

# Coastal Adaptation and Resilience Planning

FINAL REPORT

## Analysis of Costs & Benefits of modifying Agricultural Practices for Climate Change at the Coast



### Cambodia Climate Change Alliance (CCCA)

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## Abbreviations and Acronyms

ADB	Asian Development Bank
AEA	Agro-Ecological Systems Analysis
AFD	The Agence Française de Développement
AGM	Annual General Meeting
ASSP	Agricultural Sector Support Programme
CARDI	Cambodian Agricultural Research and Development Institute
CARP	Coastal Adaptation and Resilience Planning Component
CBO	Community Based Organisation
CCCA	Cambodia Climate Change Alliance
CDP	Commune Development Plan
CF	Community Fisheries
CFO	Community-based Fisheries Organisation
DAE	Department of Agricultural Extension, MAFF
DAHPP	Department of Animal Health and Production
Danida	Danish International Development Assistance
EU	European Union
FFD	Farmer Field Day
FFS	Farmer Field Schools
FiA	Fisheries Administration
FO	Farmer Organisation
GEF	Global Environment Facility
HH	Household
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management

IRR	Internal Rate of Return
IUU	Illegal, Unreported and Unregulated
JICA	Japan International Cooperation Agency
KK	Kohkong
MAFF	Ministry of Agriculture, Forestry and Fisheries
MCS	Monitoring, Control and Surveillance
MoE	Ministry of Environment
MoWRAM	Ministry of Water Resources and Meteorology
NAPA	National Adaptation Program of Actions to Climate Change
NCCC	National Climate Change Committee
NGO	Non-Governmental Organisation
NPV	Net Present Values
NRM	Natural Resource management
OFAT	On-Farm Adaptive Trials
PDA	Provincial Directorates of Agriculture
PDWRAM	Provincial Department of Water Resources and Meteorology
PFiA	Provincial Fisheries Administration
PRA	Participatory Rural Appraisal
RGC	Royal Government of Cambodia
SHV	Sihanoukville
SLPP	Smallholder Livestock Production Programme
SLR	Sea Level Rise
ST	Short Term
TOT	Training of Trainers
UNDP	United Nations Development Programme
VAHW	Village Animal Health Worker

## **Executive Summary**

This report is *an Analysis of Economic and Social Costs & Benefits of options for modified agricultural practises that are less vulnerable to impacts of climate variability and climate change*. The assessment has been formulated as CARP output 2.5.

The methodology employed is calculation and analysis of farm / household economic data on agricultural practises using the well-known gross margin methodology. These calculations are elaborated into Net Present Values (NPV) and Internal rates of Return (IRR) for the respective proposed demonstration activities. In addition, intangible social costs and benefits are considered.

The following locations have been chosen as target communities:

- TuekThla, TuekL'ak, Sameakki, Prey Nob, ToulTortoeng, O Oknha HengCommunes, Prey Nob District, Sihanoukville Province
- Peam Krasaob and Tuol Kokir Communes, MondulSeima District , Koh Kong Province

## **Overview of Proposed Demonstration Activities**

The following five short-listed activities are subjected to economic analysis:

1. Integrated Farming Training Programme for (a) agricultural extension staff and (b) households / families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water) at target communes. Preceded by agro-systems analysis as an integral part of the programme.
2. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement. The relation of community fisheries to climate change adaptation is that general fishing developments and its regulatory measures are likely to be required to adjust the livelihood of fishing communities.
3. Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy possibly enabling harvest before onset of heavy flooding and sea water surges at target communes. Such varieties will need to be tested (at no cost to farmers) in specific localities, where they are likely to be effective.

4. Promotion of increased livestock keeping at seven communes - by using a revolving scheme for improved breeds – tested successfully in Cambodia, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable.
5. Promotion of in-field water conservation, on-farm rain harvesting and small-scale irrigation methods.
6. Community Forestry at Tuol Kokir projects in cooperation with the Forestry Administration. Not enough information existed to cost this project and to prepare cost-benefit analysis.
7. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MoWRAM – for Prey Nob and Tuol Kokir. Not enough information existed to cost this project and to prepare a cost-benefir analysis.

#### **Summary Cost Estimate for CARP Demonstration Activities**

<b>Activity</b>	<b>Description</b>	<b>Amounts (\$)</b>
<b>Activity 1</b>	Farmer Training Programme in climate change adaptation and integrated farming in 7 communes	225,000
<b>Activity 2</b>	Community Fisheries project for Peam Krasaob, Koh Kong	80,000
<b>Activity 3</b>	On Farm Field Trials for Seed Varieties, demonstration and training in seed selection in 7 communes	32,000
<b>Activity 4</b>	Livestock Revolving Stock Scheme in 7 communes	175,000
<b>Activity 5</b>	On farm demonstration in water conservation, water harvesting and small-scale irrigation	50,000
<b>Total:</b>		562,000

The mentioned demonstration activity 1-5 are all profitable in economic terms for both the CARP and the participating households. The calculations are robust and likely to retain its high profitability even if assumed income levels and adoption rates become much lower than anticipated

## **Social Costs and Benefits**

The proposed demonstration activities are all in line with the expressed priorities of community representatives and builds on their present coping strategies. There are, therefore, limited social cost but rather benefits associated with the proposed activities – exactly because the proposed activities are supporting expressed community priorities. There are additional benefits, which are difficult to quantify.

The reduction of the strain on the environment as well as on animal and human health through the promotion of Integrated Pest Management (IPM) technologies. The promotion of vegetable and livestock production with likely improved nutrition as well as income.

## **Institutional issues**

All proposed demonstration activities depend for their implementation on the smooth cooperation between CARP, MoE and other RGC institutions – notably institutions under MAFF; including the Provincial Departments of Agriculture, Fisheries and PDWRAM.

There may be some functional capacity limitations within the mentioned institutions. The timely consultation and negotiation of roles and responsibilities in regard to implementation is therefore of the utmost importance.

## **The short Implementation Time available**

The CARP component is due to close by end of 1<sup>st</sup> quarter 2014; thereby allowing only one main growing season (the wet season 2013) for implementation of demonstration activities. This is not an ideal situation as all demonstration activities would benefit from the component's presence in terms of follow-up and consolidation of results and outcomes.

Of the five proposed activities subjected to economic analysis, activities 1, 3 and 5 are considered least sensitive to the short support duration – because the prime vehicle (the farmer field schools) in any case usually runs intensively for only one season per locality.

Both activity 2 and 4 are more dependent on adequate follow-up and consolidation activities after the first implementation year. The Peam Krasoab income impact is thus only expected in full by year 5, while the Livestock Revolving Stock Scheme is expected to continue to take in new participants for three or more years. *Both of these activities are therefore more risky because of this follow-up and consolidation demand.*

The cost estimates for most activities do contain consideration of these follow-up and consolidation requirement by setting aside an amount per commune for such follow-up activities. This could be in the form of outright employment by

the commune councils of commune extension workers for say 3 years – with subsequent fixed employment, if they prove their worth, and if this becomes affordable by the commune councils.

In economic terms the analysed demonstration activities compare as follows:

### Comparison of Economic Benefits

Demo Activity	Directly benefiting households	Internal Rate of Return	Net Present Value of Investment <sup>1</sup>	Benefit per household
1 and 3: FFS	1200	193 %	\$1.7 million	\$1417
2:Peam Krasoab	277	60%	\$0.5 million	\$1806
4: Livestock	600	31%	\$0.3 million	\$500
5: Water Harvesting	200	56%	\$0.1 million	\$500

It is thus clear that all five demonstration activities covered by the economic analysis is to be considered real candidates for implementation – because they are all profitable investments. In case of fund limitations, the combined demonstration activities 1 & 3 are the most highly recommended, followed by activity 2 the Peam Krasoab Community Fisheries project in second place. It is suggested also to include activity 5 together with 1 and 3. And only if funds are available for further investment should demonstration activity 4 be implemented.

The foregoing, including other than economic considerations, leads to the following recommendations:

- 1. Implement the combination of Activity 1, 3 and 5: Climate Change and Integrated Farming, Demonstration of Short-Term Varieties, and demonstration of Water Harvesting as one demonstration activity but under separate contracts – with DAE/PDA, CARDI / PDA and PDWRAM respectively.**
- 2. Consider implementation of Activity 2: Peam Krasoab Fisheries Community Development – provided that guarantees can be obtained from the commune council as well as from the National Park Authority and the Fisheries Administration as regards follow-up and consolidation after 2014. This could include certain funding commitments from the Peam Krasoab community.**

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<sup>1</sup> The lower value of the NPV (NPV(10%)) only is taken for this illustration

- 3. Consider implementation of Activity 4 (Livestock Revolving Stock Scheme) only if a suitable NGO or similar agent for implementation and follow up can be found.**
- 4. Consider implementation of activities 6-7 only after further consultations with likely partner organisations.**

All of the above are presently being subjected to further consultations and negotiations with the intended partner institutions. It is, for example, clear that Activity 1 should start field implementation preferably not later than 1 January 2013 – in order to be ready for implementation of the main event (the Farmer Field Schools) by April 2013.

These consultations and negotiations may reveal needs for revision of certain aspects of the proposed demonstration activities – as per the perspectives, resources and recommendations of these potential partner institutions.

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## 1. Introduction

The Royal Government of Cambodia has identified the coastal zone as a focal point in Cambodia's work to adapt to existing and coming impacts of climate change. Cambodia's coastal zone is threatened by severe impacts of climate change such as storms, surges, sea level rise and seawater intrusion.

This report is *an Analysis of Economic and Social Costs & Benefits of options for modified agricultural practises that are less vulnerable to impacts of climate variability and climate change*. The assessment has been formulated as CARP output 2.5.

The objective of the CARP is to build coastal zone adaptation capacity at national and provincial level, and to develop coastal adaptation plans through a practical learning-by-doing - capacity building exercise involving all relevant central and de-central stakeholders. The developed coastal adaptation plans will then be translated into practical demonstration adaptation measures to be implemented in vulnerable communities in selected agriculture or mangrove areas.<sup>2</sup>

This assessment, which has been preceded by "Assessment of Coping Strategies", "Review of the vulnerability of existing agricultural practises" and "Assessment of Vulnerability and Risks of Community Livelihoods", is prepared in order to assess proposed demonstration activities in economic terms. The selected demonstrations activities are those proposed by the report on "Assessment of Vulnerability and Risks of Community Livelihoods", July 2012.

The report is structured as follows: after introducing methodologies and the target areas in Chapters 2-3, follows, in Chapter 4, a design and planning oriented description of the proposed demonstration activities, including initial cost estimates. These are then subjected to economic analysis in chapter 5, which shows the main result of the analysis; while details are in Annex 3. After summarising other considerations, conclusions and recommendation are presented in Chapter 6.

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<sup>2</sup>Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 34

## **1.1 Methodology and Data**

### **Methodology**

The methodology employed is in short: Calculation and analysis of farm/household economic data on agricultural practises using the well-known Gross Margin methodology. These calculations are elaborated into Net Present Values (NPV) and internal rates of return (IRR) for the respective proposed demonstration activities. In addition, intangible social costs and benefits are considered.

