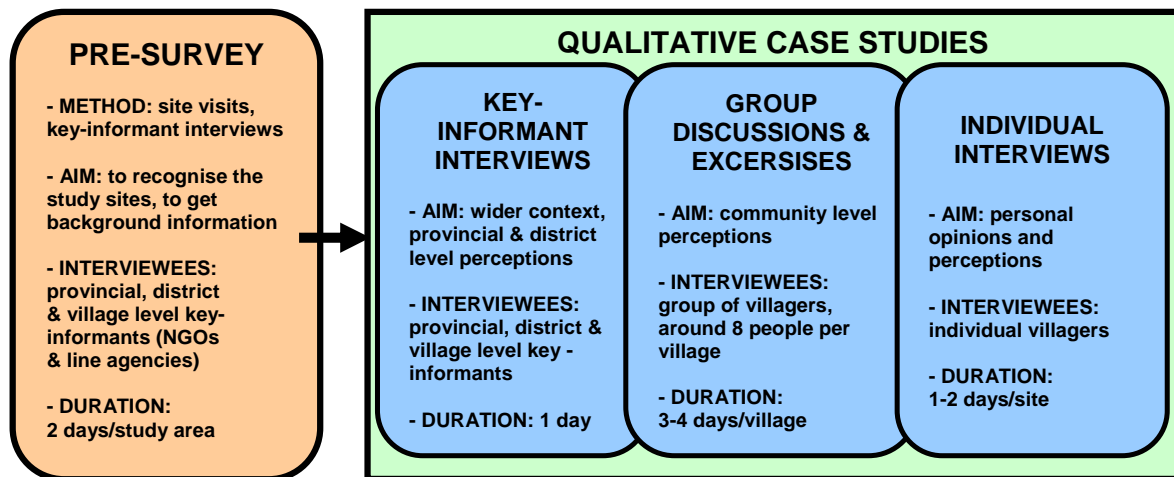


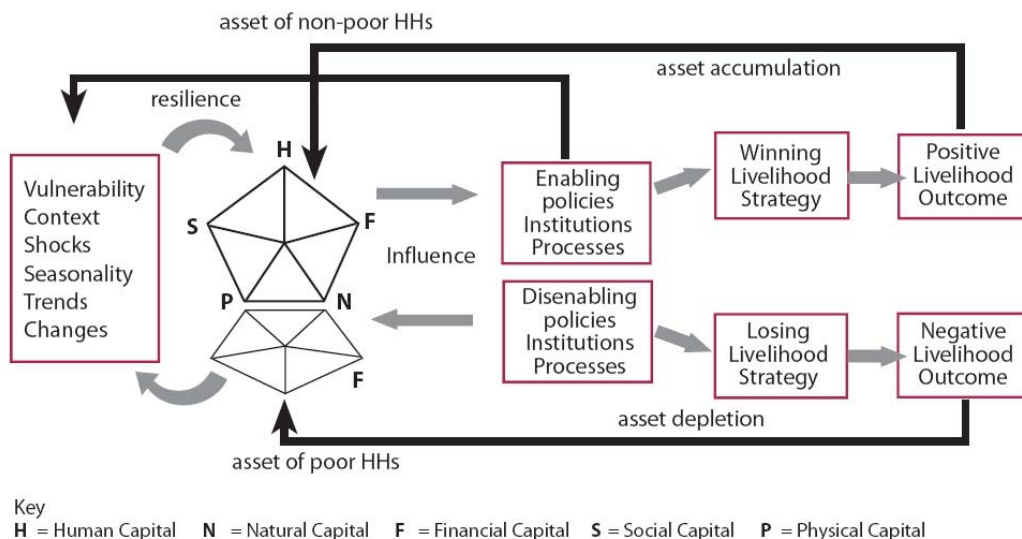
Figure 1. Details of the qualitative approach and case studies

27. The qualitative analysis focused on:
- identification of different classes of stakeholders in relation to built structures, and
  - information regarding perceptions of the interconnectivity between built structures, environment, aquatic resources and livelihoods; ideas on possible alternative livelihoods, and viewpoints on best practices for (a) planning, (b) building, and (c) operating built structures.
28. The analysis of qualitative information was based on thematic analysis of detailed field notes from the surveys. The discussions<sup>3</sup> and interviews in different case study areas and with different stakeholders were written down into field notes and translated into English. In addition, part of the discussions and interviews were also recorded, allowing use of direct quotes of local perceptions. The information available from surveys—complemented by available literature—was then analysed according to themes building on the Sustainable Livelihoods Framework.

<sup>3</sup> As the focus was on the discussions that emerged during the surveys, different kinds of group exercises (e.g. rankings) were also aimed at facilitating discussions, rather than producing an end product in the form of a matrix or table.

### II.3 SYNTHESIS OF FINDINGS USING THE SUSTAINABLE LIVELIHOODS FRAMEWORK

29. The Sustainable Livelihoods Framework (SLF) builds on the following overall idea: “A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base” (DFID, 2001). The SLF looks at livelihoods and their development with the help of different kinds of livelihood assets, livelihood strategies, vulnerability contexts, transforming processes and access to resources and institutions (ADB, 2004). As highlighted by ADB (2004), the SLF “brings attention to the inherent potential of people in terms of their skills, social networks, access to physical and financial resources, and ability to influence core institutions”. The SLF is based on “evolving thinking about poverty reduction, the way the poor and vulnerable live their lives and the importance of structural and institutional issues” (ADB, 2004).
30. Within the Built Structures study, the SLF has been used in analysing how specific built structures undermine and/or enhance different livelihood opportunities. The framework provides a way of considering the dynamic linkages between built structures and livelihoods, including the role of institutional structures and processes. It also helps in applying findings to other projects that have employed a similar framework.
31. Because the objective of the Built Structures study differs from the occasions where the SLF is normally applied, a slightly modified framework was employed based on the framework developed by Carloni & Crowley (2005) for the FAO. The main difference is that instead of focusing on the actual development of livelihoods, the aim of the Built Structures study was to look at the interconnections between livelihoods, environment, natural resources and physical capital (built structures), and analyse how physical capital impacts –either positively or negatively – the natural capital (particularly fish resources) as well as livelihoods of different social groups. Figure 2 captures how the SLF was applied within this study.



**Figure 2. The modified Sustainable Livelihoods Framework with enabling and disabling processes for livelihood development (Carloni & Crowley 2005)**

32. In the context of this livelihoods study, the objectives of the Built Structures study have been addressed within the Sustainable Livelihoods Framework by:
1. Considering both enabling and disabling aspects of built structures or associated institutions, and consequently both positive and negative livelihood outcomes
  2. Analysing how different social groups are affected by built structures by identifying different stakeholders and analysing reasons behind (possible) differential allocation of benefits and losses linked to built structures
  3. Analysing quantitatively in more detail how the households' ability to take advantage of opportunities provided by the studied built structures depends on households' assets
  4. Looking at the wider institutional context, management practices and different ways of implementing existing rules in enabling and disabling the livelihoods of different social groups, and considering institutional and management processes in different levels of planning, building and operating the built structures.

### **III RESULTS**

33. The overall TA, “Study of the Influence of Built Structures on the Fisheries of the Tonle Sap,” considers the influence of built structures at three geographic scales – Mekong Basin, Tonle Sap Lake, and local study sites. All findings from this present study on livelihoods are at the local scale. Results are presented in this section first by individual case study, then comparative results across the three cases are presented.

#### **III.1 CASE STUDY 1. ROAD DEVELOPMENT IN KRAKOR DISTRICT, PURSAT PROVINCE**

##### **III.1.1 Context: Linking road development to livelihood outcomes**

34. Roads are often assumed to be central in triggering growth in rural areas (see e.g. ADB 2006b; ADB 2004c; Cambodia New Vision 2001; Gannon and Liu 1997; IFRTD 2005). Rural roads have potentially several benefits: they connect people to markets, and farmers get better prices for their products; they provide incentives to produce crops for sale, and they enable better information sharing which facilitates livelihood development. Roads enhance access to health, education and other amenities. Rural roads also open villages for development interventions as both state actors and NGOs have better access to them. Without roads or other types of transportation networks (e.g. canals), rural areas face economic isolation and stagnation (see e.g. ADB 2006b; ADB 2004c; Gannon and Liu 1997; UN Millennium Project 2005).
35. Different studies indicate that impacts of roads on livelihoods depend on several factors and are not straightforward (see e.g. Howe and Richards. 1984). The assumption that roads generate positive development has been questioned by findings of negative economic and social effects (Simon 1996). Poverty is not always reduced as planned or expected, but just redistributed or even increased. It is often the case that roads provide new opportunities for those who already have a good asset base, while the poorest groups may not be able to take full advantage of the enhanced infrastructure (Taylor 2004). With the increased price of land, poor people are either forced or tempted to sell their land and move elsewhere, thus risking being even further away from markets and services (ibid.).
36. There are also environmental risks related to road construction. In wetlands or floodplains, building roads may alter flood patterns, fragment the habitat for fish and other aquatic animals, and create barriers for fish migration. When a road forms a barrier to the flood, it can worsen flooding in other areas and can reduce benefits derived from floods. In the Tonle Sap area, the roads in floodplains may, on one hand, enhance access to the flooded forests and increase income, but they may, on the other hand, result in unsustainable exploitation of these resources. On the whole, the impacts of roads in floodplains are not well studied, and even less so in Cambodia. There is, however, an ongoing WWF-MRC project on roads’ impact on floods in Cambodian floodplains and deltas, which aims to set standards for environmentally friendly design and engineering practices for roads<sup>4</sup>.

##### **III.1.2 Road development at the study site**

37. The case study site is located in Krakor district of Pursat province. Stung Pursat (Pursat River) is the main tributary in the province, with a large number of new construction works

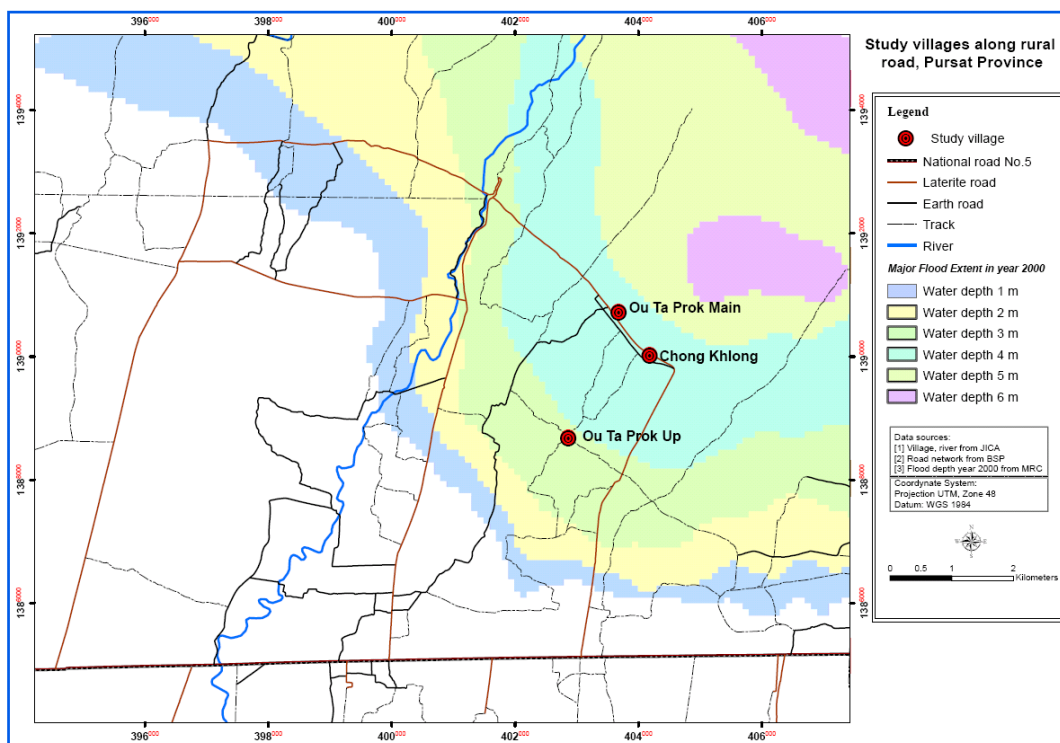
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<sup>4</sup> The project ‘Roads and Floods: Developing Economically Sound and Environmentally Friendly Guidelines’ is due to finish in 2008.

within its basin. These include five proposed dams and at least ten irrigation and water management projects, such as river diversions, reservoir upgrading and flood control dykes. Most of the projects are still at the planning or construction stage, and their impact is therefore not well known yet. Pursat province is also part of the ADB-funded Northwest Irrigation Project and it has been wisely selected – given the high number of planned projects – as an ADB pilot site for integrated river basin management.

38. Although planned irrigation structures are likely to have a remarkable impact in the Pursat sub-basin, it was decided that the case study in Pursat would be focused on roads. There are three main reasons for this decision: firstly, the (re)construction of the roads in the study area had already been completed, and the roads-dyke system therefore offered a good opportunity to study its impacts on floodplain fragmentation and loss of fish habitat as well as more broadly its social implications. Secondly, the decision to focus on roads enabled the project to cover a variety of different types of built structures around the Tonle Sap. Thirdly, the case study on irrigation schemes was already carried out in Kampong Thom, and it was assumed that at least some of the findings and recommendations from there could be applied to planned irrigation projects in Pursat.
39. The road in the case study area is a seven kilometre long secondary/tertiary road and it is built on a natural levee. It was selected for study in part because it runs parallel to the lake bank, thus raising the possibility that it might interrupt water flows and fisheries. The road passes through three communes, namely Ou Sandan, Boeng Kantout and Kampong Pou (Figure 3). There has been a very low quality oxcart road in the area since 1970s, while a better clay road was built with support from CONCERN (an international NGO) in 1995. In 2003 the road was rehabilitated into a gravel road under the Seila Program. At the same time the embankment was elevated and communal road committees were established with two representatives from each village (village chief + one member) and three members from the commune council.
40. As there are the same kinds of areas in the province without proper road connections, it is likely that similar roads will also be built in the area in the future. When compared with some of the other provinces around the Tonle Sap, the road development in Pursat's floodplains has been moderate. The densest network of roads in the Tonle Sap floodplains currently exists in Siem Reap province, where the negative environmental impacts of the roads are most probably more severe than in Pursat.





**Figure 3. Map of study villages at the road development study site, Pursat province**

41. At the same time, the rehabilitation of the national road — the major road running through the province — has led to enhanced access to the Tonle Sap's natural resources. Some key-informants have observed that the price of the land around the national road has increased, and outsiders from urban centres have started to move in and buy land areas for cash crop cultivation. Although these trajectories are outside the scope of this case study, they do influence the development of the case study area and the whole Tonle Sap Basin.

### III.1.3 Characteristics of the study villages and livelihood assets

42. The case study in Pursat has two different levels of analysis, involving three villages. Firstly, the case study compares Chong Khlong and Ou Ta Prok Main, which are both located along the new road but yet have distinct differences in terms of ethnicity and financial and social capital. While all the inhabitants in Chong Khlong consist of the Chvea minority group (a subgroup of Cham Muslims), Ou Ta Prok Main is a Khmer village. Secondly, the case study compares these two villages with Ou Ta Prok Up which is another Khmer village located 2 km upland from the road. The aim of this comparison is to examine the role of differences in terms of villages' proximity to the road. Thus, Chong Khlong is also referred to as the 'Cham village near the road,' Ou Ta Prok Main as the 'Khmer village near the road,' and Ou Ta Prok Up as the 'Khmer village far from the road.'
43. The survey indicates that Chong Khlong is better endowed than Ou Ta Prok, which is also validated by prior village survey data from 2002 to 2004 (SEILA Commune Database 2006; see Annex A, Table 1). Over 90 percent of the households in the three villages are engaged in rice farming and almost 80 percent in fishing (Table 1, see also Annex A, Table 2). On average, fishing is the most important source of income (in cash and in kind). However, other livelihood sources are also important. In Chong Khlong, fishing, followed by rice farming, farm labour and petty trade are the main livelihood sources, whereas in Out Ta Prok Main and Out Ta Prok Up, fishing, rice farming and livestock

(particularly pig rearing) are the main sources of livelihoods. Being a Muslim community, Chong Khlong does not have a piggery.