Due to free trade, absence of taxes or duties on agricultural inputs or outputs (with some exceptions such as fuel) and competitive markets in trade of agricultural commodities and inputs within the project provinces (in particular those closest to borders) it is estimated that overall economic prices of the main traded commodities and inputs closely mirror financial prices. We have for the present purpose, which is a priori assessment and choice between respective demonstration activities, therefore not seen it necessary to make separate calculations for financial and economic/social returns respectively.

Instead two sets of Net Present Values (NPV) are calculated for each demonstration activity: (a) one with a 5% discount rate over 20 years and (b) with a 10 % discount rate over 20 years. This gives a reasonable range of possible NPV's. The case for shortening the period to 15 years is considered under the sensitivity analysis for each activity.

### **Data**

The assessment is based on existing data as well as on data collected from respective communities as follows:

Data on farm/household level productions as well as related farm-gate prices and costs are partly collected by a rapid survey directly from the concerned target communities and partly from all available secondary sources of such data. It has been very difficult to obtain such data, as it does not appear to be readily available in Cambodia. An unsatisfactory situation in itself, and it is recommended to seek ways to change that situation; e.g. via regular updating of such farm level data-bases in MAFF.

In order for such calculations to become valid, the farm-gate costs and benefits, production yields and farm input quantities must be of current value at the target communities. That is, it must be the prices and farm input costs currently obtainable at the household level in the target communities. For yields and farm input quantities likewise, it must be the ones likely or normally obtained or applied at the communities and their households/farms. Such data validity is a critical success factor for the entire activity 2.6. We are reasonably confident that the data used are valid, although not perfect. Footnotes explain when assumptions had to be made.

The first list of potential agricultural<sup>3</sup> practises to be modified was collected during 24-28 April. This has been modified especially by the Results of the CARP Activity 2.5: “Review of the vulnerability of existing agricultural practises to the impacts of climate change” July 2012, as well as by the results of the CARP Activity 2.3: “Assessment of Vulnerability and Risks of Community Livelihoods”, July 2012.

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<sup>3</sup> “Agricultural practises” in this context in principle includes livestock, fisheries and forestry / plantation practises.

## 2.The Coastal Zone

Cambodia's coastal zone consists of four provinces (Kampot, Koh Kong, Sihanoukville and Kep). The total area covered by these provinces is approximately 17,237 km<sup>2</sup>. The coastal shoreline is 435 km, and runs along the Gulf of Thailand. Along the coastline there is one deep seaport located in Sihanoukville, and is considered to be one of the economic centres in Cambodia.<sup>4</sup>

The coastal zone's climate is defined as tropic monsoon with an annual rainfall between 2,000 and 4,000 mm. This amount of rainfall is higher than other areas of Cambodia.<sup>5</sup> The coastal zone has access to a substantial source of freshwater, from rivers streams, rivers and lakes that run in the area. Despite these potential sources of freshwater, the lack of freshwater is a problem in the area.

During the rainy season the rivers, streams and lakes flood, destroying crops in low lying areas. In the dry season the downstream rivers' water gets mixed with the salty seawater, making the water unsuitable for irrigation purpose.<sup>6</sup> Observations indicate that the seawater can reach up to 10 km inland along rivers and canals.

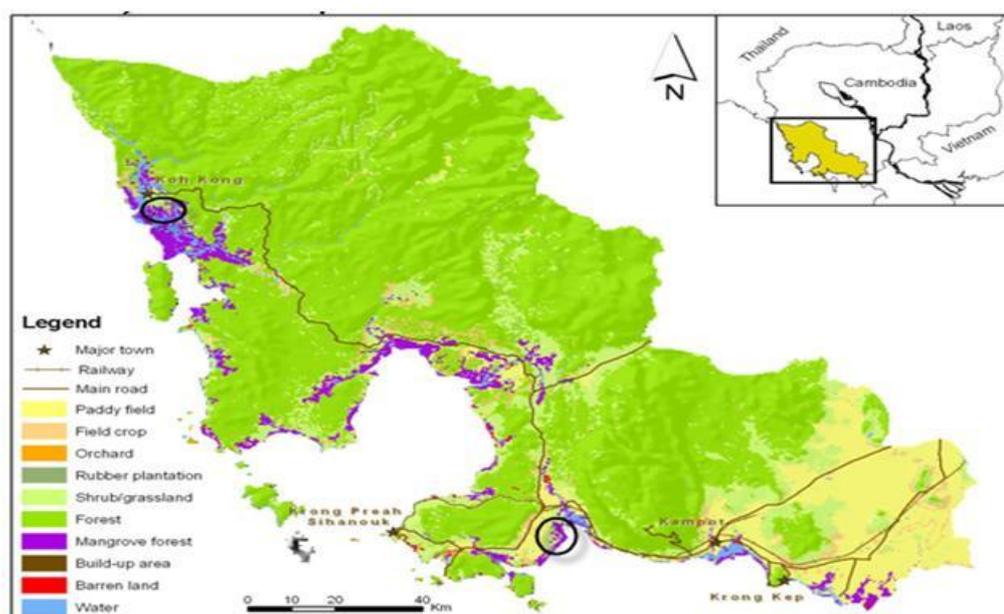


Figure 2.1: Land Uses in the Coastal Zone.

43/2-2012, <http://www.wepa-db.net/policies/state/cambodia/seaarea.htm>

5IBID

6Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 16

## 2.1 Target Communities

The following locations have been chosen as target communities:

- **TuekThla, Tuek L'ak, Sameakki, Prey Nob, Toul Tortoeng, O Oknha HengCommunes, Prey Nob District,<sup>7</sup> Sihanoukville Province -**
- **Peam Krasaob and Tuol Kokir Communes, Mondol Seima District, Koh Kong Province**

*These eight communes in two districts have been decided on in the CARP<sup>8</sup> document and sub sequentially. As stated in the CARP, "Prey Nob and MondulSeima districts were selected as pilot districts during consultations between the MoE, provincial and district authorities from the coast, the CCCA and the national and international consultants. Their selection was based on the fact that both areas border the shoreline and largely consist of low-lying land, and consequently are highly vulnerable to SLR, storm surges, saltwater intrusion and tropical storms.*

Beneath is a brief presentation of the target communities:

### **Prey Nop District, Sihanoukville Province**

Prey Nob district consists of 18,444 households with 93,141 people. This district is located in a particularly low-lying area with a total of 10,000 ha dedicated to rice production, which is protected by a dyke system. This dyke system was rehabilitated over a four-year period through funds from French Development Agency (AFD). An agreement between MoWRAM and the Prey Nob Water Users allocates responsibility for dyke maintenance. The Team observes, however, that MoWRAM seems to have been unable to adequately maintain the sea dyke system as the sea now floods parts of Prey Nob District occasionally. This may also be caused by insufficient dimensions (rise, length) of the same dyke system.

The number of households and people of the six Prey Nob communes are:

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<sup>7</sup> Prey Nob District has 14 communes, 6 of which are included in the project.

<sup>8</sup> Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, Appendix G p. 115

<b>District</b>	<b>Commune</b>	<b>Total Population</b>	<b>Total HH</b>
<b>Prey Nob</b>	TuekThla	5,123	1,133
	Tuek L'ak	4,111	861
	Sameakki	3,991	959
	<b>Prey Nob</b>	<b>7315</b>	<b>1387</b>
	Toul Tortoeng	4467	859
	O Oknha Heng	8414	1571
<b>Total</b>		<b>33,421</b>	<b>6756</b>

Source: Commune Data Bases 2012, and Provincial Plans, 2011

A map showing the location of the six communes and their physical description is available in the CARP Vulnerability and Risk Assessment Report, which also describes incidence of poverty and other aspects. These parts are not repeated in the present report.

#### **Mondol Seima District , Koh Kong Province**

Almost 95% of villagers living in Peam Krasaob undertake fishing; while 64% of households have fishing as their main occupation. Following the efforts by the government to stop mangrove destruction in the sanctuary, many of the local people changed occupations to chicken and duck raising, harvesting crabs and snails, fishing, small-scale business, hunting, small speed boat operation, repairing boat and fishing gear, thatch weaving, fish processing, and repairing houses.<sup>9</sup>

Because Peam Krasaob commune almost only consists of fishermen an additional commune in Mondol Seima District has been chosen, to ensure that farmers are also being represented in the activities for Koh Kong. This commune is Tuol Kokir.

The number of households and people of the two target communes at Koh Kong are:

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<sup>9</sup>Cambodia Climate Change Alliance, "Coastal Adaptation and Resilience Planning Component", 2010, p. 23 - 24

<b>District</b>	<b>Commune</b>	<b>Total Population</b>	<b>Total HH</b>
<b>Mondul Seima</b>	Peam Krasaob	1,318	277
	TuolKokir	1,199	241
Total		2,517	518

Source: Provincial Plans, 2012

A map showing the location of the two communes and their physical description is available in the CARP Vulnerability and Risk Assessment Report, which also describes incidence of poverty and other aspects. These parts are not repeated in the present report.

### 3. Demonstration Activities in modified Agricultural Practises

#### 3.1 Overview of Proposed Demonstration Activities

The following five short-listed activities are subjected to economic analysis:

1. Integrated Farming Training Programme for (a) agricultural extension staff and (b) households/families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water) at 7-8 target communes. Preceded by Agro-Systems analysis (a methodology in use by MAFF) as an integral part of the programme..
2. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement<sup>10</sup>. The relation of community fisheries to climate change adaptation is that general fishing developments and its regulatory measures are likely to be required to adjust the livelihood of fishing communities (see further below).
3. Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy possibly enabling harvest before onset of heavy flooding and sea water surges at all five communes. Such varieties will need to be tested (at no cost to farmers) in specific localities, where they are likely to be effective.
4. Promotion of increased livestock keeping at five communes - by using a revolving scheme for improved breeds – tested successfully in Cambodia, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable.
5. Possibly promotion of in-field water conservation and on-farm rain harvesting methods.

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<sup>10</sup>FiA has currently 21 registered Coastal Fisheries Communities. Official registration with FiA as a Community Fisheries Organisation should be sought (as is required by the RGC sub-decree on CF management) – in addition to the registration as a NRM community under MoE.

The Assessment of Vulnerability and Risks of Community Livelihoods report, July 2012, proposed two further demonstration activities – given below. However, these could not be subjected to economic analysis due to lack of data.

- i. Community Forestry projects in cooperation with the Forestry Administration, where possibilities exist at Tuol Kokir. This might include livestock grazing rights for livestock in forest areas as well as tree nurseries. The relation of community forestry to climate change adaptation is that tree planting is likely to be one of the measures for protecting homesteads, stabilising dykes, production of fuel wood and fruits as well as income generation, where suitable land may be present (as in Tuol Kokir).
- ii. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MoWRAM – for Prey Nob and Tuol Kokir.

*“These proposed demonstration activities for CARP are generally characterised as:*

- *Containing most of the climate change counter measures suggested by the target communes and concerned officials. However, the implementation arrangements proposed are still to be discussed with these and other stakeholders. (But notably do not contain rehabilitation of dyke systems, which are a clear first priority for the target communes. This concern is left to other parts of CARP, as agreed).*
- *Expected a priori (before calculations) to yield considerable social, environmental, economic and general livelihoods benefits; while at the same time being adaptive to the climate change predictions.*
- *Posing relatively low implementation risks generally and for the concerned households in particular – because the implementation modalities proposed are well and successfully tried in similar circumstances.*
- *Are expected to have realistic resource requirement*
- *Are expected to be implementable by the concerned and mentioned institutions and partners – with the capacity building measures defined in the proposals, where relevant.*

*The very short project period (CARP ends 1st Quarter 2014), however, poses a challenge because it will only allow one main crop season (2013) for implementation. Such a short implementation period is unusual for any kind of development effort, where e.g. 3-5 year periods are the norm.*

*The proposed demonstration activities, however, will still be able to start operations and be implemented as intended in the target communes. But more time would have been desirable for follow-up, consolidation, application of lessons learnt and harvesting of results – as well as for expansion of the created capacity to other areas.*

*This observation would have been relevant for any kind of demonstration activity, not just for the above six, which are selected as to be not particularly vulnerable to the short time horizon.”<sup>11</sup>*

### **3.2 Design Outlines and Cost Estimates**

#### **1. Integrated Farming Training Programme for (a) agricultural/fisheries extension staff and (b) households/families in multi-scale climate change adaptation strategies and integrated farming (integration of crops, livestock, fish, water) at 7 target communes. Preceded by Agro-Systems analysis (PRA methodology in use by MAFF).**

A concept along these lines is currently practised under the first Cambodia NAPA implementation project funded by GEF, UNDP and IFAD. It has now run since 2009 and reached about 6000 farmers in PreahVihear and Kratie provinces. Adaptation of this concept is also well in line with the CARP component document, which emphasises that links between the mentioned project and CARP will be established, in part, to exchange technology and knowledge on climate change adaptation (impact documentation from Cambodia in Annex 2).

The farmer field school concept has, furthermore, been practised in Cambodia and elsewhere (particularly in Vietnam and Bangladesh) with high degrees of successful impact on increasing rural incomes as well as on diminishing unwanted environmental and human health impact through the often associated propagation of Integrated Pest Management (IPM) technologies.<sup>12</sup>

The concept finally offers the possibility of developing tailor-made solutions to suit individual households as well as individual communities and communes – because the farmer field schools concept is integrated with a preceding agro-ecological systems analysis for each commune. A working model for agro-ecological systems analysis is currently used by the Department of Agricultural Extension. The model integrates crop, plantation, livestock and fisheries, water and other livelihood sources into the

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<sup>11</sup> Quoted from the CARP Vulnerability and Risk Assessment Report, section 6.2.

<sup>12</sup> Documentations include: (a) ASSP Impact Assessment, Danida, Dhaka, 2003, and (b) Mid-term Review of IPM Programme, Danida, Hanoi, 2003.

integrated agricultural (or livelihoods) concept, and allows individual households as well as their larger communities to develop comprehensive solutions that are tailor-made to their specific needs, preferences and opportunities<sup>13</sup>.

By providing the space for comprehensive solutions; all concerns of particular households (e.g. not only related to climate change) can be accommodated; while likely unsuccessful sub-optimisation through piecemeal solutions to particular constraints is avoided.

Proposal for Economic Assessment: Establishment of farmer training programme in integrated farming/livelihoods in seven<sup>14</sup> target communes by following the above described concept. Implementation in the following steps:

- i. Conduct of Agro-Systems Analysis in 7 communes (3 months)*
- ii. Adaptation of model and curricular to coastal conditions (1 months)*
- iii. Implementation of Training of Trainers programme - of presently concerned extension agents both in government, NGO and private sector, as relevant. (3 months). This is capacity development, which can find more widespread use also outside the present CARP target communes.*
- iv. Implementation of Farmers/Fishers training programme using the Farmer Field Schools concept – at least for one year, longer if possible. This could include visits to areas with similar problems, if affordable.*
- v. Establishment of a sustainable continuation basis for re-fresher training and possibly other types of extension support along above lines (but less intensive) – to continue after project closure.*
- vi. Monitoring and documentation of the impact and experiences through steps i-v.*

Impact expectation, logical framework and cost estimates for the proposed demonstration activity 1 follows below:

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<sup>13</sup> For example, different age-groups would have different preferences and opportunities.

<sup>14</sup> Peam Krasaob may be sufficiently covered by the proposed activities under the Fisheries Community, but a couple of specialised Farmer Field Schools could also be implemented – to be decided.

DESCRIPTION	INDICATORS	SOURCE OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome :</b></p> <p><b>Doubling of household income and adaptation to climate change for 75% of FFS participants<sup>15</sup></b></p>	<ul style="list-style-type: none"> <li>• Increase of average net household income by \$200 per ha and equivalent in livestock or fisheries</li> <li>• Increased capacity of extension agents to advise on climate change and integrated farming</li> </ul>	<ul style="list-style-type: none"> <li>• Activity reports, reviews and evaluations</li> </ul>	
<p><b>Output 1:</b> Multi-scale climate change adaptation in Integrated Farming and IPM Training Programme</p>	<ul style="list-style-type: none"> <li>• Implementation of extension activities directly reaching 1200 farming households via 48 season long Farmer Field Schools (FFS) and indirectly reaching about 6000 farming households in 7 communes by 2014.</li> </ul>	<ul style="list-style-type: none"> <li>• Activity monitoring, reviews and evaluations</li> </ul>	<ul style="list-style-type: none"> <li>• The activities supported will add sufficient confidence for farming household to take up the recommendations and gain income impact.</li> </ul>

<sup>15</sup> Documentation for achievements of the FFS approach in Cambodia is in Annex 2. FFS impact is usually immediate, but some follow-up period for consolidation is desirable (ref. Output 1.5). However, economic calculations show a large degree of robustness and tolerance for lower impact without losing profitability of the investment (ref. section Chapter 5).

<p><b>Activity 1.1:</b></p> <p>Conduct of Agro-Systems Analysis in communes. Duration: 3 months.</p>	<ul style="list-style-type: none"> <li>• Participative Agro-Systems analysis conducted in four communes lead by multi-teams from MAFF, MoWRAM and MoE; including climate change adaptations. This would form basis for community considerations during FFS season</li> </ul>	<ul style="list-style-type: none"> <li>• Seven Agro-Systems reports</li> </ul>	<ul style="list-style-type: none"> <li>• Mentioned officials are available to lead the analysis</li> </ul>
<p><b>Activity 1.2:</b></p> <p>Adapting training moduls and curricular to coastal conditions. Duration: 1 month</p>	<ul style="list-style-type: none"> <li>• Curricular with more fishing and livestock husbandry</li> <li>• Moduls to specifically consider salinity and storm threats for the Coast</li> <li>• Include on-farm water conservation measures, dyke maintenance and polder management measures</li> </ul>	<ul style="list-style-type: none"> <li>• Local consultancy report containing these adaptation</li> <li>• Teaching material produced ready for direct FFS application</li> </ul>	<ul style="list-style-type: none"> <li>• Local consultants with sufficient expertise are available</li> </ul>

<p><b>Activity 1.3:</b></p> <p>Implementation of Training of Trainers programme (of most presently concerned extension agents both in government, NGO and private sector, if relevant). Duration: 3 months.</p>	<ul style="list-style-type: none"> <li>TOT training of 28 extension agents from SHV and KK in about 16 training sessions of 8 hours each.</li> </ul>	<ul style="list-style-type: none"> <li>Training Reports</li> </ul>	<ul style="list-style-type: none"> <li>DAE, CARDI, MoWRAM &amp; MoE trainers is available in time.</li> </ul>
<p><b>Activity 1.4:</b></p> <p>Implementation of farmers training programme using the Farmer Field School concept – <u>at least for one year</u>, longer if possible. This could include visits to areas with similar problems, if affordable.  Duration : Minimum 12 months</p>	<ul style="list-style-type: none"> <li>48 season long Farmer Field Schools (FFS) with 1200 participants in climate change adaptation and integrated farming in seven communes during 2013.</li> <li>48 Farmer field days (FFD)for neighbours (6000 participants)</li> <li>Study tours</li> </ul>	<ul style="list-style-type: none"> <li>Project monitoring of activities and results</li> <li>Ex-post impact assessment</li> <li>FFS and FFD reports</li> <li>Study Tour Reports</li> </ul>	<ul style="list-style-type: none"> <li>Farmers are interested in participating</li> </ul>

<p><b>Activity 1.5</b> Establishment of a sustainable continuation basis for re-fresher training and possibly other types of extension support along above lines (but less intensive) – to continue after project closure. (1 month)</p>	<ul style="list-style-type: none"> <li>• Contractual arrangements with PDA, District and Commune Councils</li> <li>• Possibly involving fund for each commune to be replenished by local and national contributions</li> </ul>	<ul style="list-style-type: none"> <li>• Contracts and monitoring arrangement</li> </ul>	<ul style="list-style-type: none"> <li>• Authorities are interested in such arrangements</li> </ul>
<p><b>Activity 1.6:</b> Monitoring and documentation of the impact and experiences through steps i-v. (continuous)</p>	<ul style="list-style-type: none"> <li>• Monitoring by project staff and by external reviewers</li> </ul>	<p>Monitoring and Review reports</p>	<p>Project monitoring part of normal management duties at no extra cost</p>

**Table 1: Cost Estimates**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 1.1</b>	\$ 3000 per Commune: \$21,000 + Logistics & materials : \$ 7,000 + Contingencies: \$ 2,000	30,000
<b>Activity 1.2</b>	<u>Consultancy Cost</u> 30 person days @ \$200 = 6,000 logistics and materials = 2,000 Contingencies: = 2,000	10,000
<b>Activity 1.3</b>	28 participants x 16 x\$20= \$9,000 Trainers 2x 16 x \$200 \$6,400 Logistics: 4,600 <u>Contingencies: 2,000</u>	22,000
<b>Activity 1.4</b>	<u>Cost:</u> 48 FFS x \$1000 = \$ 48,000 48 FFD x\$ 250 \$ 12,000 Study Tours: 20,000 <u>Contingencies: 5,000</u>  <u>Sub-Total: \$ 65,000</u>	85,000
<b>Activity 1.5</b>	Lump-sum for commune revolving fund: \$ 10,000 per commune	70,000
<b>Activity 1.6</b>	Project monitoring part of normal management duties at no extra cost. External Review: 30 person days @ \$ 200 = \$ 6000 + logistics etc \$ 2000 =	8,000
<b>Total:</b>		<b>225,000</b>

## **2. Community Fisheries project at Peam Krasaob in cooperation with the Fisheries Administration; especially in terms of strengthening regulatory measures and their enforcement<sup>16</sup>.**

This is to further general fishing developments and its regulatory measures, including improvement of fishing stocks. This is likely to be required to adjust to climate change and increase long-term livelihood possibilities for the fishing communities (see further below).

“There is a high incidence of Illegal, Unreported and Unregulated (IUU) fishing, the impact of which on Cambodian fish stocks is unknown, and results in the potential benefits of marine fisheries currently not being captured by Cambodians. Habitat degradation is a major concern, due to dynamite/ cyanide fishing, illegal trawling in nursery areas, mangrove destruction (for firewood, shrimp culture), siltation, and urban/ industrial pollution. Conflicts between fishermen are common over access rights and gear interactions. Monitoring, control and surveillance are considered ineffective. Efforts to control/ reduce fishing effort and to find alternative livelihoods for fishers are well recognized, but present a huge challenge to RGC” (RGC 2010).