44. The main sources of income in the survey villages are fishing and rice farming. The estimated average household income of Chong Khlong is highest at around US\$ 653, followed by Ou Ta Prok Up at US\$ 569 and lowest for Ou Ta Prok Main at US\$ 459 (Table 1; details in Annex A, Table 3). The major differences in financial assets seem to result partly from remittances from overseas, particularly in Chong Khlong. It may also be linked to the differences in social capital. While Ou Ta Prok has more localised social contacts, Chong Khlong has more connections to outside the village, including even some global networks, resulting therefore in better information. It seems also that Chong Khlong has better connections to those holding positions of power, such as their Cham patron in the National Assembly. Further, while both villages have some indigenous associations, they seem to be more active and better organised in Chong Khlong, possibly associated with religion. Based on the key-informant interviews and the field observations, there is an impressive internal re-distribution mechanism of wealth to the village's poorest groups and students in Chong Khlong.

	Chong Khlong	Ou Ta Prok Main	Ou Ta Prok Up	Pursat case (combined)
Village location and proximity to the road	Along the road	Along the road	2 km upland from the road	
Ethnic group	Cham	Khmer	Khmer	
Main livelihood activities (% households participating)	Rice farming 91% Fishing 82% Other 75%	Rice farming 90% Other 76% Livestock 70%	Rice farming 90% Livestock 76% Fishing 70%	100% Rice farming 93% Fishing 93% Other 79%
Main sources of income (% total income)	Other crops 58% Livestock 56%	Fishing 58% Farm Labour 45%	Other 60% Other crops 45%	78% Livestock 66% Other crops 51%
	Fishing 17% Rice farming 13% Fish related 12% Other 8%	Rice farming 32% Livestock 17% Fishing 13% Petty trade 12% Other 8%	Fishing 27% Rice farming 21% Others 16% Livestock 16% Nonfarm labour 12%	Fishing 33% Rice farming 19% Other 19% Petty trade 13% Livestock 7%
Average household income (in US\$ per year)	653	459	569	589
Average livestock index	12.05	6.55	12.00	10.63
Average landholding (ha)	0.95	0.84	0.76	0.89
Average yrs of schooling	2.13	2.35	1.86	2.14
Average household size	5.02	4.85	6.00	5.15

Note: Livestock index was estimated using the conversion index by Taylor and Turner (1998)

**Table 1. Key characteristics and household assets by village, road development case study, Pursat province**

45. All three villages have small landholdings with an average of less than one hectare per household (see Table 1). Inequality in landholdings is high in Chong Khlong and Ou Ta Prok Main (gini coefficient of 0.46), and relatively lower in Out Ta Prok Up (gini coefficient 0.38). The livestock assets index in Chong Khlong and Ou Ta Prok Up is 12 while in Ou Ta Prok Main it is 6.5. Similar to landholding, the inequality in livestock assets is high in Chong Khlong and Ou Ta Prok Main and lower in Ou Ta Prok Up (gini coefficients of 0.62, 0.53 and 0.38, respectively). In Chong Khlong, the main livestock assets are cattle and poultry, while in Ou Ta Prok Main it is pigs and in Ou Ta Prok Up it is both cattle and pigs (Annex A, Table 4).

### III.1.4 Influence of the road development on livelihood outcomes

46. On the whole, some of the potential benefits and risks described above (section II.1.2) have been experienced in the case study area, while some have not. Contrary to the hypothesis which led to the selection of the case study area, the environmental impacts of

the roads seem not to be so relevant in the case study area, according to local perceptions. The summary of the influence of the road development on livelihood outcomes is as follows.

47. **Overall improvement in livelihood outcomes is seen through improved market access and new livelihood opportunities.** The most frequently highlighted improvement brought by the road was better access to public services, most importantly to the health centre, followed by improved access to markets. In the past, reaching the market took a long time, making it difficult for villagers to take their products there themselves. This resulted in high dependence on middlemen that were very few due to the difficult access to the villages. The situation in the Khmer village far from the road (Ou Ta Prok Up) reflects this situation, as stated by one villager:

*"It is difficult for us to bring vegetables to market and there are not so many middlemen come to buy our products such as palm sugar and vegetables and animals. They offer us low prices so we are not encouraged to grow vegetables and raise animals."*

48. Now when the road connection is better, the villagers can go to market themselves. There are also more middlemen coming to the villages. As a consequence of these two changes, the villagers are less dependent on the middlemen and are able to negotiate fair prices. Better market access has also increased the incentives to produce products for sale and encouraged new activities like pig raising in Ou Ta Prok. In Chong Khlong, many villagers have themselves started to act as middlemen, buying and selling products such as fruits, chicken, fish and medicine between villages. Chong Khlong has also become a kind of a local centre for cattle trade, where Chong Khlong middlemen trade cattle from near-by areas to middlemen from other districts and towns. In terms of increased benefits for different products, the villagers pointed out that better market access is especially significant for fish, which is not easy to preserve for a long period.
49. **The household livelihood activities and income portfolios have become more diversified since the construction of the road.** The percentage of households participating in different livelihood activities has generally increased (see Annex A, Table 2). For example, more households in the Cham village near the road (Chong Khlong) are engaged in rice farming and livestock raising while in the Khmer village near the road (Ou Ta Prok Main), the increase is seen in fishing, livestock raising and farm labour. Such increases may not all be attributed to the road, however, as seen in Ou Ta Prok Up where the highest increase in the livelihood activities portfolio is observed, particularly in fishing, fishing-related activities, rice farming and farm labour.
50. Livelihood diversification implies changes in income portfolio. For instance, the contribution from fishing to the average household income has declined in all the villages. Nevertheless, fishing is still the main source of income except in the Khmer village near the road (Ou Ta Prok Main), where income from rice farming has replaced fishing as the main source of income and livelihoods by contributing about 27 percent of the household income (Annex A, Table 3).
51. The contribution of income from livestock rearing to the average household income has increased most significantly in the Khmer village near the road (Ou Ta Prok Main) from 18 percent before the road to 21 percent after the road, while in the Khmer village far from the road (Ou Ta Prok Up) it has declined from 22 percent to 13 percent. Livestock does not contribute much to the income portfolio in the Cham village as they do not engage in pig rearing, which seems to be a quite lucrative source of income for other rural households in the area. The contribution from petty trade to the total income has increased significantly except for the Khmer village far from the road, which suggests that improved roads have helped foster developments in trade and business. While the importance of petty trade to livelihoods has increased, high remunerative trade requires

some investments, which places the asset-poor households in a disadvantaged position. A similar case was observed in relation to investment in livestock encouraged by the new road, where asset-poor households had a weaker capacity to invest. As for the contribution of non-farm labour income, it remained unchanged except in the Khmer village far from the road where a significant increase was shown.

52. **Richer households have benefited more than poorer households from the road development.** Quantitative analysis of the survey data shows a strong correlation between changes in the household income and household assets like education, livestock and financial capital (Annex A, Table 5). While the average household income may have increased, further analysis reveals that the richer households experienced a significantly higher increase in their average household income compared to the poorer households (Annex A, Table 6).
53. **Locals perceive no significant impacts on fisheries.** The impacts of the road on fish abundance and flooding pattern were perceived to be minimal by the informants. According to the villagers of Ou Ta Prok and Chong Khlong, the road neither blocked nor protected their villages from flooding as the culverts built under the road let the water flow to the other side of the road. For the same reason the road does not block fish migration, either.
54. The fact that the culverts provide new, easier opportunities for catching fish was not mentioned by the villagers, but commented on only when asked. Although fishing activities that block fish in the mouths of culverts may disturb fish migration, the villagers did not see this as very relevant. There are also regulations related to fishing that should be enforced jointly by the Road Committee and Community Fisheries Committee, but according to the field observations these seemed to be widely ignored.
55. **Households' ability to take advantage of opportunities provided by the road depends significantly on other assets.** The Cham village near the road seemed to have benefited more and also more equally from the road than the Khmer villages. This may be due to the differences in social capital and attitudinal orientation in life. The Cham community has more connections to extra-village networks. They also have better organised social institutions, including a Muslim-influenced and locally managed income re-distribution system. These and other differences in the social asset base and in livelihood strategies that are influenced by a culturally different 'ethos', result in different interests and abilities to take advantage of a changed situation. While this does not mean that Cham communities are always more capable of enhancing their living standard, the differences do indicate that cultural and social issues play a significant role in how the roads and other infrastructure – and the changes they bring – influence livelihood outcomes.
56. **Management structures and institutions are key in mitigating environmental impacts and ensuring long-term maintenance.** At present the national government is focused on the core network of primary roads, while the lower levels of government, including communal road maintenance committees, are given responsibility for local roads (IFRTD 2006). Decentralised authority can potentially result in more efficient maintenance work, but this is challenged by scarce sources of revenue. Villagers in the study pointed out that the local road committee is able to undertake only small repairs, while bigger ruptures still require assistance from the commune or higher levels. This highlights the challenge of finding a balance between decentralisation and the need for an integrated approach at broader geographic scales in road planning and maintenance.
57. Poor road maintenance has been a common problem in Cambodia (IFRTD 2006). Roads located in flood-prone areas – like the one in study area – need special emphasis on maintenance. Successful maintenance requires a stable source of revenue, responsible and controlled use of the road, and mobilisation of special funds and labour to work in

case of road ruptures. Good communication and collaboration between the villages sharing the road is important as well, which implies capacity of commune officials to network, communicate, and share information.

58. Even though the road-related institutional structures do not require the same level of mobilization as irrigation (as in the Stung Chinit case, for example), participation is still crucial. The key-informants from the road committee stated that after the CONCERN project was finished in 1995, there was no program for maintenance. The villagers felt that as the NGO was responsible for the construction of the road, it should also be responsible for its maintenance. This resulted in poor maintenance which together with high floods in 2000-03 led to major damage to the road. With the rehabilitation of the road initiated by the Seila Program, a road committee was established and road fees were introduced. According to the informants this resulted in an increased sense of ownership, and consequently more attention has been paid to the maintenance of the road. The challenge is that while the road is used in a more responsible way at the beginning — when the road is new and its benefits more apparent — less attention is paid to its maintenance later on when the existence of the road is taken for granted.
59. While there were some challenges in finding enough funds for the road maintenance, some innovative solutions came up. For example, the middlemen coming from outside have been convinced to pay fees for road maintenance. Cooperation with the local *wat* (temple), initiated by the commune council members, has also been established. When a rupture occurs in the road, funds for repairing it are raised at the temple, and not only the village where the rupture occurred but also the entire commune contributes to the repairs. People generally entrust their money more easily to the monks than to the commune authorities. These examples highlight the importance of innovative solutions based on indigenous institutional networks.

### **III.2 CASE STUDY 2. STUNG CHINIT IRRIGATION AND RURAL INFRASTRUCTURE PROJECT, KAMPONG THOM PROVINCE**

#### **III.2.1 Context: Linking irrigation infrastructure development to livelihood outcomes**

60. The Stung Chinit Irrigation and Rural Infrastructure Project (SCIRIP) is currently the largest irrigation scheme in Cambodia. The project also reflects the Cambodian government's strategy to reduce poverty through improvements in agricultural production, especially through irrigation, as emphasised in the Second Socio-Economic Plan of Cambodia. The irrigation sector is therefore expected to gain substantial investments in future, and this trend is already evident also in the Tonle Sap area. The SCIRIP can also be seen to serve as a pilot project for the ADB's Northwest Irrigation Sector Project (NWISP), where several irrigation schemes will be rehabilitated in Siem Reap, Battambang, Beanteay Meanchey and Pursat. In addition, the ADB Lowland Stabilization Project addresses agricultural issues in the Tonle Sap area, including needs for irrigation.
61. The objective of the Stung Chinit case study is to record the most important lessons learnt from the project to inform implementation of future irrigation projects in the area and in other areas around the lake. As the project is still on-going and long-term impacts are therefore not yet evident, the emphasis is on the planning and construction process, particularly that of large-scale irrigation projects. Consequently, the case study does not focus only on physical built structures, but also looks at the interaction between the different project components and livelihood outcomes.

### III.2.2 Irrigation and other infrastructure development at the study site

62. The project is located in Santuk district of Kampong Thom province, and there are two Tonle Sap tributaries in the area: Stung Chinit and Tang Krasang. The project is intended to benefit 2,400 households within 3 communes and 25 villages, mainly in Kampong Thmor commune. The irrigated area is projected to be 3,000 ha in the wet season (supplemental irrigation) and 1,800 ha in the dry season (full irrigation). The project was designed to deliver economic benefits primarily through increased agricultural income and productivity. The overall cost of project maintenance has been estimated to be US\$80/ha/year, and water use fees are planned to offset these costs.
63. The physical built structures in the project consist of irrigation and drainage canals, the dam and spillway, and the related reservoir. However, the project design acknowledges that physical infrastructure alone does not have positive livelihood outcomes. Consequently, the project components also include the establishment of irrigation management groups, agricultural extension activities, and the enhancement of roads and market access. As it is not sensible or even possible to isolate the built structures as physical structures from other project activities, the case study also looks at these other project components.

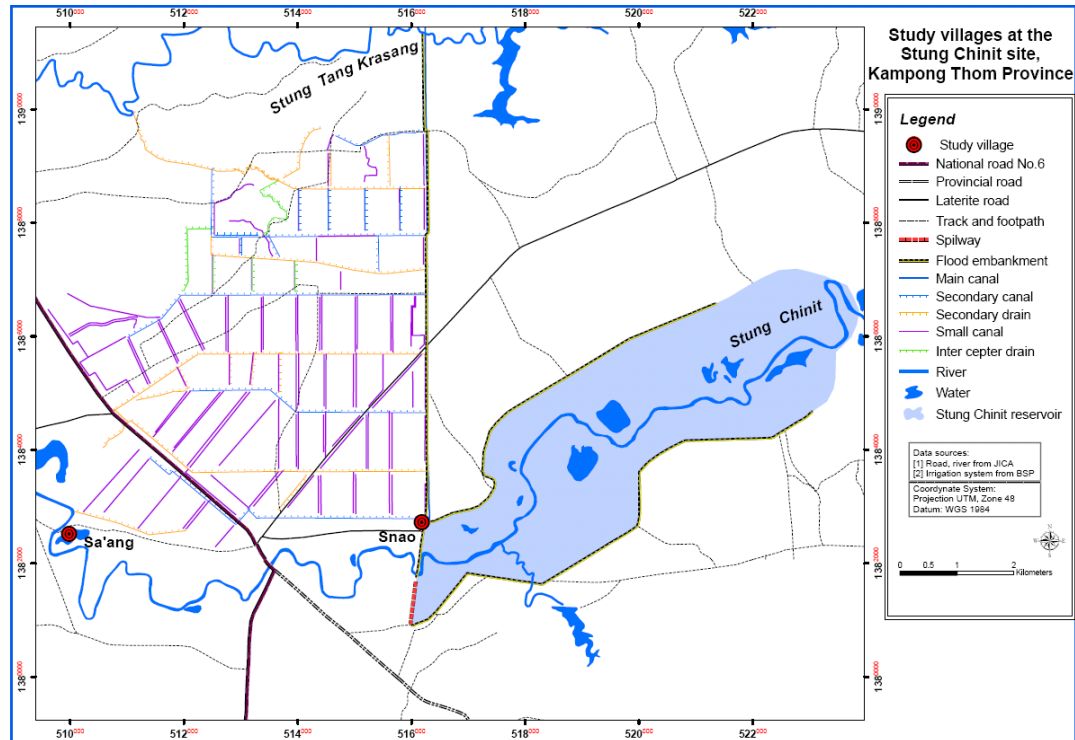


Figure 4. Map of study villages at the Stung Chinit irrigation site, Kampong Thom province

### III.2.3 Characteristics of the study villages and livelihood assets

64. The case study compares two villages within the Stung Chinit irrigation scheme, Snao and Sa'ang. Snao represents a head-user village which is very close to the reservoir, to the spillway and to the project offices. Villagers in Snao have experienced some losses related to the project due to the construction and relocation of households.<sup>5</sup> Sa'ang, on

<sup>5</sup> One of the main points for criticism of the project's planning and construction phase has concerned land losses and the compensation for these. The number of households relocated has also been higher than originally estimated. Not only villagers, but key-informants from the governmental line agencies also

the other hand, is an end-user village at the southern edge of the scheme. Given the high reliance of the villagers in Sa'ang on fish in the Stung River, fishing might be impacted negatively by the irrigation scheme and particularly by (re)construction of the dam and spillway. This case study does not, however, address impacts outside the project area (downstream or upstream).