“There has been a commendable promotion of co-management/ Community-based Fisheries Organisations (CFOs) in recent years, although many need greater financial and technical support for effective operation. A Royal Decree and Sub-Decree on Community Fisheries Management was promulgated in 2005. To reduce illegal fishing, the law allows serious penalties to be applied to those who break the law including government officers. To investigate, prevent and counteract illegal activities and compile documents for submission to courts, the officers of the fisheries administration are considered as judicial fisheries police. There is, however, a concern in regard to the efficacy of enforcing the law. Human, financial and material resources allocated for planning/management appear not to be commensurate with the socio-economic value of sector” (EU2011).

The purpose of this proposed demonstration activity could therefore be: Strengthening of the community fisheries capacity at Peam Krasaob to fully engage in the decision making processes leading to sustainable fisheries through improved management, and to deliver quality services to its members.

The current proposal is founded on the following factual observations:

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<sup>16</sup> FiA has currently 21 registered Coastal Fisheries Communities. Official registration with FiA as a Community Fisheries Organisation should be sought - as is required by the RGC sub-decree on CF management. This in addition to the already existing "Protection and Conservation of Natural Resources Community" registration with MoE.

1. The Peam Krasaob Community has clearly identified this type of activity as of high priority for them – on par with dyke maintenance. This is clearly in order to maintain and improve the productivity of their resource base. This was confirmed by a mini-workshop with the Commune Councillors, April 2012 (documented in "Assessment of Vulnerability and Risks" Annex 3, CARP, July 2012).
2. The national Strategic Framework for Fisheries 2010-19 emphasise the Community Fisheries concept as one of its priorities (RGC 2010, page 19).
3. Most donor agencies supporting the fisheries sector have agreed and are actively funding Community Fisheries (CF) activities in Cambodia. These agencies include Danida, EU, JICA, among others.<sup>17</sup>
4. There were no less than 469 CFs in the country in 2010, but only 324 were officially registered (303 inland, 21 coastal)<sup>18</sup> with FiA, as is required by the RGC sub-decree on CF management.

We understand from comments received that this type of natural resource management activity was previously tried under the Danida supported Coastal Zone Management Project 1997-2007, with limited success<sup>19</sup>. However, a critical success factor is that the concerned Commune Council be allowed to assume full responsibility by the national park authority. This may not have been possible during that period, since the Commune Councils in many respects were still under formation at that time.

The livelihood potential of this proposed demonstration activity is increased fishing opportunities for the households of Peam Krasaob commune because of enforcement of regulations, establishment of fish sanctuaries and refuges, - as well as increased income from eco-tourism etc. The Economic Assessment report quantifies this as a potential combined income benefit of USD 320 per household per year from after year 5.

This could be achieved through:

1. Stressing the need for a fully responsible management unit for the Peam Krasaob fishing estuary and to mobilise resources in line with specification of a community area management plan, if such do not already exist.
2. Bringing fishing effort into line with the reproductive capacity of the stocks, through support for the development of ecosystem-specific management plans

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<sup>17</sup>Ref. Annual Work Plan 2012 for Fisheries Strategic Framework.

<sup>18</sup> Strategic Planning Framework for Fisheries 2010-19, Vol. II, Background Information (RGC 2010)

<sup>19</sup>This 'limited success' is NOT, however, echoed by "Evaluation of Local Area Coastal Resources Management Project", June 2007, as far as Koh Kong areas are concerned.

with full engagement of fishers and other concerned stakeholders, in tandem with efforts to develop and expand stock enhancement methods such as mangrove protection and rehabilitation, demarcation of conservation areas and management of fish refuges.

3. Strengthening of fisheries monitoring, control and surveillance through capacity development of community fisheries members to undertake MCS and enforcement, together with expanded extension services to supplement and support services provided by FiA from District and Cantonment levels.

Activities could include (most of these activities are suggested by Peam Krasaob Commune Council members):

- Demarcation of community fishing zones in shallow water areas
- Set up teams to protect community fishing zones
- Plant mangrove trees
- Create tourist fishing zones
- Training and extension activities, including in mari-/aquaculture techniques like fish, crab, shell, frog and shrimp farming
- Procurement of equipment required for improving monitoring, control and surveillance of the fisheries
- Promotion of processing and marketing
- Management supports

Proposal for economic assessment: Development and costing of a Demonstration Activity Plan for Peam Krasaob as outlined in collaboration with the Peam Krasaob Commune Council, community members and FiA of Koh Kong.

A draft Logical Framework and Cost Estimate follows below – for further consultations with stakeholders.

DESCRIPTION	INDICATORS	SOURCE OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome :</b></p> <p><b>Increased income from and regulatory adaptation for fisheries of Peam Krasaob's 277 households</b></p>	<ul style="list-style-type: none"> <li>• Increase of average net household income by \$320 per household (20% increase) over time ( 5 years )</li> </ul>	<ul style="list-style-type: none"> <li>• Activity reports, reviews and evaluations</li> </ul>	
<p><b>Output 2:</b> Establishment of Community Fisheries project at Peam Krasaob</p>	<ul style="list-style-type: none"> <li>• Implementation of Community Fisheries activities directly reaching all 277 households of Peam Krasaob by 2014.</li> </ul>	<ul style="list-style-type: none"> <li>• Activity monitoring, reviews and evaluations</li> </ul>	<ul style="list-style-type: none"> <li>• The activities supported will add sufficient benefits for the targeted household to gain income impact.</li> </ul>
<p><b>Activity 2.1:</b></p> <p>Official Registration of Peam Krasaob as a Fisheries Community with FiA</p>	<ul style="list-style-type: none"> <li>• Necessary legal framework established (bye laws, etc)</li> <li>• Elections and AGM</li> <li>• strengthening of mandates, and agreements</li> </ul>	<ul style="list-style-type: none"> <li>• Registration with FiA</li> <li>• Bye-laws, agreements and minutes</li> </ul>	<ul style="list-style-type: none"> <li>• A fishing community located within a national park can be officially registered as a Fisheries Community</li> </ul>

<p><b>Activity 2.2:</b></p> <p>Specification of a community area management plan; including for dyke maintenance</p>	<ul style="list-style-type: none"> <li>• Development and approval of area management plan</li> </ul>	<ul style="list-style-type: none"> <li>• Local consultancy report containing the plan</li> </ul>	<ul style="list-style-type: none"> <li>• Local consultants with sufficient expertise are available</li> </ul>
<p><b>Activity 2.3:</b></p> <p>Implementation of fish stock enhancement measures (e.g. mangrove protection and rehabilitation, demarcation of conservation areas and management of fish refuges)</p>	<ul style="list-style-type: none"> <li>• implementation of CFi plans, conservation efforts, CFi demarcations</li> </ul>	<ul style="list-style-type: none"> <li>• Project and FiA reports</li> </ul>	<ul style="list-style-type: none"> <li>• Stakeholders will agree to such measures</li> </ul>
<p><b>Activity 2.4:</b></p> <p>Strengthening of fisheries monitoring, control and surveillance measures; including procurement of equipment</p>	<ul style="list-style-type: none"> <li>• Equipment needs assessment (e.g. small enforcement boats and/or engines)</li> <li>• Delivery and user training</li> <li>• Study tours and networking with like communities</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring of activities and results</li> <li>• Study Tour Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Community households are interested in participating</li> </ul>

<p><b>Activity 2.5</b></p> <p>Expanded extension services to supplement and support services provided by FiA from District and Cantonment levels; including promotion of processing and marketing of fisheries products</p>	<ul style="list-style-type: none"> <li>• Training needs analysis</li> <li>• Design and delivery of appropriate of training and extension activities</li> <li>• Establishment of commercial contacts and contracts</li> </ul>	<ul style="list-style-type: none"> <li>• Training and extension reports</li> </ul>	<ul style="list-style-type: none"> <li>• Community and trainers s are interested in such supports</li> </ul>
<p><b>Activity 2.6</b></p> <p>Establishment of a sustainable continuation basis for re-fresher training and possibly other types of extension support along above lines (but less intensive) – to continue after project closure</p>	<ul style="list-style-type: none"> <li>• Contractual arrangements with PFiA, District and Commune Councils</li> <li>• Possibly involving fund at the commune to be replenished by local and national contributions</li> </ul>	<ul style="list-style-type: none"> <li>• Contracts and monitoring arrangements</li> </ul>	<ul style="list-style-type: none"> <li>• Authorities are interested in such arrangements</li> </ul>
<p><b>Activity 2.7</b></p> <p>Monitoring and documentation of the impact and experiences through steps i-vi. (continuous)</p>	<ul style="list-style-type: none"> <li>• Monitoring by project staff and by external reviewers</li> </ul>	<p>Monitoring and Review reports</p>	

**Table 2: Cost Estimates**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 2.1</b>	Official Registration of Peam Krasaob as a Fisheries Community (if not already done) with FiA	1,000
<b>Activity 2.2</b>	Community area management plan  <u>Consultancy Cost</u> 20 person days @ \$200 = 4,000 logistics and materials = 1,000	5,000
<b>Activity 2.3</b>	Implementation of fish stock enhancement measures (e.g. mangrove protection and rehabilitation, demarcation of conservation areas and management of fish refuges)  Logistics: 2,000 Materials: 8,000	10,000
<b>Activity 2.4</b>	Strengthening of fisheries monitoring, control and surveillance measures; including procurement of equipment  Needs assessment 1,000 Equipment 19,000	20,000
<b>Activity 2.5</b>	Expanded extension services to supplement and support services provided by FiA from District and Cantonment levels; including <i>promotion of processing and marketing</i> Training needs assessment: 1,000 Training and extension 10,000 Study Tours: 10,000	21,000
<b>Activity 2.6</b>	Establishment of a sustainable continuation basis for re-fresher training and possibly other types of extension support along above lines (but less intensive) – to continue after project closure.	20,000
<b>Activity 2.7</b>	Project monitoring part of normal management duties at no extra cost. External Review: 10 person days @ \$ 200 = \$ 2000 + logistics etc \$ 1000	3,000
<b>Total:</b>		<b>\$80,000</b>

It is possible that the Peam Krasaob community council could participate in funding these activities. This in order to increase community ownership and commitment. There are therefore no considerations of contingencies in the above cost estimates.

**3. Promotion and increased availability of shorter duration seeds for crops; particularly for wet-season paddy possibly enabling harvest before onset of heavy flooding and sea water surges at all seven communes. Such varieties will need to be tested (at no risk or income loss to farmers) in specific localities, where they are likely to be effective. This will also include testing of other additional crops like vegetables.**

While this activity may well be part of demonstration activity 1, it can also, or even at the same time, be undertaken as a stand-alone demonstration activity. This is because of its nature of experimental trial or adaptive research; which is likely to require the participation of a research organisation experienced in this type of activity (e.g. Cambodia Agricultural Research and Development Institute (CARDI)).

The Provincial Directorates of Agriculture (PDA), and the Commune Councils, could and should participate and be given a role in this context. However, neither the PDA's nor the Commune Councils probably currently have sufficient capacity to lead this kind of demonstration activity. But the activity may be able, over the CARP period, to install such a capacity at the PDA's.

The first NAPA project has entered into a contract with CARDI for similar activities. That contract also covers other areas of agricultural adaptive research

Proposal: Development and negotiation of a contract with CARDI for the above. This may also include other activities, e.g. field trials on vegetables, farmer field days and training in seed selection.