65. Both of the study villages embody occupational pluralism with a strong seasonal character. As shown in Table 2, the main livelihood activities in both head-user and end-user villages are rice farming, livestock and fishing. The income sources of the people include rice farming, water melon and vegetable crops, fishing, forestry (firewood and timber cutting and non-timber forest products), sugar palm, livestock raising, trade and labour work. The main difference in asset base is that financial capital is much lower in the end-user village (Sa'ang), which is linked to the lower average household income (US\$ 589, compared to an average of US\$ 785 in the head-user village (Snao). In addition, the villagers in the end-user village are more dependent on fishing. In the head-user village, a significant income source consists of forestry activities (firewood, timber cutting and non-timber forest products) in an area 40 km upland from the village. In the end-user village, forestry is less important and limited only to non-timber forest product collection in the vicinity of the village. Vegetables or other upland crops are not very significant in the villages, but the project aims to augment their importance. A common characteristic in both villages is that the households with less landholding are more dependent on fish and other aquatic resources (see Table 2). In other words, fishing and other aquatic resources provide a higher proportion of income for the poorer households, even if wealthier households earn more from these activities.

Livelihood assets	Snao	Sa'ang	Kampong Thom case (combined)	
Village location and proximity to the irrigation scheme	Head-user, closer to the scheme	End-user, farther from the scheme		
Main livelihood activities (% households participating)	Rice farming	89% Rice farming	91% Rice farming	91%
	Livestock	73% Livestock	67% Livestock	73%
	Fishing	67% Fishing	64% Fishing	67%
	Other	65% Other	60% Other	66%
	Other crops	63% Other crops	49% Other crops	63%
Main sources of income (% total income)	Fishing	27% Fishing	30% Fishing	28%
	Rice farming	19% Rice farming	20% Rice farming	19%
	Livestock	16% Other	14% Livestock	15%
	Petty trade	12% Livestock	13% Other	13%
	Other	12% Farm labour	13% Petty trade	9%
Average household income (US\$ per year)		786	589	688
Average livestock index		18.9	19.8	19.4
Average landholding (ha)		1.0	1.0	1.0
Average yrs of schooling		1.3	0.7	1.0
Average household size		5.1	10.0	7.5

*Livestock index measures estimated using the conversion index by Taylor and Turner (1998)*

**Table 2. Key characteristics and household assets by village, irrigation development case study, Kampong Thom province**

66. According to the household survey, the head-user village is richer in its asset base and has a higher average income than the end-user village. This finding is also consistent with prior village survey data (SEILA 2006; see Annex A, Table 7). Some of the income differences can already be related to the irrigation scheme as the location of Snao, the head-user village, with regard to the scheme is more favourable, and thus even prior to the operation some indirect benefits had been accruing there. For example, Snao

highlighted the problematic nature of the compensations and resettlements. Many villagers expressed concern about the village chiefs not representing the different stakeholders in the village fairly in this process. The land losses due to the scheme have occurred in both Santuk and Baray districts (see also FACT 2004).

villagers worked as labourers during the construction phase, and the vicinity of the reservoir has brought an increasing number of tourists to the area.

67. There were no marked differences observed between the villages in terms of social capital. In both villages, several self-help and indigenous associational initiatives exist. However, the level of institutional capital in terms of links to higher level and/or state institutions seems to be rather low in both villages. This represents a common situation in the rural areas of Cambodia (cf. Pellini and Ayers 2005). Related to this, there seems to be a lack of confidence in the initiatives of higher level officials and some suspicion related to the projects coming from outside.

#### **III.2.4 Influence of the irrigation and rural infrastructure development on livelihood outcomes**

68. **It is still too soon to assess the direct impacts of improved irrigation, but the influences of other aspects of the infrastructure project are noted.** The Stung Chinit Irrigation and Rural Infrastructure Project (SCIRIP) has been delayed, and as a result the actual irrigation structures of the project only became operational in 2006, three years later than originally planned.<sup>6</sup> The long construction period meant additional hardship for the villagers, as some of the canals were closed for long periods during the construction work and farmers were not able to get water to their fields. The water gates letting the reservoir water into the rice fields were opened on 20 July 2006.
69. Consequently, the surveys under this study were carried out too early to assess the actual impacts of the irrigation project as the first crop cultivated under the irrigation system had not even been harvested (harvest took place in December-February) when the surveys took place (in September). Instead, the case study can address only the impacts that had already emerged— mainly due to construction of the irrigation structures – and illustrate some of the possible future impacts that were addressed during the surveys.
70. **Livelihood portfolios have diversified in all wealth groups, but for different reasons.** In both villages, the households have become slightly more diversified in terms of their livelihood activities (see Annex A, Table 8). However, it is important to distinguish whether this change is due to a “push” (increased threats to the traditional livelihoods) or a “pull” (promising new opportunities).<sup>7</sup> The poor household may diversify out of the need to make their living, while richer households may diversify in order to maximise their outcomes. In the case of the head-user village, it seems that households have been pulled to diversify because of new opportunities offered by being close to the built structures (Annex A, Table 9), while in the end-user village, diversification has resulted from a decline in income (Annex A, Table 10). This conclusion is supported by the survey result showing that in the end-user village, more households are currently engaged in farm and non-farm labour compared to before the irrigation project was built (Annex A, Table 8).
71. In the head-user village (Snao), the percentage of households participating in fishing activities has increased from 51 percent before the irrigation project to 67 percent at

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<sup>6</sup> The delay of the project is related in part to changes in project design, including a reduction of the project area from around 7,000 ha to less than 3,000 ha. The original TA documents underestimated the costs of the project and included estimates of the internal economic rate of return which have since been revised downward.

<sup>7</sup> Livelihood adaptation is defined as the continuous process of change to livelihoods, often geared towards enhancing security and wealth, reducing vulnerability and poverty (Ellis 2000). Adaptation can be positive or negative; it is positive if it is by choice, reversible and increases security; negative if it is out of necessity, irreversible and fails to increase security. Negative adaptation leads to the adoption of a successively more vulnerable livelihood system over time (Davis 1999).



present (Annex A, Table 8). In both villages, the percentage of households engaged in rice farming has increased marginally. The percentage of households engaged in livestock rearing has shown a significant increase from 58 percent to 73 percent in the head-user village, while it has registered a marginal decline from 69 percent to 67 percent during the same period in the end-user village. Significant increase in diversification into livestock (particularly pig rearing) in the head-user village could have resulted from increased market access (a “pull” towards livelihood diversification).

72. **The distribution of income from fishing has been affected by the reservoir.** The contribution of fishing to household income in the head-user village has increased significantly from 21 percent before the project to 27 percent at present, while in the end-user village (Sa’ang), the contribution from fishing to total income has declined from 47 percent to 30 percent. The increase in the contribution from fishing in the head-user village may be credited to the reservoir, while the villages in the end-user village reported that the decline in contribution of the fishery is due to increased competition from other fishers downstream. As shown by the quantitative study, livelihood options, particularly in the head-user village, have increased and household income portfolios have become diversified, thereby spreading risk and reducing vulnerability to food insecurity, poverty and income fluctuations. Despite a decrease in the contribution of fishing to total household income for those in the end-user village, it continues to be the highest contributor to household income on average (Annex A, Table 9).
73. **Overall, villagers in the two case study villages were not particularly concerned about the irrigation project’s possible impacts on fisheries.** For example, in the end-user village, where the involvement in fishing was clearly higher, the villagers were actually more concerned about the impacts of downstream fishing activities than on the impacts of the irrigation scheme *per se*. In general, the villagers in both cases have noticed an overall decline in the availability of fish, and this trend is feared to continue. Illegal fishing is seen as the main reason for the decline, and better control of illegal fishing activities is considered to be the key to stop the decline. At the same time, the project has brought benefits particularly to members of the head-user village as they have easy access to the reservoir as well as to the areas just downstream of the spillway. Both of these areas have seen increased availability of fish (at least temporarily) after the construction of the spillway. Finally, it is important to remember that both study villages are located within the scheme, and the project’s impacts further away downstream and upstream from the dam and spillway were therefore not assessed by the surveys.<sup>8</sup>
74. When discussing specifically the impacts caused by the irrigation structures, the main impact locals perceived was that the structures –essentially the dam and the spillway – block fish migration between the Tonle Sap and areas upstream from the reservoir. According to villagers, the reason for this is that the water flow in the spillway is too strong. In addition, there is only one way for fish to pass through the water gate (i.e. fish pass), and it still seemed unclear for villagers at this point whether the fish pass was actually functioning. In addition, during the construction phase of the dam and spillway, the partial destruction of the Stung Chinit dam in 2005 killed many fish, and villagers in the end-user village also lost their boats and fishing equipment.
75. **Households’ ability to take advantage of opportunities provided by the irrigation and infrastructure scheme depends significantly on other assets.** Households with more education and livestock holdings are better positioned to take advantage of more profitable opportunities (Annex A, Table 10). Though the direct impact of the built structure through the irrigation scheme is yet to be realised, some of the indirect impact have been felt by the households, particularly those in the head-user village. Similar to the situation in Pursat, households belonging to the richer group registered a much higher

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<sup>8</sup> For a more thorough assessment of the impacts of the dam and irrigation system on fisheries, see the companion fisheries component report within this technical assistance study.

increase in their income (Annex A, Table 11) suggesting that the richer households have more capacity to take advantage of the opportunities. Qualitative findings also support these conclusions. The households' possibility to make use of the emerging opportunities from the development of the irrigation structures depends very much on the larger context where the development happens. The wealthier households usually have better capacity to adapt to changes.

76. In the case of the irrigation project in Stung Chinit, it is yet too early to clearly say which groups are set to benefit most and if the project will really bring equal benefits to the villagers living in the project area. It is, however, relatively evident that – similar to many other infrastructure projects with participatory institutional arrangements – the farmers' water-user groups in Stung Chinit, which have been set up as part of the scheme, face the possible risk of being dominated by the local elite and thus failing to include the poorest and weakest groups. In addition, the sheer scale of the Stung Chinit scheme adds to the challenge, as experiences from other irrigation projects demonstrate that equitable water distribution is more commonly achieved in smaller-scale systems than in large ones (Hussain *et al.* 2006).
77. **The quality of local participation in infrastructure planning is key in villagers' perception of the scheme's suitability and their willingness to invest in long-term maintenance.** The findings from the Stung Chinit irrigation project illustrate the challenges related to participation of local villagers in the planning and construction phases of the project. Based on the interviews, most villagers in both case study villages feel that they did not have possibility for real participation during the planning of the project, but were just briefed about up-coming project activities. At the same time, villagers consistently expressed a desire to have more input into technical decisions, so that the hoped-for benefits of improved irrigation would be realized. One of the reasons for the communication difficulties was related to language. As one respondent described, "*They [project staff] used too technical language and we were afraid to say anything*".
78. Feedback from villagers included in the study suggests inadequate local ownership. In the case of Stung Chinit, the farmers' participation is wanted for the maintenance of the structures, but the villagers seem to be bit hesitant about this, as they feel their participation was not encouraged during the planning and construction phases. The results from the Stung Chinit case indicate that it will be difficult to create ownership of local farmers only at the later stages of the project.
79. **Comparison with other irrigation and water management projects suggests that many of the planning and management challenges of the Stung Chinit scheme may be related to its large scale.** Other studies have suggested that the risks of large-scale infrastructure projects are generally greater than those of smaller-scale projects. The scale of the impacts of a possible failure is greater in a larger project while in a smaller project, there are more chances for correction during implementation and running of the scheme (Öjendal 2000). Also, participation and mobilization of local farmers is more challenging the larger the scale of the project is. There are also studies demonstrating that equitable water distribution in a smaller-scale system is more likely than in a large one (see e.g. Hussain *et al.* 2006). In the specific case of Cambodia, there have been concerns about large-scale projects because of the lack of sufficient capacity for their planning, construction and maintenance (Molle 2005, Öjendal 2000).
80. Examples around the world indicate that in large-scale solutions the costs of construction and running are often higher than anticipated and that the cost recovery in terms of water fees is difficult (Öjendal 2000). In the Stung Chinit scheme, some interviewed for this study are beginning to question the local economic benefits of the investment, a concern raised by other observers as well (cf. FACT 2004). In Cambodia, a special challenge is related to intersectoral coordination (cf. e.g. Ovesen *et al.* 1996, Öjendal 2000, Molle 2005). Due to its scale and integrative approach, the Stung Chinit project has different

components under the responsibility of different government sector agencies. The communication and cooperation between the agencies seems, however, not to have worked as well as planned<sup>9</sup>.

### III.3 CASE STUDY 3. FISHING LOTS IN AND AROUND PREK TOAL CORE AREA, BATTAMBANG PROVINCE

#### III.3.1 Context: Linking large fishing structures and fishing lot management systems to livelihood outcomes

81. The built structure studied in the Battambang case consists of large-scale bamboo fences used in the fishing lot. The fences form a barrier across the floodplain for fish leaving the inundated floodplain on their way back to the lake when the flood recedes. The physical closure of the lot by bamboo fences starts when the water begins to recede in January and February. It is thus the lot management system, with its privileges granted to leasees, rules for restricted access and relatively effective enforcement of access, that has the main influence on local livelihoods, and not the physical structures themselves.
82. Thus, **in assessing livelihood outcomes, the influence of the physical built structures (large bamboo fence gear) is inseparable from the management system of the fishing lots.** The qualitative study looks broadly at how the restricted access and the management practices of the private concessions are perceived to influence the local communities. It also focuses on the successes and shortcomings of community fisheries management practices. In addition to fishing Lot #2, the study also examines the experiences of community fisheries in the area formerly covered by Lot #3. The experiences related to the release of Lot #3 are relevant in order to understand some of the opportunities, challenges and constraints that the cessation of commercial fishing lots could bring. The quantitative analysis, on the other hand, concentrates mainly on comparing the livelihood outcomes before and after the release of Lot #3.