This demonstration activity should be coordinated with especially demonstration activity 1: Climate Change and Integrated Farming.

DESCRIPTION	INDICATORS	SOURCE OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome:</b></p> <p><i>Securing and increasing household income from paddy and vegetables demonstrated to 6000 farming households</i></p>	<ul style="list-style-type: none"> <li>Adoption by 20% of households with resulting net income increase of \$ 200 per ha.</li> </ul>	<ul style="list-style-type: none"> <li>Activity reports, reviews and evaluations</li> </ul>	
<p><b>Output 3:</b> Promotion and field trial of short-term higher yielding paddy varieties during wet season at Prey Nob and Tuol Kokir</p>	<ul style="list-style-type: none"> <li>Implementation of field trails, farmer field days and training in seed for about 6000 farming households in 7 communes by 2014.</li> </ul>	<ul style="list-style-type: none"> <li>Activity monitoring, reviews and evaluations</li> </ul>	<ul style="list-style-type: none"> <li>The activities supported will add sufficient confidence for farming household to take up the recommendations and gain income impact.</li> </ul>
<p><b>Activity 3.1:</b></p> <p>Conduct wet season On-Farm Adaptive Trials (OFAT) for ST paddy varieties</p>	<ul style="list-style-type: none"> <li>Trials conducted and documented on 20 sites in 7 communes during 2013</li> </ul>	<ul style="list-style-type: none"> <li>Trial Reports</li> </ul>	<ul style="list-style-type: none"> <li>CARDI and PDA have sufficient capacity to conduct the trials</li> </ul>

<p><b>Activity 3.2:</b> Conduct wet and dry season On-Farm Adaptive Trials (OFAT) for selected vegetable varieties</p>	<ul style="list-style-type: none"> <li>• Trials conducted and documented on 20 sites in 7 communes during 2012-14</li> </ul>	<ul style="list-style-type: none"> <li>• Trial Reports</li> </ul>	<ul style="list-style-type: none"> <li>• CARDI andPDA have sufficient capacity to conduct the trials</li> </ul>
<p><b>Activity 3.3:</b> Conduct Farmer Field Days (FFD) in connection with commune clusters</p>	<ul style="list-style-type: none"> <li>• Ten Farmer Field Days held</li> </ul>	<ul style="list-style-type: none"> <li>• Trial Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers interested in participating</li> </ul>
<p><b>Activity 3.4:</b> Conduct demonstration of seed purification (one per commune) and train one farmer group in seed purification techniques</p>	<ul style="list-style-type: none"> <li>• 7 seed purification demonstrations</li> <li>• 28 farmers trained in seed purification</li> </ul>	<ul style="list-style-type: none"> <li>• Seed purification report</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers are interested in participating</li> </ul>
<p><b>Activity 3.5:</b> Monitoring and documentation of the impact and experiences through steps i-iv. (continuous)</p>	<ul style="list-style-type: none"> <li>• Monitoring by project staff and by external reviewers</li> </ul>	<p>Monitoring and Review reports</p>	<p>Cost: Project monitoring part of normal management duties at no extra cost</p>

**Table 3: Cost Estimates**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 3.1</b>	20 OFAT for Paddy @ \$ 600	12,000
<b>Activity 3.2</b>	20 OFAT for vegetables @ \$ 600	12,000
<b>Activity 3.3</b>	10 Farmer Field Days	5,000
<b>Activity 3.4</b>	Demos and training in seed purification	2,500
	Contingencies	2,000
<b>Total:</b>		<b>35,000</b>

- 4. Promotion of increased livestock keeping at five communes - by using a revolving scheme for improved breeds – tested successfully in Cambodia including the Coastal area, Laos and elsewhere. This is in response to increased flooding problems as livestock are moveable as well as in response to increasing the capital base and income of involved farmers. Although livestock also need water and fodder in the dry season the quantities of water involved are much less than for e.g. a ha of paddy; while fodder conservation makes it possible to manage dry periods.**

“The increase in extreme weather events, such as severe drought or floods, is likely to increase the importance of livestock for rural household, particularly for poor and remote ones. Livestock is much more resilient to climatic and natural changes or disasters than crop agriculture because livestock can be displaced and may find ways to survive events that will inexorably destroy crops. For rural household, and most particularly for poor rural households, livestock is thus of prime importance not only as tilling power, for traditional celebrations and emergency cash but also for income generation, savings, and adaptation to climate change” (EU 2012, page 12).

The major problem categories that plague livestock production in Cambodia are (a) diseases, (b) poor nutrition and (c) the low genetic potential of the local breeds. Disease could be minimised by vaccination, quarantine and management measures. Improved nutrition is both a management and a fodder availability problem. With the increase of population the availability of wild fodder or feed is getting scarce. The farmers also lack the knowledge and the capital to improve the situation. Similarly, there is little incentive to improving the genetic potential.

It is considered, however, that a revolving livestock scheme for improved breeds can address the abovementioned constraints. It will, in addition, increase the capital, income and nutrition base of the involved households, and thereby improve their livelihood prospects. The scheme can function as follows:

1. A few progressive farmers in each commune are selected to receive (as a grant with obligations) individual female animal(s) of an improved breed. The selected breeds must have a proven record of adequate productivity under Cambodian conditions. This could be pigs, or small flock of ducks or hens, depending on local preferences and circumstances.
2. A pre-condition is that the first female<sup>20</sup> (and possibly more) offspring of these improved animals is passed (again as a grant with obligations) to a second selection of farmers in the same commune or village. Another pre-condition is that the farmers in question agree to receive advice and to follow certain guidelines on the husbandry of these animals. Contracts to the above effect are entered into between

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<sup>20</sup> Or the equivalent in cash.

the concerned farmers and the Commune Councils, if this is appropriate. Subsequently 'passing' the gift' in this way can, in principle, continue into eternity, or at least until all interested households have received their improved breed.

3. Extension and disease control support must be made available through the Village Animal Health Workers (VAHW)<sup>21</sup> as well as from the Animal Health and Production Department at provincial levels. The appropriate training of these extension agents might be incorporated into demonstration activity 1, if feasible (to be decided).
4. A farmer or community based organisation at each participating village should be established to take responsibility for all appropriate measures in this context<sup>22</sup>, and provide a basis for recording and selection process, without which the introduction of improved breeds simply may dissipate into the unknown.
5. It is suggested to distribute the livestock in lots of 10 to the same village or Farmer organisation for reasons of: (a) mutual support and (b) reducing logistical costs.

The implementation of this demonstration activity could be outsourced to an NGO or similar organisation with experience of operating such schemes or at least with experience in promoting animal production. The commune councils need to be party to such contractual arrangements, but do not themselves have sufficient experience and capacity to act as managers of this demonstration activity.

This demonstration activity would thus provide starting stock to farmers, as well as appropriate vaccination, feed pots, worming, and performance recording organisation in farmer groups. This will be accompanied with regular coaching in livestock management, nutrition, recording, pasture improvement, fodder conservation, etc. The incentive for recording, breeding selection and improved management could be provided by organising rural fairs in which prizes will be given to the owner of the best animal. Prize money (or in kind) may be donated by the private sector as promotional action (CP feed, Pharma, vaccines...).

It will give farmers a tool to actually gain net income from produce livestock, and at the same time, deal with one of the major constraints, which is farmer's lack of capital to invest. This is to be done without actually making straightforward donations, which diminish ownership and motivation.

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<sup>21</sup>The Department of Animal Health and Livestock Production, MAFF, has confirmed the existence of more than 14000 VAHW in Cambodia. These VAHW have very basic training and may be able to perform very simple tasks for disease protection, surveillance and livestock production. It is MAFF policy to turn most of these VAHW into general village agricultural extension workers – and about 50% has received general extension training in this context by 2012. The VAHW are private agents and do not receive government salaries. Their existence at the target commune level has been confirmed by the team in the field at Tuol Kokir, but not yet at Prey Nob.

<sup>22</sup>Commune Councils may play a role in this as well but cannot replace a village level support group specialised in livestock production in this context.

The concept is based on the experience of the EU-supported Livestock Farmer Support Project in Laos, Smallholder Livestock Production Programme (SLPP) in Cambodia 2005-10 and similar projects elsewhere. The former Coastal Zone Management Project 1997-2007 also used this concept. This experience has proven that the system of “passing the gift” (used by Heifer International<sup>23</sup> for many years) is an effective way to introduce good livestock management practices. It is now also part of a major new EU-funded livestock sub-sector programme for Cambodia due to start beginning of 2013.

Proposal: It is proposed to develop and cost an implementation plan for a ‘rotating livestock scheme’ as described above. In doing that emphasis will be on: (1) getting the scheme started and complete the first rotation round before CARP closure beginning 2014, and (2) establish sustainable farmer organisations and support mechanisms also before CARP closure in 2014 – thereby securing that the rounds of rotation can continue on the basis of the livestock donated in the first round.

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<sup>23</sup> Heifer International was also used to implement a similar activity under the Coastal Zone Management Project, 1997-2007.

DESCRIPTION	INDICATORS	SOURCE OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome:</b></p> <p><i><b>Doubling of participating household's income from livestock</b></i></p>	<ul style="list-style-type: none"> <li>Increase of average net household income by \$200 per year<sup>24</sup> for each of 100 participating households after year 1 – with addition of 50 households per year thereafter</li> </ul>	<ul style="list-style-type: none"> <li>Activity reports, reviews and evaluations</li> </ul>	
<p><b>Output 4: Revolving scheme for improved breeds of livestock</b></p>	<ul style="list-style-type: none"> <li>Implementation of revolving stock scheme activities directly reaching 100 farming households in the first round of revolving in 7 communes by 2014.</li> </ul>	<ul style="list-style-type: none"> <li>Activity monitoring, reviews and evaluations</li> </ul>	<ul style="list-style-type: none"> <li>The activities supported will add sufficient confidence for farming household to take up the recommendations and gain income impact.</li> </ul>

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<sup>24</sup> Ref Annex 2, where (partial) livestock budgets show that such a level of increased income is feasible across all types of commonly reared livestock at the Coast.