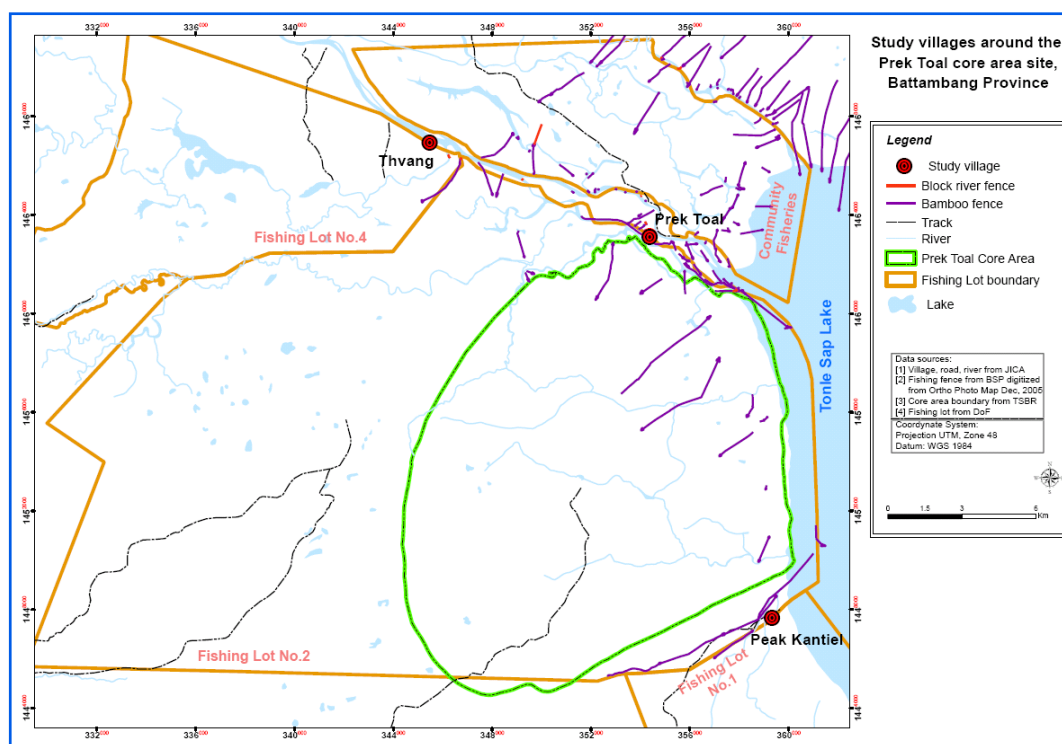
#### III.3.2 Characteristics of the study villages and livelihood assets

83. The case study in Battambang includes two main villages, Prek Toal and Thvang. The villages differ in their location, with Prek Toal being closer to the Tonle Sap Lake (TSL), closer to Lot #2 and closer to the commune centre, while Thvang is situated 8 km upstream along Stung Sangkae without any areas connected directly to Lot #2. Villagers of these two sites have different access to fishing grounds and Community Fisheries Areas (CFA) as shown in Table 3. Additionally, Peak Kantiel, situated between Lots #1 and #2, was included in the qualitative study to represent a village<sup>10</sup> under more direct influence of the lot system and with no direct access to the Community Fisheries Area.

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<sup>9</sup> For example, agro-ecosystem analysis of the project – a prerequisite for any irrigation scheme – was carried out only after the design of the structures had already been completed. In addition, one key-informant from the project indicated that the construction of new roads and markets is not well connected with the actual scheme.

<sup>10</sup> Officially, Peak Kantiel is a settlement rather than a recognized village.



**Figure 5. Map of study villages around the Prek Toal core area site, Battambang province**

84. According to the village survey data from the previous study (Annex A, Table 12), the village far from the TSL (Thvang) seems to be slightly better endowed than the village close to the TSL (Prek Toal). The quantitative analysis shows, however, no major differences between the livelihood portfolios of the two main case study villages, as both are predominantly fishing communities (Annex A, Table 13). The main source of livelihoods in both villages is fishing and most of the other significant activities are also fishing-related, such as processing (including fish paste, salted, and fermented fish) and marketing. The better-off families also engage in cage culture of fish and/or crocodile rearing. The possibilities for livestock raising are understandably very limited, but some chickens and pigs are raised on the floating platforms for household consumption and sale. Farming is not feasible in the area as the riverbanks are inundated for most of the year (June-January) and the flooded forests in the nearby area are protected and theoretically cannot be cleared for agricultural purposes.
85. The distance from the commune and less frequent connections to centres such as Chong Kneas harbour in Siem Reap make Thvang more isolated than Prek Toal. There are currently no NGOs working in Thvang, and there have been far fewer development projects than in Prek Toal where, for example, the environmental NGO “oSmoSe” has been active. The distance from the communal offices also makes Thvang less frequently patrolled by the local authorities. The internal differences and divisions are actually notable in both villages. One categorising factor for the fishers is their financial resources which distinguishes those who fish primarily for subsistence from those who market more of their catch. Ethnicity (ethnic Vietnamese and Khmer) is also an important distinguishing characteristic, as is the distinction between the villagers and the seasonal fishers from outside the area.
86. In terms of social capital, the villages in the Battambang case study seem to be worse off than in the two other other case study sites. At the village level, the relations between the different social groups are often characterised by competition over fish resources, and solidarity between the different social groups seems to be quite low. There are also

internal patron-client relations, and the poorest groups seem to be highly indebted to their wealthier neighbors. There are, however, also more horizontal networks in the form of indigenous associations e.g. related to schools, funeral arrangements, and communal platform management that seem to work rather well. Villagers spoke of being much more comfortable in dealing with local village leaders as compared to other officials from outside the immediate area.

Livelihood assets	Prek Toal	Thvang	Battambang case (combined)	
Village location and proximity to Tonle Sap Lake and the fishing lot	Close to Lot #2 and Tonle Sap Lake	Far from Lot #2 and Tonle Sap Lake		
Fishing locations and access to Community Fisheries Areas (CFA, former Lot #3)	Fishing in Tonle Sap Lake, Lot #2 and CFA	Fishing in CFA (and also in Lot #4)		
Main livelihood activities (% households participating)	Fishing	100%	Fishing	96%
	Other	80%	Other	96%
	Fishing labour	38%	Fishing labour	20%
	Fish culture	20%	Fish culture	27%
Main sources of income (% of total)	Fishing	65%	Fishing	69%
	Other	16%	Crocodile	11%
	Fish culture	6%	Petty trade	9%
	Crocodile	5%	Other	5%
Average household income (\$US per year)		984		1033
Average livestock index		2.0		3.7
Average yrs of schooling		3.0		2.7
Average household size		5.6		5.8

*Livestock index measures estimated using the conversion index by Taylor and Turner (1998)*

**Table 3. Key characteristics and household assets by village, fishing lot case study, Battambang province**

### III.3.3 Influence of the fishing lots on livelihood outcomes

87. **Fishing remains the main source of income in both villages; the overall decline in fish catch per household highlights a significant vulnerability.** Survey results show a decline in the fish catch per household in both villages during the recent season (2005/2006) as compared to before the release of Lot # 3 (2000/2001). That decline is most significant in the village near the TSL (Prek Toal). Such a decline in the fish catch per household may be influenced by increasing pressure from migrants coming from other provinces like Kampong Thom, Siem Reap, Kampong Cham and Banteay Meanchey. However, the sales/catch ratio remains the same in both periods. This has resulted in a drop in the contribution of fishing to the total income, but fishing remains the dominant source of income.
88. **Livelihood portfolios have diversified because of other opportunities becoming available, but also in response to the decline in income from fishing.** In both villages the livelihood portfolio has become slightly more diversified, particularly in response to the loss of income per household from fishing sources (Annex A, Table 13). But fishing is still the main livelihood source for the majority of the households, signifying the higher dependence on fishing activity.
89. The contribution of fishing to average household income has declined from 75 percent before the release of Lot #3 to 65 percent after the release in the village near the TSL (Prek Toal), and from 85 percent to 69 percent in the village far from the TSL (Thvang). (See Annex A, Table 14). The contribution from fish culture has declined in the former village but it has remained at the same level in the latter. The contribution from crocodile culture has shown a significant increase in both villages. In the village far from the TSL,

the contribution from petty trade has increased significantly from 2 percent to 9 percent. The contribution from other activities has also registered an increase in both villages.

90. **The release of fishing Lot #3 has opened access to local villages but also increased competition with outside groups; livelihood benefits for local villages are less than anticipated.** The main change in both villages due to the release of the Lot #3 was the increased access to the fishing grounds that were previously restricted during the open season from October to May. This provided new fishing grounds for those households that previously could not afford the licenses and were thus solely dependent on fishing outside the restricted area (the river, near-by flooded forest or the lake). The increased access provided better chances to secure yearround subsistence and income. For the previous sub-leasees, the change did not offer entirely new fishing grounds, but less expensive and less controlled access. The downside was, however, that the fishing domain became more crowded than before.
91. The release opened the restricted area not only for the locals, but also for fishers from outside. After the release the number of seasonal migrants, mostly from upland areas<sup>11</sup>, has been growing and new social tensions have emerged between these newcomers and the locals. Many local fishers pointed to the seasonal migrants when asked to explain the decline in catch per household, but there is little direct evidence. The actual role of the seasonal migrants and their indirect influence on local livelihoods requires further research, also to gain a better understanding of their motivations and possible methods to ease the pressure on Tonle Sap Lake fisheries by upland farmers.
92. **The continued operation of Lot #2 entails significant trade-offs in terms of conservation, economic returns, and equity.** Although fishing inside the lot is intensive, the exclusive management system does provide a controlled habitat for fish and other fauna, which may provide a conservation benefit as compared to more open access. The lot system with armed patrols and guards and heavy penalties and fines effectively keeps unwanted fishers out of the area, while the subleasing system provides the possibility to identify and regulate the fishers within the lot. The management system in effect channels economic benefits to the lot concessionaire, while restricting local villagers' access to the most productive fishing areas of the Tonle Sap Lake. There are also regular complaints about restricted transportation routes that leave the fishers without access to the flooded forests on the other side of the lot.<sup>12</sup>
93. On the other hand, negotiations and commercial partnerships take place (cf. Goes 2005). The lot provides rich fishing grounds for those who can afford to sublease fishing grounds (streams or lakes) or other sections of the lake from the operator. For the poorest groups, the lot provides working opportunities in patrolling and fish processing, particularly to households in the lower income group. However, outside labour increasingly appears to be substituted for this local employment, and the use of processing machines is reducing the overall labour demand.
94. Lot operations also appear to undermine the legitimacy of official management interventions and law enforcement in the eyes of local villagers. Villagers reported receiving conflicting information about the boundaries and regulations of the lot and obligations of the lot concessionaire, with the result that they frequently feel decisions are arbitrary. Interviewees regularly expressed frustration about the reluctance of fisheries officials to take action on lot practices which they suspected to be illegal or destructive. In

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<sup>11</sup> Villagers reported seasonal migrants from Siem Reap, Kampong Thom, Pursat, and Banteay Meanchey provinces, as well as upland areas of Battambang, coming to access the community fishing area (formerly Lot #3) during the period February – May before returning to their home villages for the rice harvest.

<sup>12</sup> Villagers reported that the concessionaire of Lot #2 does not allow villagers to travel through the lot to the common fishing area located on the other (upland) side of the lot, although this was allowed before and the villagers' right to cross the lot seems also to be stated in the lot's burden book.

addition, many villagers found the community fishery regulations that restrict fishing to small-scale gears hard to justify, as compared to the entitlements given to the lot operator.

95. **Households' ability to take advantage of opportunities provided by the release of the lot depends significantly on other assets.** Wealthier and more educated households are significantly more represented in community fisheries, and are realizing a significantly higher catch per household as compared to poorer households. The study finds that there is a direct correlation between household assets and the capacity to benefit from the opportunities offered by the reforms (Annex A, Tables 15 and 16). Survey results show that chronically poor households have lower levels of education, financial capital and livestock assets. This finding is supported by the qualitative analysis that shows inequality in benefits derived by households from the community fishery areas.
96. One might anticipate that the group most benefiting from increased access to fishing areas would be the poorer fishers who, prior to the release, were unable to pay for access. Many villagers interviewed reported, however, that richer fisher groups have maintained their higher income level, and intensive large-scale fishing activities have continued despite the community fishery regulations that allow only family-scale fishing. Several interviewees claimed that local power imbalances have enabled wealthier households to capture the community fishery area's best locations, and to restrict the access of poorer groups. These imbalances are not merely about wealth, but also reflect differences in peoples' access to decision-making. As stated by a poor fisherman: *"If we have conflict over fishing activities with rich people who are involved in large-scale fishing activities, we can't win..."*

#### **III.4 COMPARATIVE FINDINGS**

97. In this section, we analyze both qualitative and quantitative findings from the three case studies from a comparative perspective, incorporating additional analyses to draw conclusions regarding trends in income inequality, poverty, and the role of household assets in influencing people's ability to capture benefits from the changes in built structures.

##### **III.4.1 The institutions and processes of planning and managing built structures are highly influential in determining livelihood outcomes**

98. All case studies demonstrate that livelihood outcomes (e.g. access to natural resources, income benefits, and equity) cannot be predicted based on physical structures *per se*. The allocation of benefits and costs from built structures depends strongly on processes of planning and management. With poor planning and management, the built structure's benefits threaten to be short-term and unequal (with better-off households benefiting more), and costs unbearably high for some stakeholders (e.g. downstream fishers). Well-functioning management is thus crucial for equal distribution of benefits, and consequently for poverty reduction. The success of planning and management is related to the institutional and socio-political structures at different levels of society (see also Kibler and Perroud 2006).
99. For all types of built structures, the planning phase with prompt environmental and social impact assessments is crucially important. With regard to fishing structures, the questions about planning and management primarily refer to rules about access, gear restrictions, and the enforcement of these. In terms of roads, the most important aspect of management is maintenance, which is also very important with the irrigation structures, and more complex. A common management issue for both community fisheries committees and farmers' water user groups is conflict settlement between the users.

100. The case studies demonstrate that informal institutional structures and arrangements are often not well incorporated into the implementation of built structure projects. Yet, against the commonly held idea of the lack of social capital in Cambodia (e.g. Ovesen *et al.* 1996), many of the studied communities illustrated strong capacity and will to act collectively. In all case studies, the project interventions had acknowledged at the planning stage the need to set up appropriate community user groups. However, in each case, community members also reported unfulfilled expectations related to participation. A common challenge related to irrigation structures and roads was the difficulty in changing the role of recipients to active and responsible partners in maintenance.
101. While the new institutional and participatory arrangements (user groups, community fishery committees, etc.) are set up to secure more long-term and equal benefit allocation, they can also have exactly the opposite consequences. The case study on community fisheries, for example, demonstrated how community user groups can fail to include the poorest groups. This partially explains why progress in poverty reduction is slow in some areas (see section III.4.5).

#### **III.4.2 On average, household income is rising and livelihood portfolios are diversifying, though the influence of built structures on these trends varies significantly by case.**

102. Survey data shows that overall average income increased for all villages included in the study (Figure 6). In all cases, survey respondents overwhelmingly judged the changes in built structures as positive, in reference to the construction of the road in Pursat (100 percent), the irrigation scheme in Kampong Thom (96 percent), and the *removal* of Lot #3 in Battambang (93 percent).
103. In the case of the road development, there is strong evidence that the road is significantly contributing to improvements in income and other positive livelihood changes. The comparison between the Khmer village and the Cham village, both of which are near the road, shows that the increases in overall income are higher in the Cham village, which may be attributed to high social and financial capital among villagers that enable them to take advantage of the new livelihood opportunities emerging with the road development. For the irrigation project, it is still too soon to determine the net effects of the irrigation and infrastructure scheme, but expectations about the future point to a strong anticipated benefit in terms of an increase in average income for the villages studied. Of the two villages near the irrigation project, the income increase is higher in the head-user village, where there are both higher asset endowments and a favorable location within the core of the project area. Finally, in the case of fishing structures, both villages experienced an increase in income, but for different reasons. For the village far from the TSL, such an increase may be largely explained by gains among the wealthier households from crocodile farming and improvements in fish catch. In the village near the TSL, though some households are benefiting from the increased access offered by the removal of Lot #3, many, and particularly poorer, households are not (discussed further below in section III.4.4).



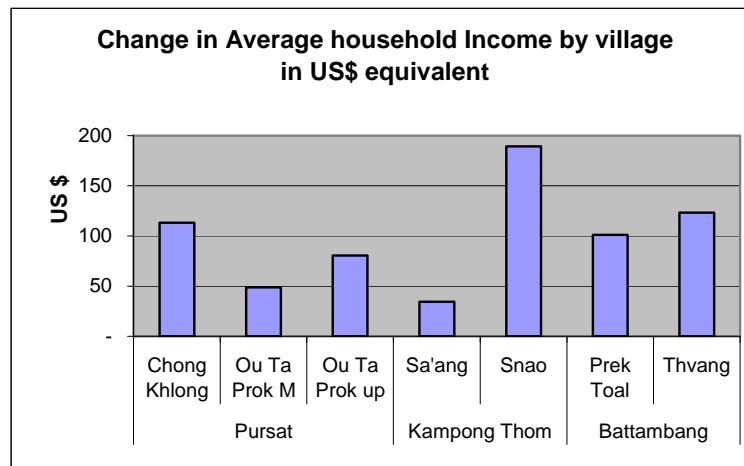


Figure 6. Change in average annual household income by village, in US\$ equivalent

104. Most households are diversifying their livelihood portfolios, which appears linked variously to new opportunities from changes in built structures and to new risks. Across the three study sites, the survey results show a modest decline in the degree of reliance on wild fisheries as a source of income, but fishing and fishing-related activities remain the leading sources of income. (Figure 7). For many households, this appears to reflect a reduction in vulnerability as they shift their livelihood strategies to spread risk. For other households, particularly those who are diversifying with no gains (or only minor gains) in income, it seems to be better explained as a necessary reaction to declining opportunities from traditional livelihood sources. Note, however, that, in the case of the fishing structure, the dependence of the villages on fisheries resources is relatively high, despite increased livelihood diversification.