<p><b>Activity 4.1:</b></p> <p>Development of the plan for the Revolving Stock Scheme; including:</p> <ul style="list-style-type: none"> <li>• Detail actions and modalities defined (i.e. breeds, distribution, vaccinations, training of farmers, promotion of fodder production, farm-grown feed, feed conservation etc)</li> <li>• Identify beneficiaries and partners</li> <li>• Establish contracting procedure</li> </ul>	<ul style="list-style-type: none"> <li>• The plan and its approval</li> <li>• Involvement of DAHP, PDA and Village Animal Health Workers (VAHW)</li> </ul>	<ul style="list-style-type: none"> <li>• Planning document and project reports</li> </ul>	<ul style="list-style-type: none"> <li>• Expertise for plan development is available</li> </ul>
<p><b>Activity 4.2:</b></p> <p>Contracting of CBO/FO/NGO for operating the Livestock Revolving Stock Scheme not later than December 2012.</p>	<ul style="list-style-type: none"> <li>• Contracting negotiations and arrangements</li> </ul>	<ul style="list-style-type: none"> <li>• Signed contracts</li> <li>• Project reports</li> </ul>	<ul style="list-style-type: none"> <li>• Qualified contractors interested in bidding for contracts.</li> </ul>
<p><b>Activity 4.3:</b></p> <p>Implementation of the Revolving Stock Scheme during 2014 - mainly delivery and installation of first revolving round of livestock - and agreements with participating farmers for scheme continuation</p>	<ul style="list-style-type: none"> <li>• 100 farmer households enrolled and trained</li> <li>• 10 lots of livestock distributed</li> </ul>	<ul style="list-style-type: none"> <li>• Supervision and monitoring by CARP</li> <li>• Project reports</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers' interest confirmed</li> </ul>

<p><b>Activity 4.4:</b></p> <p>Support program for continuation of the villages' animal revolving stock schemes - involving VAHW, Commune Councils, District and Provincial Departments after 2014</p>	<ul style="list-style-type: none"> <li>• Number and type of local arrangements established</li> <li>• Inclusion into Commune Development Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring of activities and results</li> <li>• Ex-post impact assessment</li> <li>• Commune Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Commune Council and Provincial Department commitments</li> </ul>
<p><b>Activity 4.6:</b></p> <p>Monitoring and documentation of the impact and experiences through steps i-v. (continuous)</p>	<ul style="list-style-type: none"> <li>• Monitoring by project staff and by external reviewers</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring and Review reports</li> </ul>	<ul style="list-style-type: none"> <li>• Project monitoring part of normal management duties at no extra cost</li> </ul>

**Table 4: Cost Estimates**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 4.1</b>	<u>Consulting Cost:</u> 30 person days @ \$200 = 6,000 logistics and materials = 2,000 Contingencies: = <u>2,000</u>	10,000
<b>Activity 4.2</b>	<u>Consulting Cost:</u> 30 person days @ \$200 = 6,000 logistics and materials = 2,000 Contingencies = <u>2,000</u>	10,000
<b>Activity 4.3</b>	<b>Cost:</b> 10 lots (each of 10 heads or flocks) of livestock x 5000 = 50,000 Logistics at @ 1000 per lot: 10,000 Vaccinations @100 per lot ? 1,000 Coaching services <sup>25</sup> : 12,000 Training: 2 basic courses 2,000 <u>Contractor Logistics and overheads (7%):</u> <u>5,000</u>	80,000
<b>Activity 4.4</b>	Lump-sum revolving fund: \$ 10,000 per commune	70,000
<b>Activity 4.5</b>	Project monitoring part of normal management duties at no extra cost. External Review: 15 person days @ \$ 200 = \$ 3000 + logistics etc \$ 1000 =	4,000
	Contingencies	1,000
<b>Total:</b>		175,000

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<sup>25</sup> Coaching Visits by local experts: Minimum 2 times per month during first year @ \$ 50 per lot ( 2 x 12 x 50 = 1200 per lot)

**5. On-farm water conservation and rain harvesting methods. This in response to underground seepage of salt water into the water table – thereby to some extent possibly reinforcing the fresh groundwater table.**

Future pressures from climate change may intensify water shortages, such as those already experienced by the target communities, i.e. fresh water scarcity. Rainwater harvesting can improve water supplies (e.g., in terms of own consumption) or increased crop production.

Rainwater harvesting locally collects and stores rainfall through various technologies. In the format envisaged, in situ rainwater harvesting system, rainwater harvesting technologies include soil and water management strategies that improve rainfall infiltration in the soil and decrease surface runoff. Thus, rainwater is efficiently put to use and soil erosion is countered. Examples of such systems are terracing, pitting and conservation tillage practices. Due to rainwater harvesting soil water is recharged to primarily better crop growth and increase farm productivity. Yet, the water can also be used for other purposes.

This activity could also include promotion of improved and more efficient on-farm irrigation practices, for example, drip irrigation in vegetable and fruit production.

Further information from the first NAPA follow-up project includes the following:

Annual Water Use for Family			
Use	Size	Water Need	Total Use
Rice field	1 ha	1 crop = 12,000 m <sup>3</sup>	12,000
Vegetables	0.2 ha, 6 mths/yr	5mm per day	1,500
Domestic	20 l / pers / day	5 pers x 365 days	36.5
Cows	40 l / cow / day	2 cows x 365 days	29.2
Pigs	10 l / pig / day	3 pigs x 365 days	10.95
Chickens	0.5 l / chicken / day	10 chickens x 365 days	1.825
<b>TOTAL ANNUAL WATER USE</b>			<b>13,578</b>

The total amount of water the family uses is only about 75% of the water falling as rain onto their land. If they need more water, they can take it out of rivers or pump it from wells. Note that water used for rice growing is about 90% of the total in this calculation. In most families it would be more than 90%, because 0.2ha is a very large vegetable plot.

Cost of water: we pay directly for water for many kinds of use. Some examples:

- The cost of “ordinary” drinking water in a shop is usually about \$US 0.05 for ½ litre. \$US 20 / m<sup>3</sup>.

- In rural districts with no wells, water sellers often charge 2000 riel (\$US 0.50) for a 200 litre drum of water. \$US 2.50 / m3.

For description of possible activities see the logical framework format below.

Proposal: This activity can be included under the curricula of demonstration activity 1. In addition, it could become a demonstration activity in its own right. To be decided.

DESCRIPTION	INDICATORS	SOURCE OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome:</b></p> <p><i>More water (of good quality) for household consumption and increased crop (vegetable) production. Reduced impact of moisture stress on yields – increased opportunity for supplementary crops in the dry season.</i></p>	<ul style="list-style-type: none"> <li>• Increase of average net household income by \$200 per hectare.</li> <li>• Increased vegetable production by 0.1 ha per household in dry season.</li> </ul>	<ul style="list-style-type: none"> <li>• Activity reports, reviews and evaluations</li> </ul>	
<p><b>Output 5: In-field water conservation method and on-farm rain harvesting and small-scale irrigation methods</b></p>	<ul style="list-style-type: none"> <li>• Implementation of these as demonstration and training activities</li> </ul>	<ul style="list-style-type: none"> <li>• Activity monitoring, reviews and evaluations</li> </ul>	<ul style="list-style-type: none"> <li>• The demonstrations and training activities will add sufficient confidence for farming household to take up the recommendations and gain income impact.</li> </ul>

<p><b>Activity 5.1:</b></p> <p>Assessment of farming techniques, soil/water quality, crop production potential in this context via the Agro-Ecological systems Analysis (AEA) already part of demonstration activity 1 – at no extra cost</p>	<ul style="list-style-type: none"> <li>• Appropriate water harvesting techniques, water conservation and small-scale irrigation activities as identified by AEA at 7 or 8 communes</li> </ul>	<ul style="list-style-type: none"> <li>• AEA Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Mentioned officials are available to lead the AEA analysis</li> <li>• No extra cost assumed</li> </ul>
<p><b>Activity 5.2:</b></p> <p>Implementation of on-farm demonstration activities in water conservation, rain harvesting and appropriate irrigation. Example drip irrigation for supplementary crops (i.e. vegetables) in dry season.</p>	<ul style="list-style-type: none"> <li>• Demonstrations conducted and documented on 20 sites in 7-8 communes during 2013</li> </ul>	<ul style="list-style-type: none"> <li>• Supervision and monitoring by CARP</li> <li>• Site reports</li> </ul>	<ul style="list-style-type: none"> <li>• PDA and others have sufficient capacity to conduct demonstrations</li> </ul>
<p><b>Activity 5.3</b></p> <p>Conduct Farmer Field Days (FFD) in connection with each demonstration sites – one FFD per commune</p>	<ul style="list-style-type: none"> <li>• Seven Farmer Field Days held</li> </ul>	<ul style="list-style-type: none"> <li>• FFD Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers interested in participating</li> </ul>

<p><b>Activity 5.4:</b></p> <p>Training of farmers/households on in-situ rainwater harvesting techniques – possibly in connection with demonstration activity 4. May include visits to other places in Cambodia</p>	<ul style="list-style-type: none"> <li>• 200 farmer households enrolled and trained in 32 sessions</li> </ul>	<ul style="list-style-type: none"> <li>• Project reports</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers are interested in participating</li> </ul>
<p><b>Activity 5.5:</b></p> <p>Monitoring and documentation of the impact and experiences through steps i-iv. (continuous)</p>	<ul style="list-style-type: none"> <li>• Monitoring by project staff and by external reviewers</li> </ul>	<p>Monitoring and Review reports</p>	<p>Cost: Project monitoring part of normal management duties at no extra cost</p>

**Table 5: Cost Estimates**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 5.1</b>	Part of AEA under demonstration activity 1	0
<b>Activity 5.2</b>	20 demonstrations @ \$ 1200	40,000
<b>Activity 5.3</b>	7-8 Farmer Field Days	3,500
<b>Activity 5.4</b>	Training of 200 farmers (32 sessions)	5,000
	Contingencies	1,500
<b>Total:</b>		<b>50,000</b>

**6. Community Forestry projects in cooperation with the Forestry Administration, where possibilities exist at Tuol Kokir. May include livestock grazing rights for livestock in forest areas.**

We do not currently have sufficient information on this possible demonstration activity. Consultations with the Forest Department at Koh Kong province revealed, however, that a community forestry project has recently been established at Tuol Kokir commune (now lacks funds), and that another associated activity could be one or more forestry nurseries for the target and possibly other communes. Perhaps other species for fuel wood production could be found relevant for promotion in this context. This is closely linked to the climate change agenda via its potential for promotion of appropriate tree species for shelter, food and fuel.

The proposed demonstration activity cannot, therefore, be further outlined and costed, nor can an economic assessment be made at this stage.

Proposal: Further consultations in January 2013 on this with the Forestry Administration, MAFF, Provincial Department, Koh Kong, and Tuol Kokir Commune Council.

**7. Reinforcement of community dyke maintenance, drainage and irrigation systems management in cooperation with MoWRAM – for Prey Nob and Tuol Kokir.**

The concerned Community Councillors have themselves suggested most of the following in this category, which also includes suggestions from the mentioned CARP reports:

1. Build and rehabilitate sea water protection dykes
2. Build protective dykes for village homesteads
3. Repair water gates (sluice gate)
4. Repair (or deepen) other infrastructures (roads, canals, drains, reservoirs)
5. Develop proper water management plans
6. Construct water weirs for agriculture and livestock farming
7. Soil quality surveys for agriculture
8. Dig ponds for aquaculture
9. Integrate these action plans into government/ commune investment programmes
10. Management supports; including systematic monitoring of salinity and land subsidence

Proposal: Development and costing of a Demonstration Activity Plan for Prey Nob and Tuol Kokir as outlined above in collaboration with the Polder Management, Commune Council, community members, district authorities and MoWRAM provincial departments.

This plan should include significant financial or in-kind contributions from the concerned local communities, and become part of the Commune Investment and Operational Plan on a re-current basis.

We do not at this time have sufficient information to further plan and cost these activities. Further stakeholder consultations are on-going.

**Table 6: Summary Cost Estimate for CARP Demonstration Activities**

<b>Steps</b>	<b><u>Cost Estimate (details)</u></b>	<b>Amounts (\$)</b>
<b>Activity 1</b>	Farmer Training Programme in climate change adaptation and integrated farming in 7 communes	225,000
<b>Activity 2</b>	Community Fisheries programme for Peam Krasaob, Koh Kong	80,000
<b>Activity 3</b>	On Farm Field Trials for Seed Varieties, demonstration and training in seed selection in 7 communes	32,000
<b>Activity 4</b>	Livestock Revolving Stock Scheme in 7 communes	175,000
<b>Activity 5</b>	On farm demonstration in water conservation, water harvesting and small-scale irrigation	50,000
<b>Total:</b>		562,000

This leaves a minimum reserve of \$ 138,000 for direct support to infrastructure relevant measures included in the Commune Investment Plans and for activities related to climate change awareness rising and climate change resilient irrigation, should all the above demonstration activities be implemented in full.

## 4 Analysis of Costs and Benefits

### Introduction

These calculations use the model described in Action Plan 2.6 – Attachment 2; that is work on the expected differences between before and after the concerned demonstration activities.

In order to apply this methodology it was necessary to construct and calculate as step1:

- (1) Average gross margin budgets for each type of main crop, livestock and fishery activity at the current time for typical households, and
- (2) The same for the expected improvement caused by the concerned activity.

This concisely documents in all necessary detail what the concrete improvement expectations are and how they come about. The crop budgets are in Annex 2. But for livestock and fisheries another procedure had to be followed due to data limitations.

Step 2 is the up-scaling of the above expectations for an average household to the CARP project level. This gives the basis for calculation of Net Present Values (NPV) and Internal Rates of Return (IRR)<sup>26</sup>. These are the primary tools for assessing investment opportunities and for choosing between alternative investments – in economic and financial terms. The details of these calculations are in Annex 3.

### 4.1 Economic Analysis for Demonstration Activities 1 and 3

The two demonstration activities are combined because they are mutually supportive, and a distinction between their impacts will be difficult.

#### 4.1.1. Household Economic Impact/Year, Paddy.

Note: The calculation works on the differences between two agricultural practises ('old' and 'new'). Please refer to the separate crop budgets for 'old' and 'new' in Annex 2). The initial calculations per household are structured in two sets for Prey Nob East and West<sup>27</sup>, respectively, due to substantial differences in both paddy yield and use of outside labour and services.

#### Table 4.1 Household Economic Impact / Year for Paddy

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<sup>26</sup>The Internal Rate of Return (IRR) is the rate that makes the NPV equal to zero, if applied into the NPV formular.

<sup>27</sup>Prey Nob East consist of the three communes of TuekThla, Tuek L'ak and Sameakki and Prey Nob West consists of the three communes of Prey Nob, Toul Totoeng and O Oknha Heng Communes, Prey Nob District

## Analysis of Economic and Social Costs & Benefits

### **PREY NOB (EAST)<sup>28</sup>**

Note: The calculation works on differences between two agricultural practises ('old' and 'new') – not on total costs and benefits (ref. separate crop budgets for 'old' and 'new' are in Annex 2).

<b>Household Impact for an average Paddy Holding from attending Farmer Field Schools (FFS)</b>	Unit (kg)	\$ /Unit	Value	Totals \$
<b>Benefits / Average Holding<sup>29</sup>.</b>				
1. Increase in Paddy yield	904	0.235	216	
2. Increased value of straw			11	227
<b><u>Costs</u></b>				
3. Increased variable costs/holding			-70	
4. Increased semi-fixed costs (e.g. equipment, rent, interest etc)			-15	
5. Opportunity Cost (forgone annual income, if any)			0	-85
<b>NET INCREMENT PER HOLDING</b>				<b>142</b>

The main difference between 'before and after project' is caused by the use of improved seeds, 40% more fertiliser, and 20 more hired labour days. The increased fertiliser usage is included in order to take a conservative approach, but it may not be necessary. In overall terms the main impact is secured through improved general crop husbandry and management, which may actually be able to reduce the proposed level of fertiliser use.

### **PREY NOB (West)<sup>30</sup>**

Note: The calculation works on differences between two agricultural practises ('old' and 'new') – not on total costs and benefits (ref. separate crop budgets for 'old' and 'new' are in Annex 2).

<sup>28</sup> Prey Nob East consists of the three communes of TuekThla, Tuek L'ak and Sameakki

<sup>29</sup> The average farm size for paddy at Prey Nob East is 0.8 hectare of paddy field (Rainy season only)

<sup>30</sup> Prey Nob West consists of the three 'new communes' of Prey Nob, Toul Totoeng and O Oknha Heng Commune, Prey Nob District.

## Analysis of Economic and Social Costs & Benefits

<b>Household Impact for an average Paddy Holding from attending Farmer Field Schools (FFS)</b>	<b>Unit (kg)</b>	<b>\$ /Unit</b>	<b>Value</b>	<b>Totals \$</b>
<b><u>Benefits / Average Holding</u><sup>31</sup>.</b>				
3. <u>Increase</u> in Paddy yield:600kgx1.5 ha	900	0.234	209	
4. Increased value of straw			<u>12</u>	221
<b><u>Costs</u></b>				
3. Increased variable costs/holding			-11	
4. Increased semi-fixed costs (e.g. equipment, rent, interest etc)			-15	
5. Opportunity Cost (forgone annual income, if any)			<u>0</u>	-26
<b>NET INCREMENT PER PADDY HOLDING of average 1.5 ha</b>				<b>195</b>

The main difference between 'before and after project' is caused by the use of improved seeds, 10% more fertiliser, and reduction of pesticide use. The increased fertiliser usage is included in order to take a conservative approach, but it may not be necessary. In overall terms the main impact is secured through improved general crop husbandry and management, which may actually be able to reduce the proposed level of fertiliser use as well as save on hired labour and services.

*Comparison with other Farmer Field School impact assessments:*The FFS concept has been practised in various projects in Cambodia for more than a decade. For paddy yield increases, evaluation results generally vary from about 750 kg /ha to about 1400 kg (documentation in Annex 2), but with results also outside these range even to 3500 kg increase per ha<sup>32</sup>.

Given that the presently contemplated FFS-based demonstration activity is further supported by field demonstrations of paddy varieties, the expected yield increase is assessed as likely.

<sup>31</sup>The average paddy area per holding, for Prey Nob West (polder area proper) is 1.5 ha.

<sup>32</sup> For comparison. The above tabel 4.1 comes in at 1130 kg/ha

## Analysis of Economic and Social Costs & Benefits

### **4.1.2. Household Economic Impact/Year, Vegetables**

In addition to paddy, Prey Nob households cultivate on average 0.1 ha of vegetables as well as supplementary crops. It is further assumed that the net increment per household of these vegetable cultivations will be at least equal to the above for paddy. (The net increment for vegetables is likely to be much higher. But in order not to be too optimistic the (lower) paddy values is assumed for the purposes of these calculations).

For Tuol Kokir Commune, Koh Kong, the average household cultivates 0.5 ha of paddy and vegetables; plus supplementary crops. However, the same consideration (as for Prey Nob) is also applied for Tuol Kokir – i.e. assuming identical net increments per ha for paddy and vegetables.

### **4.1.3. Household Economic Impact/Year, Livestock and Fisheries**

The integrated farming demonstration activity's impact on livestock and fisheries is calculated from the proportion of total income attributable to livestock and fisheries at target communes. It is thereby assumed that the 'after project' proportion attributable to livestock and fisheries will remain as 'before project'.

This, admittedly, indirect way of calculation has become necessary, because data and information made available is insufficient to calculate proper livestock and fisheries budgets for an average household of the target communes.

Profiles of current productive assets in livestock and fisheries at the different target communes as well as partial budgets for livestock and fisheries are in Annex 2.

### **5.1.4. Project Economic Impact/Year**

Combining individual household impacts, the overall impact from the Integrated Farming demonstration activities (demo activity 1 and 3) is in Table 4.2:

## Analysis of Economic and Social Costs & Benefits

**Table 4.2 Project Level Economic Impact/Year**

<b>Project Economic Impact For 1200 FFS participants</b>	<b>\$ / holding</b>	<b>No. of holding</b>	<b>Value (1,000)</b>	<b>Totals (1,000) \$</b>
<b><u>Gross Benefits</u></b>				
1. Annual Net Increments	(236)			
Paddy Producing HH Prey Nob East <sup>33</sup>	142	700	99	
Paddy Producing HH Prey Nob West	195	500	98	
Vegetable Producing HH <sup>34</sup>	36	1200	43	
Livestock and fishing HH <sup>35</sup>	<u>36</u>	1200	<u>43</u>	283
<b><u>Adjustments</u></b>				
2. Adoption Rate (75%):				-71
3. Lateral Spread Factor (10%)				+21
Interim Income Effect				233
Income Multiplier Factor <sup>36</sup> (standard )	1.2			47
<b>TOTAL INCOME IMPACT</b>				<b>280</b>

The eventual annual economic impact at seven target communes for demonstration activity 1 and 3 is thus expected to be \$ 280,000 per year. This is scaled to impact over 15 years below.

<sup>33</sup>This includes consideration of the two Koh Kong target communes

<sup>34</sup> Each household with 0.1 ha and/or supplementary crops

<sup>35</sup> Assessed as 15% of crop increment. This is based on proportion of livestock and fish income in total income at Prey Nob. For further evaluation.

<sup>36</sup>The general income multiplier for Cambodia (across all sectors) is 1.08. But the agricultural multiplier is assessed as being higher.

**Table 4.3 Project Economic Impact Projection**

Measurements	Value
1. Project Total Income Impact (15 Years)	\$1.9– 2.6 million <sup>37</sup>
2. Less Project Cost (as planned for 2013-14)	\$ 257.000
3. Net Present Value (1-2):	\$ 1.7 – 2.2 million
4. Internal Rate of Return:	193 %

These returns are very high by any standards, but this is not unusual for FFS projects. And the investment is absolutely lucrative. However, please note that the investment amount included (\$257,000), is only for the involved demonstration activities, which is the relevant decision platform for this assessment. The further overall project or component overheads for the CARP planning, management and administration is not included. These are not relevant for this calculation because at this stage the decision is about which demonstration activities to implement.

It appears that combined demonstration activities 1 & 3 are highly recommendable from an economic perspective.

### **Sensitivity Analysis**

The objective is to calculate the effect of likely changes in the variables and the effects on the IRR of the base case. This sensitivity analysis focuses on 3 quantifiable variables that influence the activities' IRR (and success). The key variables identified are income pr. household, adoption rate and lateral spread. Table 4.4 shows what effects a decrease in these variables will have on the Internal Rate of Return as follows

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<sup>37</sup> The lower figure is for NPV(10%); while the higher figure is for NPV(5%). The two rates (5-10%) signifies the range of interest discounted. Currently a rate near 5% p.a. is probably the one most synchronised to international interest rates.

**Table 4.4 Sensitivity Analysis for Demonstration Activities 1 and 3**

Item/variable	Change	IRR
Base case	N/A	193%
Income/HH (\$)	-\$172	20%
Adoption Rate	-0.59	20%
Lateral Spread	-0,89	20%

This means that the incremental income per household can be reduced by \$ 172 and still comfortably retain an internal rate of return of 20%. It is by all means very unlikely that the incremental income would be subject to such a reduction, and the calculations are therefore very robust to such changes.

For the adoption rate this can similarly be reduced by 59 percentage points (to an adoption rate of only 16%) and still retain an IRR of 20%. This too, is a very unlikely scenario, and thus, the calculations are very robust. The same can be said for the lateral spread. The lateral spread can be reduced to Nil and still retain healthy return.