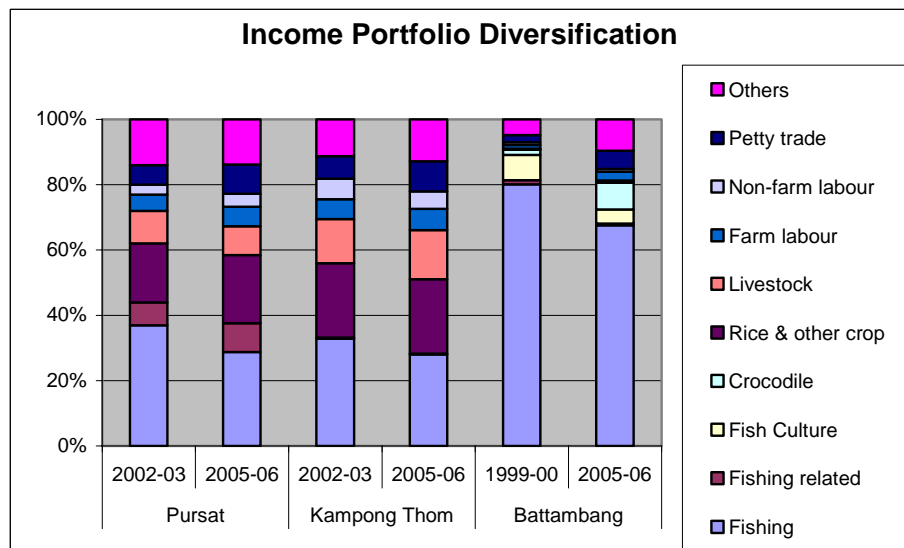
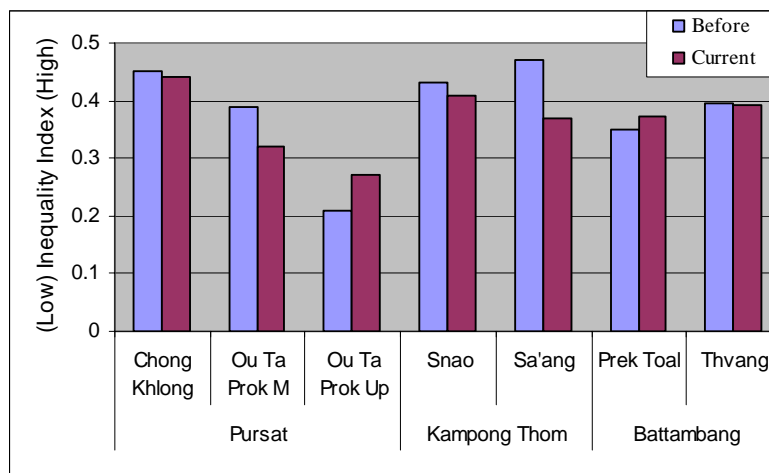


Figure 7. Comparison of income portfolio diversification within each case study site before and after the change in built structure, shown as percentage contribution of various livelihood activities to average household income

**III.4.3 In the villages studied, the built structure changes are generally benefiting wealthier households more; many poor households are also benefiting, but at a slower rate.**

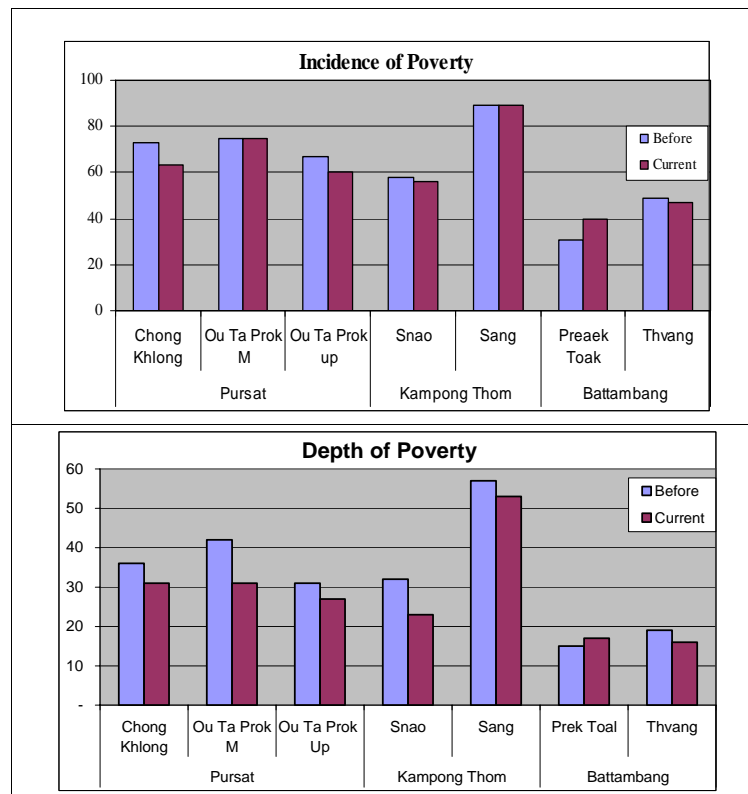
105. In addition to assessing the influences of built structures on livelihoods at the aggregate level (comparisons among communities), it is important to examine the relative benefits for different social groups (comparisons among households). Who is gaining most? Who is falling behind? Answers to these questions are essential in designing future infrastructure investments and complementary policy interventions. Note, however, that evaluating such trade-offs requires a broader perspective – assessing the potential gains and losses for all communities affected, including those farther upstream and downstream. The results in this report address only the villages studied, which were all intended beneficiaries of the interventions.
106. The rural households are placed differently in terms of their capacity to benefit from the opportunities provided by the road, the irrigation scheme and related infrastructure, and by the release of the fishing lot. This survey analysis confirms that households with higher asset endowments generally have been able to capture higher return (more profitable) activities, while poorer households are left with low return activities. Poorer households lack capital to makes investments in more remunerative activities, and other assets to take advantage of the changing opportunities (see section III.4.5 below).
107. Income inequality generally remains high in the study sites. According to the survey results, it has generally been slightly reduced in most of the villages studied, except in two villages, the Khmer village far from the road (Ou Ta Prok Up) and the fishing village near the TSL (Prek Toal), where it increased (Figure 8).



**Figure 8. Change in income inequality, by village, as measured by the gini coefficient of inequality**

### III.4.4 With few exceptions, chronically poor households are not yet benefiting enough to step out of poverty.

108. The two previous subsections focused on trends comparing changes among different economic groups within the study villages. In this section, we conduct the analysis with reference to the nationally-defined poverty line<sup>13</sup>. This provides a means of assessing progress in poverty reduction, and the dynamics of households' movements in and out of poverty. It is important to note the distinct differences among the study villages in reference to this national norm. The study villages in the road development and irrigation cases are poor compared to the average for rural Cambodia, while those in the fishing lot case are relatively well off in relation to the floating villages of the Tonle Sap.
109. In terms of absolute measures of poverty, survey results from most of the study villages indicate either no change or a slight decline (Figure 9). Despite having the lowest incidence of poverty at the initial time period (before the fishery reforms), the village near the TSL (Prek Toal) is the only village in the study where survey data shows an increase in both incidence of poverty (the percentage of households categorised as falling below the poverty line) and depth of poverty (how far below the poverty line these households are on average).



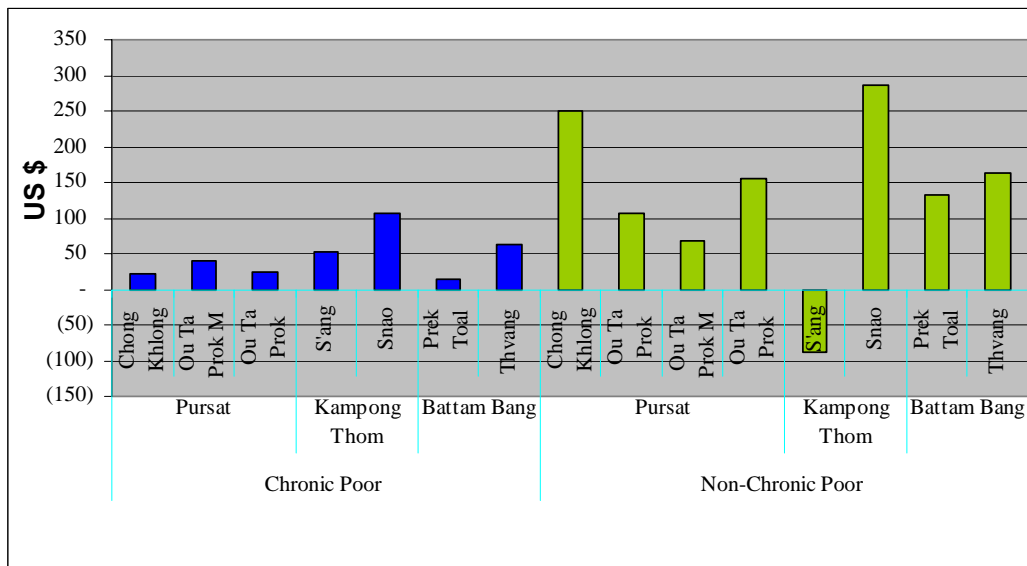
**Figure 9. Change in incidence and depth of poverty, by village**

110. The ability of villagers to rise above poverty is assessed to provide some inference about the influence of built structures. In this analysis, households are categorised as chronic poor and 'non-chronic' poor. The "chronic poor" are defined as households that remained

<sup>13</sup> The poverty line is defined as the minimum requirement for subsistence living in monetary terms. Poverty line information is taken from World Bank (2005) and JICA (2001). Poverty measures were estimated using Foster, Greer, and Thorbecke's index (Foster *et al.* 1984).

poor between the period prior to the built structure development (or, in the fishing lot case, prior to the removal of the fishing lot) and the current period. The “non-chronic poor” are households above poverty line during both time periods. The latter group also includes those who are “vulnerable to chronic poverty” (previously in the non-poor group but then fell below the poverty line), and those who were previously in the poor group but then managed to move above the poverty line.

111. Based on the current study, there is no indication that the chronically poor households (normally those with the lowest asset endowments) are benefiting enough to step out of poverty. The increase in the average absolute income of the chronically poor households is much lower than the non-chronic poor, highlighting again that the most disadvantaged have gained less than other households from the changes in livelihood opportunities, including those related to built structures. (See Figure 10.) The analysis shows that on average the non-chronic poor in each study village increased their incomes between 2 and 10 times more than the chronic poor, with an overall average of 3.2 times more.



**Figure 10. Change in average household income, chronic versus non-chronic poor**

112. Chronic poverty is severe in the road development and irrigation sites, and still significant in the fishing lot site. On average, over the period studied, there have not been large numbers of households stepping out of poverty. But the trends vary significantly by village. For the road development case study in Pursat, a significant positive trend of people moving out of poverty has been observed: 13 percent in the Cham village near the road (Chong Khlong), 10 percent in the Khmer village near the road (Ou Ta Prok Main) and 7 percent in the Khmer village far from the road (Ou Ta Prok Up). In the case of the irrigation project, chronic poverty remains high, most notably in the end-user village (Sa'ang). In the fishing lot case study, a significant percentage of households have moved out of poverty – 21 percent in the village near the TSL (Prek Toal) and 23 percent in the village far from the TSL (Thvang), but an almost equal number have slipped below the poverty line, demonstrating a relatively dynamic situation. (See Figure 11.) However, keep in mind that the time period in consideration for the fishing lot case study in Battambang is also longer – five years as opposed to three for the other cases – so more change is to be expected.

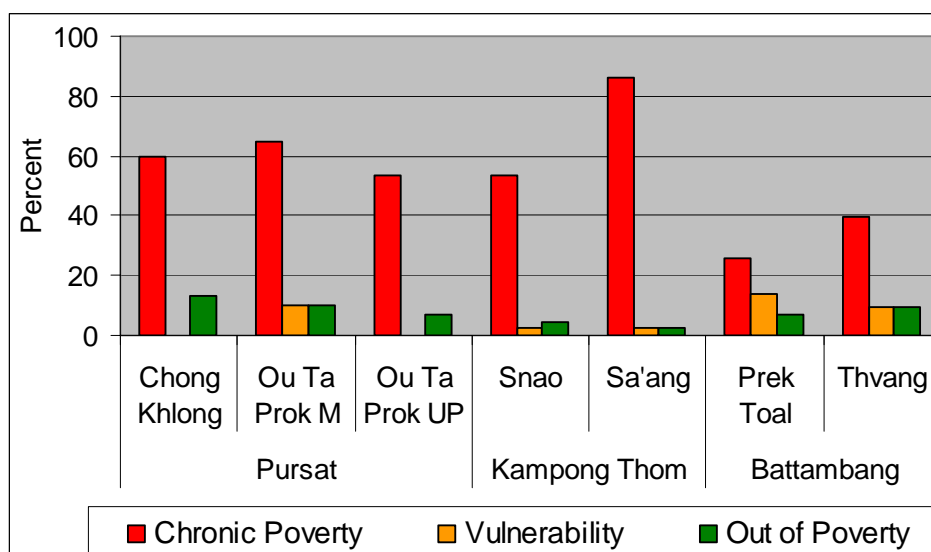


Figure 11. Dynamics of poverty, by village

#### III.4.5 The capacity to take advantage of new livelihood opportunities offered by changes in built structures depends on other household assets, particularly education.

113. The study also shows a strong relationship between household asset endowments and the capacity to take advantage of opportunities offered by changes in the physical environment (built structures) and related institutions. The asset endowment of households plays a major role in determining the influence of built structures and related institutional reforms on livelihoods. This finding is consistent with other research in development economics showing that household asset endowments are critical determinants of acute and chronic poverty, vulnerability and income (Gaiha 1992, Gaiha 1989, Gunawardena 1982, Jalan and Ravallion 1998, Makhanya and Ngidi 1999).
114. Quantitative analysis of the survey data shows education is the most significant variable in explaining the ability of households to get out of poverty; next is livestock, a form of savings (see Annex A, Table 23).<sup>14</sup> Landholding was not shown to be a statistically significant contributing factor to the ability of households to move out of poverty (Annex A, Table 24). Indeed, counterintuitively, in two case study villages (Sa'ang and Ou Ta Prok Main) the chronic poor actually have slightly more landholdings than the non-chronic poor<sup>15</sup> (Annex A, Table 23). However, these villages also have the highest rates of chronic poverty and their landholdings are relatively small. Financial capital also seems to play a crucial role in determining the influence of built structures on chronic poverty. Physical proximity to the structure is a less important factor in making comparisons among the households studied (though location would be very important in the case of clear upstream-downstream impacts).
115. In the qualitative analysis, social capital emerged as a key factor in explaining the degree to which the benefits of changes in built structures were broadly shared or captured by more privileged households alone. In the fishing lot case, particularly in the village near the TSL (Prek Toal) the relations between the different social groups are characterised by

<sup>14</sup> These findings are indicated both by a simple correlation analysis (Annex A, Table 23), and by a regression analysis that measures the statistical significance of correlation independent of other variables (see Annex A, Table 24, with accompanying note.)

<sup>15</sup> Non-chronic poor consist of three groups, namely: those who were above the poverty line in both periods, those who were previously above but then dropped below the poverty line ("vulnerable to poverty"), and those who moved above the poverty line ("out of poverty").

competition over the fish resources, and the solidarity between the different social groups seems to be quite low. In addition, the management of community fisheries seems to be in the hands of local elites, which has resulted in an unequal distribution of benefits with poorer and weaker groups suffering more. In the road development case, on the other hand, the differences in social organisation within the villages explains in part why the Cham village (Chong Klong) – with more active and effective community organizations – has benefited somewhat more than the Khmer village (Ou Ta Prok) from opportunities brought by the new road.

## IV CONCLUSIONS

116. This study has examined cases involving three different types of built structures in an effort to draw broader conclusions concerning the influence of built structures on local livelihoods around the Tonle Sap Lake and beyond. Building on the case studies, what more general conclusions can we draw?
117. First, the type of built structure clearly influences how direct benefits are distributed. The case studies illustrate that different types of built structures (roads, irrigation schemes, fishing gears) have different degrees of openness or exclusion in terms of the ability of poor households to access the livelihood opportunities enabled by the structures (see Figure 12). Overall, roads are most open as they provide public access with no direct exclusion. Irrigation is meant to bring livelihood benefits by increasing the seasonal availability of water, but still to a limited group, i.e. for landholders within the irrigation scheme and possibly to laborers and marketers nearby. In addition, the irrigation reservoir creates a new open access resource for fishing, although access to the reservoir may be limited by different kinds of regulation and management practices. Fishing structures in the lots are clearly most exclusive as they in effect funnel benefits to a small group and exclude the majority from the fishing area. Other institutional implications concern demands for conflict resolution, maintenance, and decision-making related to the distribution of direct costs and benefits from the intervention.

	<b>Pursat case: Roads</b>	<b>Kampong Thom case: Irrigation structures</b>	<b>Battambang case: Fishing structures</b>
<b>Level of exclusion</b>	Low	Medium	High
<b>Need to settle conflicting interests</b>	Medium	High	Very high
<b>Maintenance / local ownership</b>	High	Very high	Not relevant (private)
<b>Importance of equal distribution</b>	Relevant only in additional interventions (larger context)	High	High

**Figure 12. Institutional implications of different built structures in the case studies**

118. Yet there is also much we can say that applies across different types of built structures in different social and ecological settings. Institutions matter quite significantly, in ways that enable positive livelihood strategies (for example, through effective participation and consultation in project planning), and that disenable opportunities for the poor (for example, through mechanisms that reinforce inequitable access to aquatic resources and their livelihood benefits). (Refer to Figure 2.) This finding is also strongly supported by other studies (see, for example, Kibler and Perroud 2006). Scale also matters, as many of the factors that either threaten local livelihoods or open new opportunities are not within the direct influence of local communities. The cross-scale factors that emerged as significant in the case studies include such issues as seasonal migrants making use of community fishing grounds, markets that develop to provide for a demand for local products (e.g. pig rearing), and, of course, environmental factors, including the relationship between hydrological change, habitat, and fisheries productivity.

119. Built structures – by definition, purposeful modifications to the physical environment – clearly do affect livelihood outcomes, but they are by no means a “magic bullet.” This study examined the influence of changes in both directions, namely interventions to introduce new (or improved) structures as with roads and irrigation schemes, and interventions to remove structures (large fishing gears associated with the fishing lot). In all cases, the changes were justified on the grounds of poverty reduction. Yet, as the study shows, progress in poverty reduction has been modest, and inequality remains high. While it will be some years before the outcomes of these particular cases can be measured conclusively, the results already raise a justifiable concern. The ability of individual households to take advantage of changes depends very clearly on other assets, especially education. In certain contexts, other assets such as livestock holdings may be key, and smaller family size may be an advantage. These observations signal the need to pay close attention to the livelihood context in which changes are being introduced, and the ways in which different households may or may not be able to benefit. In essence, it means considering infrastructure as one element in a broad array of useful investments to encourage pro-poor rural development.



## V RECOMMENDATIONS

### V.1 LINK PLANNING OF NEW STRUCTURES TO DECENTRALISED NATURAL RESOURCE MANAGEMENT

120. **Planning, construction, and operation of built structures cannot operate in a vacuum and must have strong connections both to long-term management of the Tonle Sap's natural resources and to local development planning.** Many infrastructure projects seem to be considered short-term and localised interventions without appropriate consideration of the larger context in which they operate. In other instances, complex project management units and systems have been set up that isolate decision-making too much from local stakeholders and authorities.
121. The case studies indicate that **the best way to ensure community involvement and ownership is to link planning of built structures to on-going processes of decentralised rural development and natural resources management.** In terms of roads and irrigation canals, this would mean the planning processes led by commune councils and the forthcoming provincial and district councils in particular. In planning road developments, for example, this coordination is essential so as to identify and mitigate potential environmental impacts, particularly on fish habitat and migration routes, and to ensure that more remote local communities will indeed be able to access the main road. At the maintenance stage, too, intersectoral coordination remains critical, as responsibility for the maintenance of roads falls under the Ministry of Rural Development, culverts under the MOWRAM, and regulation of fishing effort under the Fisheries Administration. In both planning and maintenance, commune councils have a natural coordinating role to play, including where appropriate local organizations such as community fishery committees, road maintenance committees, as well as informal networks such as the Buddhist *sangha* or Muslim networks that have local legitimacy and can mobilize collective action.
122. **In advance of the physical infrastructure, it is often necessary to strengthen local institutional capacity to address the new challenges to collective decision-making.** Irrigation projects, for example, tend to be technically complex, so training is likely needed to help build effective communication between engineers, local officials, and community members. Support to establish and facilitate the work of water user committees is also helpful in promoting equitable water distribution and avoiding conflicts over operation and maintenance of the system. Similarly, future analysis and decision-making regarding the possible release of additional fishing lots should carefully consider the advance preparation of new local institutions to assume management and enforcement responsibility, as well as rules and conflict resolution mechanisms to address the increased competition from fishers within and outside the local area.

### V.2 STRENGTHEN INSTITUTIONAL MECHANISMS TO INTEGRATE DECISION-MAKING ACROSS SECTORS AND GEOGRAPHIC SCALES

123. The Tonle Sap Lake's ecosystem productivity is highly sensitive to changes in the flood regime. Even relatively small changes to the quantity and timing of flood patterns, and to the connectivity of aquatic environments may have significant consequences for the productivity of the lake, with direct and indirect implications for the livelihoods of millions of people. This demands an integrated approach to the area's water resource management, connecting existing actors and information from different sectors and levels.
124. **Social, economic, and ecological trade-offs stemming from alternative scenarios of infrastructure and water resource development need to be explicitly evaluated and publicly debated.** Planned developments expected to have an effect on the flood regime need to be clearly summarised together, and their possible cumulative impacts assessed.

This requires a comprehensive database including information on projected developments at different geographic scales.

125. **Government policies and strategies should clearly prioritize the relative importance of different social and economic benefits derived from the fisheries of the Tonle Sap Lake.** In the case of fishing lots and community fisheries, this should address the trade-offs regarding the role of fisheries as a source of government revenue (a benefit of the lot system), a “safety net” for vulnerable groups from around the basin (a benefit of unrestricted access for small-scale fishing), or a source of wealth generation for lakeshore communities (a potential benefit of community fisheries organizations with appropriate implementation).
126. **An integrated approach should start by overcoming the communication gaps and improving cooperation between different sectoral ministries.** Priorities here include, for example, cooperation between the Ministry of Water Resources (MOWRAM) and the Ministry of Agriculture (MAFF) in irrigation planning, and between the Fisheries Administration and Ministry of Public Works in assessing the potential influence of road development on fisheries.

### **V.3 ADOPT PROCESSES OF CONSULTATION AND PARTICIPATION IN PROJECT PLANNING THAT RECOGNISE THE DIFFERENCES AMONG LOCAL HOUSEHOLDS**

127. Stakeholder consultation and participation are key factors influencing the success of infrastructure projects. The fundamental question is how to further improve actual participation and consultation so that projects can result in more equitable resource allocation and a stronger sense of ownership. When this expectation comes too late, as when locals are asked to contribute their efforts primarily for maintenance once the structure has already been built, it is extremely difficult to build a genuine partnership.
128. Therefore, **more attention must be paid to participation and ownership from the very initial stages of project planning.** Active involvement of commune councils from the project area is required in reviewing potential infrastructure developments. At the village level, identification of existing networks (both formal and informal) and cooperation with locally respected leaders in all stages of the project is crucial. Regular information sharing is important so that the division of responsibilities is clear and the expectations not unrealistic.
129. **At the planning stage, it is important to analyze sensitively how the anticipated benefits and costs of a project are likely to be distributed among different social groups, taking into account the role of local institutions and differences in household assets.** The case studies demonstrate the importance of recognizing the heterogeneity of communities as well as the social groups within communities, considering not only wealth and income, but also education, ethnicity, the strength of social networks, and local power relations.
130. **Special provisions need to be made so that the poorest groups can indeed participate effectively.** A variety of approaches have been shown to be effective. NGOs that have legitimacy in the area, good local knowledge, and experience working with the more vulnerable households can sometimes be good intermediaries in bringing local insights and helping organise consultations with the poorest groups. Consultations conducted separately with more vulnerable groups, with women, or with ethnic minorities that protect individuals’ confidentiality can help ensure a more frank sharing of views. And, quite practically, it is important to provide appropriate compensation (such as meals and transportation) so that participation does not become an economic burden for the people involved. Even with such efforts, however, successful participation is not a uniquely local process. It is also contingent on the broader context of governance,

particularly the degree of accountability of public officials, which either encourages or discourages people from making the effort (and sometimes assuming the risk) of seeking a voice in public decision-making.

#### **V.4 TARGET BUILT STRUCTURE INVESTMENTS WITH AN UNDERSTANDING OF HOW THE POOREST GROUPS CAN BENEFIT**

131. This research has shown that even when the net benefits of infrastructure developments in terms of average household income appear to be positive, the poorest groups can be left behind. Addressing these distributional issues requires reconsidering priorities in terms of the links between infrastructure development and changes in livelihood opportunities, as well as types of infrastructure and their scale and complexity of operations.
132. **Be clear about the livelihood opportunities that structures are meant to help facilitate.** Because the influence of built structures on livelihoods varies significantly based on the institutional context, assets and vulnerabilities of households affected by the change, project planning should explicitly identify what groups are expected to benefit and how. Making these expectations clear helps facilitate informed public debate about whether the investment is worthwhile, or how it might be adapted to reach the groups intended. Such adaptations may include technical design modifications, as well as changes to the planned operation and management of the structures. With road development, for example, this may entail including smaller, feeder roads in the construction plan, or choosing labor-intensive building approaches that can help build financial capital among poorer households in the area while simultaneously developing a local skill base to support maintenance in subsequent years.
133. **Favor investments in structures with high degrees of openness in terms of social groups that can access the benefits.** Public roads are by design available to all users without a fee (apart from toll roads and possible maintenance fees), and access can be increased as the network of feeder roads expands. Irrigation systems deliver water to a defined area, so the number of people who can directly benefit is limited, though there are significant indirect benefits from associated labor opportunities, trade, etc. Large fishing structures are designed specifically to exclude the majority of fishers and channel the fish catch to a few; it would be very difficult to shift the institutional arrangements so that the benefits of such structures would be equitably distributed.
134. **Where feasible, favor smaller-scale projects that are more easily adapted to local needs, more easily managed locally, and less attractive for elite capture.** Many of the common risks encountered with large infrastructure projects are associated with their scale and complexity of operation.

#### **V.5 PLAN COMPLEMENTARY INVESTMENTS TO ADDRESS THE ASSET GAPS OF POORER GROUPS**

135. Many households fail to take advantage of the livelihood opportunities offered by built structures because they lack other essential assets. Ensuring that the poorest households have a chance to access these new opportunities is essential if infrastructure investments are to make a measurable contribution to reducing poverty.
136. **Alongside infrastructure improvements, investments in basic education, training and technical support services, and credit may be needed, as well as support to community organizing capacity.** Setting priorities for such complementary investments should be part of the local livelihood assessment associated with infrastructure planning.

In many areas, securing land rights is an essential step, as the value of agricultural land typically rises along with irrigation or road improvements, and villagers may face pressure to vacate or sell if they feel their tenure is insecure. Special attention should be given to the phasing of investments as well – in many instances it may be wise to begin support to develop these other household assets long before construction of the physical infrastructure begins.

137. **Invest in building household assets to take advantage of alternative livelihood opportunities, not to increase fishing effort.** Unlike the case with irrigated agriculture or road development, the potential advantages from the release of fishing lots and support to community fisheries stem from a more equitable distribution of economic benefits, not from an intensification of production. For communities that have depended overwhelmingly on fishing (such as most floating villages), efforts to regulate fishing and make it more sustainable need to be complemented with support for alternatives such as ecotourism, post-harvest processing, and (for those who wish) training for jobs on shore.

## References consulted

- ADB (1999). Governance: Sound Development Management. Asian Development Bank.
- ADB (2003). Technical assistance to the Kingdom of Cambodia for Preparing the Tonle Sap Sustainable Livelihood Project. ADB TAR: CAM 36608.
- ADB (2004a). Tonle Sap Sustainable Livelihoods (Phase 1). ADB TA CAM-4197, Final Report (September 2004).
- ADB (2004b). Tonle Sap Sustainable Livelihoods, Tonle Sap Initiative Brochure, December 2004. Available online at [http://www.adb.org/Projects/Tonle\\_Sap/articles.asp](http://www.adb.org/Projects/Tonle_Sap/articles.asp)
- ADB (2004c). Transport Sector Strategy Study, Technical Assistance for Greater Mekong Subregion Transport Sector Strategy Study, Asian Development Bank. Available online at <http://www.adb.org/Documents/TARs/REG/tar-stu-38052.pdf>
- ADB (2005). The Tonle Sap Initiative: The Tonle Sap and Its Fisheries. Available at [http://www.adb.org/Projects/Tonle\\_Sap/](http://www.adb.org/Projects/Tonle_Sap/)
- ADB (2006). The Tonle Sap Initiative: Reconciling Multiple Demands with a Basin Management Organization.
- ADB (2006b). When do rural roads benefit the poor and how? An In-depth Analysis Based on Case Studies. Asian Development Bank. Available online at [http://www.adb.org/Documents/Books/ruralroad\\_benefits/rural-roads.pdf](http://www.adb.org/Documents/Books/ruralroad_benefits/rural-roads.pdf)
- AERU/KE & RUA/FFA (2003). Inception report: The Environment Impact assessment for Stung Chinit Irrigation and Rural Infrastructure Project. ENSAT/KOSAN, Phnom Penh.
- Banuri, T., Chadwaick, M., Juntopas, M., Raingsey, P., & Sithirith, M. (2006). Sustainable Livelihoods in Tonle Sap. FACT/SEI/Sumernet.
- Billon, P.L. (2000). The Political Ecology of Transition in Cambodia 1989-1999: War, Peace and Forest Exploitation. Vol.31 (2000), pp.785-805. UK: Blackwell Publisher.
- Cambodia New Vision (2001). Addressing the Annual Conference of the Ministry of Rural Development: "Performance in 2000 and Targets for 2001". Speech by Prime Minister Hun Sen, Issue 37, the Cabinet of Samdech Hun Sen. Available online at [http://www.cnv.org.kh/cnv\\_html\\_pdf/cnv\\_37.pdf](http://www.cnv.org.kh/cnv_html_pdf/cnv_37.pdf)
- Carlioni, A.S and Crowley, E. (2005). Rapid guide for missions – Analysing local institutions and livelihood. Food and Agriculture Organization of United Nations (FAO). Available online at <ftp://ftp.fao.org/docrep/fao/008/a0273e/a0273e00.pdf>
- Chamnan, H., & Evens T. (2005). Consultation on the proposed Stoung-Chikreng Grassland and Wildlife Management Area and Veal Srangai Grassland and Wildlife Management Area. WCS/WPO, Cambodia.
- DFID (2001). Sustainable livelihoods guidance sheets, The Department for International Development (DFID). Available online at [http://www.livelihoods.org/info/info\\_guidancesheets.html](http://www.livelihoods.org/info/info_guidancesheets.html)
- Deap, L., Degen, P., & Zalinge, N.V. (2003). Fishing Gears of the Cambodian Mekong. Inland Fisheries Research and Development Institute (IFReDI), Phnom Penh.
- Dupuy, H.E. (2001). Report on Sustainable Livelihood Activities in Prek Taol for the tonle Sap Conservation Project, Consultancy Report: Wetland International-Asia Pacific. UNDP-FEF, Phnom Penh.
- ENSAT/KOSAN/FFA Cambodia. (2003). Inception Report: The Environment Impact Assessment for Stung Chinit Irrigation and Rural Infrastructure Project. Inp ENSAT/ KOSAN

- Evans, P.T. (2002). Fishing disarmed: Community fisheries development is taking off in Cambodia, as demonstrated in the Tonle Sap Lake in the province of Siem Reap. SAMUDRA
- Evans, T., Gray, T., Chamnan, H., Mouyheang, S., & Vanny, L. (2005). Farming and its Impact on Flooded Grasslands around the Tonle Sap Lake: A Survey in the Krous Kraom Area of Kampong Thom. WCS Cambodia Program, Phnom Penh.
- FACT (2004). The Stung Chinit Irrigation and Rural Infrastructure Project. Tonle Sap Watch Newsletter Issue 2 November - December 2004, Fisheries Action Coalition Team (FACT), Phnom Penh.
- Foster, J., J. Greer and E. Thorbecke. (1984). A Class of Decomposable Poverty Measures. *Econometrica*, Vol. 52, no. 3, 761-766.
- Fox, J. (2002). Siam Mapped and Mapping in Cambodia: Boundaries, Sovereignty, and Indigenous Conceptions of Space. East-West Center Working Paper, Honolulu, HI.
- Gaiha, R. (1992). On the chronically poor in rural India. *Journal of International Development*, Vol.4, No.3, 273-289.
- Gaiha R. (1989). Are The Chronically Poor Also The Poorest In Rural India? *Development And Change*, Vol.20, No. 2, 295-322
- Gannon, C. and Liu, Z. (1997). Poverty and Transport. The World Bank Group. Available online at <http://www.worldbank.org/transport/publicat/twu-30.pdf>
- GCP/CMB/002/BEL (1997). The Community Management and the Traditional Cambodian Society: Village of the Inundatd Forest of the Tonle Sap Lake. Report Technique Par Fabienne LUCO. (Summary of the Original in French).
- Goes, F. (2005). Four Year of Water bird Conservation Activities in Prek Toal Core Area of the Tonle Sap Biosphere Reserve (2001-2004). WCS Cambodia Program, Phnom Penh
- GRET/CEDAC (2003). Prioritization of Farmer's Needs for Agricultural Research and Development in Stung Chinit Irrigation and rural Infrastructure Project. Workshop Report (Khmer Version), 7-9 April 2003.
- GRET (2005). Household Income & Wealth, Stung Chinit Irrigation and Rural Infrastructure: Baseline Income Survey Report.
- Guillaume, J. (2003). Technical note: Survey on farmer's participation to construction of canals and drains. Stung Chinit Irrigation Project, GRET/CEDAC, Water Users Organization and Agricultural and Research for Deveopment.
- Gum, W. (1998) Natural Resource management in the Tonle Sap Biosphere Reserve in Battambang Province. Consultancy Report for the European Comission Support Programme to the Environmental
- Gum, W. (2000). Inland Aquatic Resources and Livelihoods in Cambodia: A Guide to the Literature, Legislation, Institutional Framework and Recommendations. Oxfam GB and NGO Forum on Cambodia. Available at <http://www.oxfamkambodia.org>
- Gunawardena, P. J. (1982). Poverty among labour households in a southern dry zone village in Sri Lanka. *Labour, Capital and Society*. Vol. 15, no. 2, 58-85.
- Howe, J. and Richards P. (eds) (1984). Rural roads and poverty alleviation ILO, Intermediate Technology Publications, London; 168 pp.
- Hussain I., Wijerathna D., Arif, S.S., Murtiningrum, Mawarni A. and Suparmi (2006). Irrigation, Productivity and Poverty Linkages in Irrigation Systems in Java, Indonesia. *Water Resource Management*, 20: pp. 313-336.
- IFReDI, RUA/FFA, & AERU (2006). The Environment Impact Assessment for Stung Chinit Irrigation and Rural Infrastructure Project. Sub Contract of the establishment of Community of Fishery in the reservoir area: Technical and Financial Proposal. InpENSAT/IFReDI, Phnom Penh.

IFRTD (2006). Rapid Assessment of Rural Road Prioritisation in 12 Developing Countries. Study commissioned by TRL. The International Forum for Rural Transport and Development (IFRTD). Available online at <http://ifrtid.gn.apc.org/new/issues/RRPrioritisation.doc>

IFRTD (2005). Network Report 2005. The International Forum for Rural Transport and Development (IFRTD), London.

IFRTD (1997). Annotated Bibliography on Rural Transport, International Forum for Rural Transport and Development (IFRTD)

Jalan, J. and M. Ravallion. (1998) 'Determinants of Transient and Chronic Poverty: Evidence from Rural China'. *Policy Research Working Paper 1936*. Washington DC: World Bank. <http://econ.worldbank.org/>

Kibler J-F. and Perroud C. (2006). Towards Co-Management of Hydro-Agricultural Infrastructures: Lessons Learnt from the Prey Nup Project in Cambodia, Coll. Études et Travaux, série en ligne n°7, Éditions du Gret, Available online at <http://www.gret.org/ressource/pdf/07710.pdf>

Koroma, B.M. (2002). Local Reform of Community Forest and Fisheries Management in Cambodia. *International Review for Environmental Strategies*. Vol.3 (No.2), pp. 304-318.

Kosal, M. (1998). Social Implication of Conservation of the Designated "Prek Toal" Core Area of the Tonle Sap Biosphere reserve, Cambodia. DoNcAP/MoE, Phnom Penh.

Kurien, J., Baran, E., & Nam, S. (2006). Factors That Drive Cambodia's Inland Fish Catch: What Role Can Community Fisheries Play? *Inland Fisheries Research and Development Institute (IFReDI)*, Phnom Penh. 12 pp.

Kurien, J., Nam, S., & Sam Onn, M. (2006). Cambodia's Aquarian Reforms: The Emerging Challenges for Policy and Research. *Inland Fisheries Research and Development Institute (IFReDI)*, Phnom Penh.

Lamberts, D. and Bonheur, N. (2006). Major floodplain ecosystems governance issues in the Mekong Region, Background document for Mekong Region Waters Dialogue Event on July 6-7 2006. Available online at: <http://www.mpowernet.org/mweb.php?pg=133>

Loeung D., Degen, P., & Zalinge, N.V. (2003). Fishing Gears of the Cambodian Mekong. *IFReDI, Phnom Penh. Cambodia Fisheries Technical Paper Series, Volume IV (2003)*, 269 p. ISSN: 1726-3972.

Lorenzen, K. *et al.* (2005). Guidance Manual for the Management of Impacts of Irrigation Development on Fisheries. United Kingdom: Imperial College London. Draft 3: July 2005

Makhanya E. M. and Ngidi M. M. (1999). 'Poverty and rural livelihoods in Umzumbe', *South African Geographical Journal*, Vol. 81, No.1, 44-51.

Middleton, C. & Tola, P. (2006) Indigenous Water Resource Management around Tonle Sap Lake: Opportunities and Constraints. Forthcoming in *Modern Myths of the Mekong*.

Mitra, M. (2003). Technical Assistance to the Kingdom of Cambodia for the Participatory Poverty Assessment of the Tonle Sap. ADB TAR: CAM 37250.

MOWRAM & ADB (2003). Stung Chinit Irrigation and Rural Infrastructure Project: Potential for Fisheries and Aquaculture Development at Stung Chinit. SMEC/SCC, Phnom Penh.

MOWRAM & ADB (2005). Stung Chinit Irrigation and Rural Infrastructure Project: Draft plan for Fisheries and Aquaculture management and development at Stung Chinit. SMEC&SCC, Phnom Penh.

MOWRAM & ADB (2002). Stung Chinit Irrigation and Rural Infrastructure Project: Design Parameters for Fishpass at Stung Chinit. SMEC&SCC, Phnom Penh.

Molle, F. (2005). Irrigation and water policies in the Mekong region: Current discourses and practices. Colombo, Sri Lanka: IWMI. 43 pp.

Navy, H., Chuenpagdee, R., & Kurien, J (2006). Livelihood Importance and Values of Tonle Sap Lake Fisheries. *IFReDI*, Phnom Penh.

- Navy, H., Leang, S., & Chuenpagdee, R. (2006). Socioeconomic and Livelihood Values of Tonle Sap Lake Fisheries. IFRDI, Phnom Penh.
- Nettleton, D. & Baran, E. (2003). Fishery stakeholder groups and Livelihood Variation around the Tonle Sap Great Lake, Cambodia. TA WorldFish/ADB/IFREDITA No. T4025-CAM
- Öjendal, J. (2000). Sharing the Good: Modes of Managing Water Resources in the Lower Mekong River Basin. Göteborg: Department of Peace and Development Research, Göteborg University.
- Ovesen, J., I. Trankell and J. Öjendahl (1996). When Every Household is an Island – Social Organization and Power Structures in Rural Cambodia, Uppsala Research Reports in Cultural Anthropology no. 15, Department of Cultural Anthropology, Uppsala University, Sweden.
- Pellini, A. & Ayers, D. (2005) Social Capital and Village Governance: Experiences with Village Networks. A Discussion Paper. GTZ.
- Puy, L. & Sovan, L. (2005). Stung Chinit Irrigation and Rural Infrastructure Project, Environmental Impact Assessment: Pre-impoundment Report. INP ENSAT/KOSAN/ GRET, Phnom Penh.
- Rab, M.A., Hap, N., Ahmed, M., Keang, S.L. and Viner, K. (2005). Socioeconomics and Values of Resources in Great Lake – Tonle Sap and Mekong - Bassac Area: Results from a Sample Survey in Kampong Chhnang, Siem Reap and Kandal Provinces. WorldFish Center, Penang, Malaysia. Available at [www.ifredi.org](http://www.ifredi.org)
- Ratner, B.D., Ha, D.T., Kosal, M., Nissapa, A., & Chanphengxay, S. (2004). Undervalued and Overlooked: Sustaining Rural livelihoods through Better Governance of Wetlands. WorldFish Center Studies and Reviews 28, 24 pp.
- Ratner, B.D. (2006). Community management by decree? Lessons from Cambodia's fisheries reform. *Society and Natural Resources* 19:79-86.
- Resurreccion, B.P. (2006). Rules ,Roles and Rights: Gender, Participation and Community Fisheries Management in Cambodia's Tonle Sap Region. *International Journal of Water Resources Development*, Vol. 22, No. 3, 433–447.
- Rosien, J. (2006). Can the Asian Development Bank Save the Tonle Sap from Poverty?: An Analysis of the Asian Development bank's Operations in the Tonle Sap Basin. Oxfam Australia, Australia.
- SEI&ADB (2002). Strategic Environmental Framework for the Greater Mekong Subregion: Integrating Development and Environment in the Transport and Water Resource Sectors.
- SEILA Commune Database (2006). Available at <http://www.seila.gov.kh/>
- Sina, L. (2003). Cambodia Fisheries Conflicts in the Post War Era and the Creation of Fishing Communities: A Case of Fishing lot Conflicts around Tonle Sap River and the Great Lake. *Journal of Regional Fisheries*. pp. 89-105.
- Simon, D. (1996) *Transport and development in the third world*. Routledge (Introductions to Development), London; 194 pp.
- Sithirith, M. & Warr, C.G. (2005). Political Geography of Floating Villages in The Tonle Sap Lake–Maps and Counter-Map: Local realities of Floating Village in Tonle Sap Lake. FACT, Phnom Penh.
- Tarr, C. M. (2003) Fishing Lots and People in Cambodia. In Kaosa-ard, M. and Dore, J. (eds.): *Social Challenges for the Mekong Region*, White Lotus, Bangkok. [[http://rockmekong.org/pubs/Year2003/social/13\\_chou.PDF](http://rockmekong.org/pubs/Year2003/social/13_chou.PDF)]
- Taylor, P. (2004). Redressing Disadvantages or Re-arranging Inequality? Development Interventions and Local Responses in the Mekong Delta. In Taylor P. (ed.) *Social Inequality in Vietnam and the Challenges to Reform*. Institute of Southeast Asian Studies, Singapore.



UN Millennium Project (2005). Halving hunger: it can be done, Summary version Task Force on Hunger. Available online at [www.unmillenniumproject.org/documents/HTF-SumVers\\_FINAL.pdf](http://www.unmillenniumproject.org/documents/HTF-SumVers_FINAL.pdf)

Van Acker, F. (2005). 'Cut the shoe to fit the foot': Decentralized natural resource management in Cambodia—Powers and functions for local councils. Report for the Ministry of Interior-Royal Government of Cambodia, December 2005, 114 pp.

World Bank (1996) *Sustainable transport, priorities for policy reform*. Development in Practice Series, Washington D.C., 131pp.

## ANNEX A: DATA TABLES

### Road development case study, Pursat province (Tables corresponding to section III.1)

**Table 1: Village level socioeconomic indicators for the case study villages, Pursat province**

	2002		2003		2004	
	Chong Khlong	Ou Ta Prok	Chong Khlong	Ou Ta Prok	Chong Khlong	Ou Ta Prok
Number of households	148	182	152	182	158	195
Number of females	341	514	356	514	365	522
Number of males	305	422	322	422	339	430
Percent of houses with thatched roofs	38.5	74.7	23.7	74.7	20.3	76.9
Percent of houses with tiled roofs	25.7	12.1	25.7	12.1	25.9	10.3
Percent of houses with fibro roofs	2.7	0.0	2.6	0.0	2.5	0.0
Percent of houses with zinc roofs	33.1	9.9	42.8	9.9	47.5	12.8
Percent of houses with concrete roofs	0.0	0.0	0.0	0.0	0.0	0.0
Percent of households with cattle	71.6	95.1	57.9	95.1	63.9	93.8
Percent of households with pigs	0.0	93.4	0.0	93.4	0.0	97.4
Number of motorcycles per 100 people	6.5	0.0	7.4	1.1	7.5	1.6
Number of cars per 100 people	0.0	0.1	0.0	0.1	0.0	0.1
Number of ox carts per 100 people	15.6	6.4	10.0	6.4	9.7	6.8
Number of bicycles per 100 people	10.2	0.0	12.4	16.0	12.4	16.1
Number of row boats per 100 people	8.5	3.7	9.4	3.7	9.7	5.5
Number of motor boats per 100 people	0.3	0.9	0.0	0.9	0.0	1.4
Percent of households with TV	24.3	8.2	27.0	9.3	30.4	24.6

Source: Estimated using SEILA Commune Database 2006

**Table 2: Changes in livelihood activities in Pursat (shown as percentage of households participating in each activity)**

Activities	Pursat		Chong Khlong		Ou Ta Prok Main		Ou Ta Prok Up	
	Before	Current	Before	Current	Before	Current	Before	Current
Fishing	76.3	78.8	82.2	82.2	60.0	65.0	80.0	86.7
Fishing related activities	22.5	23.8	33.3	33.3	10.0	10.0	6.7	13.3
Rice farming	90.0	92.5	88.9	91.1	90.0	90.0	93.3	100.0
Other crops	52.5	51.3	60.0	57.8	40.0	40.0	46.7	46.7
Livestock	62.5	66.3	53.3	55.6	60.0	70.0	93.3	93.3
Farm labour	26.3	31.3	20.0	22.2	40.0	45.0	26.7	40.0
Non-farm labour	10.0	12.5	4.4	6.7	20.0	20.0	13.3	20.0
Petty trade	28.3	29.8	15.6	15.6	11.7	13.8	13.3	14.2
Other	79.2	79.4	74.6	75.6	76.0	75.5	78.3	78.0

**Table 3: Changes in livelihood portfolio diversification in Pursat (shown as percent contribution to the total household income)**

Activities	Pursat		Chong Khlong		Ou Ta Prok Main		Ou Ta Prok Up	
	Before	Current	Before	Current	Before	Current	Before	Current
Fishing	37.5	28.9	42.8	31.8	24.9	16.2	33.9	32.5
Fishing related activities	7.1	8.8	8.6	12.9	5.3	1.0	3.9	2.7
Rice farming	16.2	19.4	14.8	17.2	20.0	27.0	16.8	18.9
Other crops	2.0	1.9	2.5	2.2	1.6	1.9	0.7	0.6
Livestock	9.5	8.9	2.9	3.8	18.4	21.4	22.1	13.2
Farm labour	5.0	5.6	7.4	8.1	1.5	1.8	0.7	1.2
Non-farm labour	2.8	3.8	3.5	3.4	2.2	2.5	1.1	6.8
Petty trade	6.5	9.4	4.6	8.4	13.7	16.2	4.5	5.2
Other	13.5	13.4	13.1	12.3	12.2	12.1	16.3	18.9

**Table 4: Percentage of household by assets (Pursat)**

Livestock assets	Percentage of household			
	Pursat	Chong Khlong	Ou Ta Prok (Main)	Ou Ta Prok (Up)
Livestock	87.5	86.7	90.0	86.7
Cows/oxen	27.5	40.0	10.0	13.3
Buffalo	45.0	46.7	45.0	40.0
Pigs	32.5	0.0	70.0	80.0
Chickens	66.3	66.7	55.0	80.0
Ducks	25.0	33.3	20.0	6.7

**Table 5: Correlation between assets and changes in income (Pursat)**

	Correlation coefficient of the household asset with changes in income			
	Landholding	Livestock Index	Education	Household size
Pursat	0.49	0.32	0.04	0.03
Chong Khlong	0.59	0.35	0.06	0.06
Ou Ta Prok Main	(0.15)	0.01	0.05	(0.11)
Ou Ta Prok Up	0.41	0.18	0.26	(0.30)

**Table 6: Income change by chronic poor vs. non-chronic poor (Pursat)**

Groups	Village	Change in average household income (US\$)	
		Change in average household income (US\$)	Average household income (US\$)
Overall Average	Pursat	91.2	589.2
Chronic Poor	Chong Khlong	22.3	312.3
	Ou Ta Prok Main	38.9	327.3
	Ou Ta Prok Up	25.6	443.4
	Chong Khlong	249.7	1,164.9
Non-Chronic Poor	Ou Ta Prok Main	67.0	702.6
	Ou Ta Prok Up	154.0	737.1

Irrigation case study, Kampong Thom province (Tables corresponding to section III.2)

**Table 7: Village level socioeconomic indicators for case study villages, Kampong Thom province**

	2002		2003		2004	
	Snao	Sa'ang	Snao	Sa'ang	Snao	Sa'ang
Number of households	172	71	172	69	195	69
Number of females	423	186	448	186	450	187
Number of males	396	163	409	171	434	173
Percent of houses with thatch roofs	66.9	22.5	66.9	23.2	67.7	23.2
Percentage of houses with tiled roofs	23.3	42.3	23.3	43.5	21.5	43.5
Percent of houses with fibro roofs	0.0	5.6	1.2	5.8	1.0	5.8
Percent of houses with zinc roofs	5.8	18.3	4.7	18.8	4.1	18.8
Percent of houses with concrete roofs	0.0	0.0	0.0	0.0	0.0	0.0
Percent of households with cattle	88.4	93.0	88.4	95.7	92.8	100.0
Percent of households with pigs	62.8	91.5	59.9	94.2	76.9	91.3
Number of motorcycles per 100 people	1.3	1.1	1.6	1.4	3.1	1.7
Number of cars per 100 people	0.0	0.0	0.0	0.0	0.3	0.0
Number of ox carts per 100 people	15.8	18.1	15.1	17.6	14.7	17.5
Number of bicycles per 100 people	12.2	19.8	11.7	19.3	12.4	18.9
Number of row boats per 100 people	3.1	1.4	2.3	1.4	2.3	1.4
Number of motor boats per 100 people	0.0	0.0	0.0	0.0	0.0	0.0
Percent of households with TV	12.8	8.5	13.4	15.9	14.9	34.8

Source: Estimated using SEILA Commune Database 2006

**Table 8: Livelihood activities diversification in Kampong Thom (shown as percentage of households participating in each activity)**

Activities	Kampong Thom		Snao		Sa'ang	
	Before	Current	BBefore	Current	Before	Current
Fishing	58.9	66.7	51.1	66.7	66.7	64.4
Fishing related activities	10.0	10.0	6.7	10.0	13.3	6.7
Rice farming	86.7	91.1	88.9	91.1	84.4	91.1
Other crops	66.7	63.3	53.3	63.3	80.0	48.9
Livestock	63.3	73.3	57.8	73.3	68.9	66.7
Farm labour	32.2	42.2	33.3	42.2	31.1	42.2
Non-farm labour	18.9	18.9	31.1	18.9	6.7	31.1
Petty trade	11.1	12.2	11.1	12.2	11.1	13.3
Other	62.1	66.3	61.6	65.2	58.7	60.2

**Table 9: Income portfolio diversification in Kampong Thom (shown as percent contribution to the total household income)**

Activities	Kampong Thom		Snao		Sa'ang	
	Before	Current	Before	Current	Before	Current
Fishing	33.6	28.0	20.7	26.7	47.4	29.6
Fishing related activities	0.3	0.3	0.3	0.2	0.3	0.5
Rice farming	19.6	19.3	25.7	18.6	13.0	20.3
Other crops	3.7	3.5	4.9	3.6	2.4	3.4
Livestock	13.9	15.0	17.4	16.2	10.1	13.3
Farm labour	6.2	6.5	1.8	1.9	11.0	12.8
Non-farm labour	6.4	5.4	11.6	8.8	0.9	0.8
Petty trade	7.1	9.2	8.8	12.2	5.3	5.1
Other	11.5	12.8	12.4	11.8	10.5	14.0

**Table 10: Correlation between assets and changes in income (Kampong Thom)**

	Landholding	Livestock asset	Education	Household size
Kampong Thom	(0.07)	0.05	0.17	(0.18)
Snao	(0.09)	0.03	0.20	0.17
Sa'ang	(0.08)	0.04	0.13	(0.15)

**Table 11: Income change by chronic poor vs. non-chronic poor (Kampong Thom)**

Groups	Village/province	Change in average household income (US\$)	Average household income (US\$)
Combined average change	Kampong Thom	91.2	687.6
Chronic Poor	Snao	105.3	482.8
	Sa'ang	53.4	401.6
Non-Chronic Poor	Snao	285.3	1,281.5
	Sa'ang	(88.6)	1,224.9

Fishing lot case study, Battambang province (Tables corresponding to section III.3)

**Table 12: Village level socio-economic indicators in case study villages, Battambang**

	2002		2003		2004	
	Thvang	Prek Toal	Thvang	Prek Toal	Thvang	Prek Toal
Number of households	180	467	200	497	244	497
Number of females	545	1308	576	1346	650	1351
Number of males	516	1270	505	1242	656	1247
Percentage of houses with thatch roofs	38.3	58.9	35.5	60.4	17.6	60.4
Percentage of houses with tiled roofs	0.6	0.0	0.5	0.0	0.4	0.0
Percent of houses with fibro roofs	0.0	0.0	0.0	0.0	0.0	0.0
Percent of houses with zinc roofs	60.6	39.6	64.0	37.2	82.0	39.6
Percent of houses with concrete roofs	0.0	0.0	0.0	0.0	0.0	0.0
Percent of households with cattle	0.0	0.0	0.0	0.0	0.0	0.0
Percent of households with pigs	2.8	2.4	3.5	3.0	2.1	0.6
Number of motorcycles per 100 people	0.0	0.0	0.0	0.0	0.0	0.0
Number of cars per 100 people	0.0	0.0	0.0	0.0	0.0	0.0
Number of ox carts per 100 people	0.0	0.0	0.0	0.0	0.0	0.0
Number of bicycles per 100 people	0.0	0.0	0.0	0.0	0.0	0.0
Number of row boats per 100 people	38.8	27.9	39.1	29.0	22.1	32.7
Number of motor boats per 100 people	6.1	6.6	6.9	7.3	16.1	7.7
Percentage of households with TV	48.3	36.4	51.5	36.2	49.2	50.1

Source: Estimated using SEILA Commune Database 2006

**Table 13: Livelihood activities diversification in Battambang (shown as percentage of households participating in each activity)**

Activities	Battambang		Prek Toal		Thvang	
	Before	Current	Before	Current	Before	Current
Fishing	97.8	97.8	100.0	100.0	95.6	95.6
Fishing related activities	10.0	6.7	11.1	8.9	8.9	4.4
Fish culture	12.2	23.3	17.8	20.0	6.7	26.7
Crocodile	2.2	6.7	0.0	4.4	4.4	8.9
Rice farming	1.1	1.1	0.0	0.0	2.2	2.2
Other crops	3.3	4.4	2.2	4.4	4.4	4.4
Livestock	3.3	8.9	0.0	4.4	6.7	13.3
Fishing labour	18.9	28.9	22.2	37.8	15.6	20.0
Non-farm labour	4.4	4.4	0.0	0.0	8.9	8.9
Petty trade	7.8	8.9	11.1	11.1	4.4	6.7
Other	88	88	82.2	80.0	93.3	95.6

**Table 14: Income portfolio diversification in Battambang (shown as percent contribution to the total household income)**

Activities	Battambang		Prek Toal		Thvang	
	Before	Current	Before	Current	Before	Current
Fishing	80.1	67.4	75.2	64.8	85.1	69.4
Fishing related activities	1.3	0.6	1.6	0.7	0.9	0.5
Fish culture	7.7	4.3	13.2	6.3	2.0	2.9
Crocodile	1.6	8.2	0.0	4.6	3.2	11.0
Rice farming	0.1	0.0	0.0	0.0	0.2	0.1
Other crops	0.1	0.2	0.1	0.3	0.1	0.2
Livestock	0.2	0.4	0.0	0.0	0.5	0.6
Fishing labour	1.1	2.7	1.2	5.4	1.0	0.7
Non-farm labour	0.8	0.8	0.0	0.0	1.6	1.5
Petty trade	2.2	5.6	2.8	1.9	1.6	8.5
Other	4.8	9.9	5.8	16.0	3.8	4.6

**Table 15: Correlation between assets and changes in income (Battambang)**

	Livestock assets	Education	Household size
Battambang	0.293	0.107	0.066
Prek Toal	-	0.031	0.123
Thvang	0.874	0.219	(0.004)

**Table 16: Income change by chronic poor vs. non-chronic poor (Battambang)**

Groups (Chronic poor and non-chronic poor)	Village/province	Change in average household income (US\$)	Average household income (US\$)
Overall average change	Battambang	112.2	1033.8
Chronic Poor	Prek Toal	13.3	505.5
	Thvang	62.0	540.1
Non-Chronic Poor	Prek Toal	131.4	1148.9
	Thvang	163.3	1438.4

Comparative findings (Tables corresponding to section III.4)

**Table 17: Change in average household income by village**

Province	Village	Income Change (US\$)
Pursat	Chong Khlong	113.26
	Ou Ta Prok Main	48.74
	Ou Ta Prok Up	80.66
Kampong Thom	Sa'ang	34.44
	Snao	189.30
Battambang	Prek Toal	101.16
	Thvang	123.24

**Table 18: Change in income inequality, by village, as measured by the gini coefficient of inequality**

Province	Village	Gini Index	
		Before	Current
Pursat	Chong Khlong	0.45	0.44
	Ou Ta Prok Main	0.39	0.32
	Ou Ta Prok Up	0.21	0.27
Kampong Thom	Snao	0.43	0.41
	Sa'ang	0.47	0.37
Battambang	Prek Toal	0.35	0.37
	Thvang	0.40	0.39

**Table 19: Incidence of poverty (Head Count Index) by village**

Province	Village	Incidence of Poverty (%)	
		Before	Current
Pursat	Chong Khlong	73	63
	Ou Ta Prok Main	75	75
	Ou Ta Prok Up	67	60
Kampong Thom	Snao	58	56
	Sa'ang	89	89
Battambang	Prek Toal	33	40
	Thvang	49	49



**Table 20: Depth of poverty (Poverty Gap Index) by village**

Province	Village	Depth of Poverty (%)	
		Before	Current
Pursat	Chong Khlong	36	31
	Ou Ta Prok Main	42	31
	Ou Ta Prok Up	31	27
Kampong Thom	Snao	32	23
	Sa'ang	57	53
Battambang	Prek Toal	15	17
	Thvang	17	20

**Table 21: Changes in average income, chronic vs. non-chronic poor**

Province	Village	Average Income Change (US\$)	
		Chronic Poor	Non-Chronic Poor
Pursat	Chong Khlong	22.30	249.70
	Ou Ta Prok Main	38.92	66.97
	Ou Ta Prok Up	25.63	154.00
Kampong Thom	Snao	105.26	285.34
	Sa'ang	53.40	(88.64)
Battambang	Prek Toal	13.30	131.36
	Thvang	62.00	163.30

**Table 22: Dynamics of poverty**

Province	Village	Percentage		
		Chronic Poverty	Vulnerability	Out of Poverty
Pursat	Chong Khlong	60	0	13
	Ou Ta Prok Main	65	10	10
	Ou Ta Prok Up	53	0	7
Kampong Thom	Snao	53	2	4
	Sa'ang	85	2	2
Battambang	Prek Toal	26	14	7
	Thvang	40	9	9

**Table 23. Household assets and chronic poverty**

Province	Village		Assets		
			Land (ha)	Livestock Index	Education (years schooling of household head)
<b>Pursat</b>	Chong Khlong	Chronic poor	0.85	10.34	1.81
		Non-chronic poor	1.11	14.52	2.61
	Ou Ta Prok Main	Chronic poor	0.86	6.39	2.29
		Non-chronic poor	0.79	6.61	2.38
	Ou Ta Prok Up	Chronic poor	0.64	11.03	1.00
		Non-chronic poor	0.70	13.14	3.00
<b>Kampong Thom</b>	Snao	Chronic poor	2.04	15.23	1.25
		Non-chronic poor	2.05	22.55	1.33
	Sa'ang	Chronic poor	2.00	19.00	0.64
		Non-chronic poor	1.50	19.91	1.33
<b>Battambang</b>	Prek Toal	Chronic poor	-	-	2.59
		Non-chronic poor	-	-	3.73
	Thvang	Chronic poor	-	-	2.24
		Non-chronic poor	-	-	2.29

**Table 24. Determinants of poverty (Probit estimation)**

Variables	Pursat (Road development) Coefficient	Kampong Thom (Irrigation development) Coefficient	Battambang (Release of Fishing Lot) Coefficient
If male headed	-0.59 (0.49)	0.21 (0.38)	-0.71 (0.45)
Age of household head	0.02 (0.01)	0.00 (0.01)	0.01 (0.01)
Household size	<b>0.23**</b> (0.10)	0.06 (0.06)	<b>0.31***</b> (0.08)
Education of household head	<b>-0.02*</b> (0.07)	<b>-0.11*</b> (0.08)	<b>-0.08*</b> (0.06)
Livestock assets	<b>-0.01*</b> (0.01)	<b>-0.02*</b> (0.01)	
Landholding	-0.16 (0.26)	0.11 (0.22)	
Number of observations	70	82	86
LR chi2(8)	17.25	20.82	19.05
Prob > chi2	0.03	0.00	0.00
Pseudo R2	0.19	0.21	0.16

Note: This table shows the results of a regression analysis (probit estimation) to estimate which factors are significant in explaining the ability of households in the case study villages to move out of poverty. Only the bold figures are statistically significant, noted as follows: \*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%. A positive value indicates a positive correlation with poverty, whereas a negative value indicates that the variable is significant in explaining the ability of households to move out of poverty. "If male headed" is a dummy variable (binary). Standard error is shown in parenthesis. All regression estimates include constant. The estimation controlled for location using village dummies.