In the scenarios presented in table 4.4 the returns remain relatively high, despite significant changes in the above variables. Thus, the demonstration activities do not show significant sensitivity to the above variables. In fact, demonstration activities 1 and 3 show a large extent of robustness, considering an IRR of 20%.

### **Conclusion**

Demonstration activity 1 and 3 is highly profitable in economic terms for both the project and the participating households. The calculations are robust and likely to retain its high profitability even if assumed income levels and adoption rates become much lower than anticipated.

## 4.2 Economic Analysis for Demonstration Activity 2

The dominating livelihood and income source in Peam Krasaob is fisheries. Demonstration activity 2 is therefore solely concerned with fisheries and management of the fisheries habitat at Peam Krasaob commune. Current gross income / household for Peam Krasaob is estimated as \$1608 per year<sup>38</sup> – of this, approximately 60-70% is from fisheries and 25 % from eco-tourism.

### 4.2.1. Household Economic Impact/Year for Fisheries.

Note: The calculation works on differences between two fisheries scenarios ('before' and 'after') – budgets in Annex 2. It is estimated that demonstration activity 2 can increase the total gross income (from both fisheries and eco-tourism) by about 20% over time (5 years) for each of the 277 households as follows:

**Table 4.5 Household Impact Peam Krasaob**

<b>Household Impact from demonstration activity 2: Community Fisheries</b>	<b>Unit (kg)</b>	<b>\$ /Unit</b>	<b>Value</b>	<b>Totals \$</b>
<b><u>Benefits / Average Household</u></b>				
1. <u>Net Increase</u> from fisheries	133	1.8/kg	240	
2. Net Increase from eco-tourism			<u>80</u>	320
<b>NET INCREMENT PER Household</b>				<b>320</b>

### 4.2.4 Project Economic Impact/Year

Combining individual household impacts, the overall impact from the demonstration activities is as follows:

<sup>38</sup>Ref. "Vulnerability and Risk Assessment Report", CARP, June 2012.

**Table 4.6 Project Level Economic Impact/Year**

<b>Project Economic Impact For 277 Households</b>	<b>\$ / HH</b>	<b>No. of Househ olds</b>	<b>Value (1,000)</b>	<b>Totals (1,000) \$</b>
<b><u>Gross Benefits</u></b>				
1. Annual Net Increments	320	277	89	
<b><u>Adjustments</u></b>				
2. Adoption Rate (100% after year 5):	0		0	89
3. Lateral Spread Factor (Nil)				
<b>Interim Income Effect</b>				<b>89</b>
<b>Income Multiplier Factor (standard )</b>	<b>1.2</b>			<b>17</b>
<b>TOTAL INCOME IMPACT</b>				<b>106</b>

The eventual annual economic impact at Peam Krasaob commune for demonstration activity 2 is thus expected to be \$ 106,000 per year. This is scaled to impact over 15 years below.

**Table 4.7 Project Economic Impact Projection**

<b>Measurements</b>	<b>Value</b>
1. Project Total Income Impact (15 Years)	\$0.5-0.8 million <sup>39</sup>
2. Less Project Cost (as planned for 2013-14)	\$ 80.000
3. Net Present Value (1-2):	\$ 0.5 – 0.7 million
4. Internal Rate of Return:	60 % <sup>40</sup>

<sup>39</sup> The lower figure is for NPV(10%); while the higher figure is for NPV(5%). The two rates (5-10%) signifies the range of interest discounted. Currently a rate near 5% p.a. is probably the one most synchronised to international interest rates.

<sup>40</sup>Exclusion of the economic multiplier effect would reduce the IRR to 57%. However, the multiplier is necessary in order to give an accurate economic assessments of such investments.

## Analysis of Economic and Social Costs & Benefits

These returns are high by any standards and the investment is assessed as beneficial in economic terms. However, please note that the investment amount (\$ 70,000), is only for the involved demonstration activities, which is the relevant decision platform for this assessment. The further overall project or component overheads for the CARP planning, management and administration is not included. And also not relevant for this calculation because at this stage the decision is about which demonstration activities to implement.

It appears that demonstration activity 2 is recommendable from an economic perspective.

### Sensitivity Analysis

The objective is to calculate the effect of likely changes in the variables and the effects on the IRR of the base case. This sensitivity analysis focuses on 3 quantifiable variables that influence the activities' IRR (and success). The key variables identified are income pr. household, adoption rate and lateral spread. Table 4.8 shows what effects a decrease in these variables will have on the demonstration activities' IRR.

**Table 4.8: Sensivity Analysis for Demo Activity 2**

Item/variable	Change	IRR
Base case	N/A	60%
Income/HH (\$)	-165	20%
Adoption Rate	-0.75	20%
Lateral Spread	-0,77	20%

This means that the incremental income per household can be reduced by \$ 165 and still comfortably retain an internal rate of return of 20%. It is a very unlikely scenario that the incremental income would be subject to such a reduction, and the calculations are therefore very robust to such changes.

For the adoption rate this can similarly be reduced by 75percentage points and still retain an IRR of 20%. This too, is a very unlikely scenario, and thus, the calculations are very robust.

### Conclusion

Demonstration actvity 2is highly profitable in economic terms for both the project and the participating households. The calculations are robust and likely to retain its high profitability even if assumed income levels and adoption rates become much lower than anticipated.

### 4.3 Economic Analysis for Demonstration Activity 4

#### 4.3.1. Household Economic Impact/Year, Livestock

Note: The calculation works on differences between two agricultural practices ('before revolving stock scheme' and 'after'). Please see partial livestock budgets for reference in Annex 2.

**Table 4.9 Household Impact Livestock**

<b>Household Impact for an average Holding from participating in the Revolving stock scheme</b>	<b>Unit (kg)</b>	<b>\$ /Unit</b>	<b>Value</b>	<b>Totals \$</b>
<b><u>Benefits / Average Holding</u></b>				
1. <u>Increase</u> in net income from 'Revolving livestock scheme'	100	2.5	250	250
<b><u>Costs</u></b>				
2. Increased variable costs/holding			-35	
3. Increased semi-fixed costs (e.g. equipment, rent, interest)			-15	
4. Opportunity Cost (forgone annual income, if any)			<u>0</u>	-50
<b>NET INCREMENT PER HOLDING</b>				<b>200</b>

#### 4.3.2. Project Economic Impact/Year

Combining individual household impacts, the overall impact from the demonstration activity is in Table 4.10:

**Table 4.10 Project Level Economic Impact/Year**

<b>Project Economic Impact For 100 initial participants</b>	<b>\$ / holding</b>	<b>No. of holding s</b>	<b>Value (1,000)</b>	<b>Totals (1,000) \$</b>
<b><u>Gross Benefits</u></b>				
1. Annual Net Increments	200	100	20	20
<b><u>Adjustments</u></b>				
2. Adoption Rate (75%):				-5
3. Lateral Spread Factor (10%)				+2
<b>Interim Income Effect</b>				<b>17</b>
<b>Income Multiplier Factor (standard )</b>	<b>1.2</b>			<b>3</b>
<b>INCOME IMPACT (first round only)</b>				<b>20</b>

The expected annual economic impact at seven target communes for demonstration activity<sup>4</sup> is thus expected to be \$ 20,000 per year – for the first rotation round only. This is scaled to impact over 15 years with 50 new households expected to join for the first 10 years. The results are below.

**Table 5.11 Project Economic Impact Projection**

<b>Measurements</b>	<b>Value</b>
1. Project Total Income Impact (15 Years)	\$0.5 -0.7 million <sup>41</sup>
2. Less Project Cost (as planned for 2013-14)	\$ 175.000
3. Net Present Value (1-2):	\$ 0.3 – 0.5 million
4. Internal Rate of Return:	31 %

<sup>41</sup> The lower figure is for NPV(10%); while the higher figure is for NPV(5%). The two rates (5-10%) signifies the range of interest discounted. Currently a rate near 5% p.a. is probably the one most synchronised to international interest rates.

## Analysis of Economic and Social Costs & Benefits

These returns are high and the investment is profitable. However, please note that the investment amount included (\$ 175,000), is only for the involved demonstration activities, which is the relevant decision platform for this assessment. The further overall project or component overheads for the CARP planning, management and administration is not included. It is also not relevant for this calculation because at this stage the decision is about which demonstration activities to implement.

It appears that demonstration activity 4 is highly recommendable from an economic perspective.

### Sensitivity Analysis

This sensitivity analysis focuses on 3 quantifiable variables that influence the activities' IRR (and success). The key variables identified are income pr. household, adoption rate and lateral spread. Table 4.12 shows what effects a decrease in these variables will have on the demonstration activities' IRR.

Table 4.12 Sensivity Analysis for Demo Activity 4

Item/variable	Change	IRR
Base case	N/A	31%
Income/HH	-76	20%
Adoption Rate	-0.30	20%
Lateral Spread	-0,41	20%

This means that the *incremental income per household* can be reduced by \$ 76 and still comfortably retain an internal rate of return of 20%. It is very unlikely that the incremental income would be subject to such a reduction, and the calculations are therefore very robust to such changes.

For the adoption rate this can similarly be reduced by 30percentage points and still retain an IRR of 20%. This too, is a very unlikely scenario, and thus, the calculations are very robust.

The same can be said for the lateral spread. The lateral spread can be reduced by 41 percentage points and retain an IRR of 20%. Again, this scenario is very unlikely and thus the calculations are very robust.

Thus, despite significant changes in the above variables, the demonstration activities show a large extent of robustness, considering an IRR of 20%.

## Conclusion

Demonstration activity 4 is profitable in economic terms for both the project and the participating households. The calculations are robust and likely to retain its high profitability even if assumed income levels and adoption rates become much lower than anticipated.

### 4.4 Economic Analysis for Demonstration Activity 5

#### 4.4.1. Household Economic Impact/Year, Water Harvesting.

Note: The calculation works on the differences between 'old' and 'new' practices.

**Table 4.13 Household Impact Water Harvesting**

<b>Household Impact for an average household</b>	<b>Unit (kg)</b>	<b>\$ /Unit</b>	<b>Value</b>	<b>Totals \$</b>
<b><u>Benefits / Average Holding.</u></b>				
1. <u>Increase</u> in vegetable yield of 0.1 ha during the dry season (water melon)	200	0.36	72	
2. Supplementary vegetables			18	
3. Household water (10 m) <sup>3</sup>	10	2.5	<u>25</u>	<b>115</b>
<b><u>Costs</u></b>				
4. Increased variable costs/holding				
5. Increased semi-fixed costs			-25	<u>-25</u>
6. (e.g. equipment, rent, interest etc)				
7. 5. Opportunity Cost (forgone annual income, if any)			<u>0</u>	
<b>NET INCREMENT PER HOLDING of average 0.1 ha for vegetables</b>				<b>90</b>

**Table 4.14 Project Level Economic Impact/Year**

<b>Project Economic Impact For 200 Households</b>	<b>\$ / HH</b>	<b>No. of Househ olds</b>	<b>Value (1,000)</b>	<b>Totals (1,000) \$</b>
<b><u>Gross Benefits</u></b>				
1. Annual Net Increments	90	200	18	
<b><u>Adjustments</u></b>				
2. Adoption Rate (90 %):	0		0	18
3. Lateral Spread Factor (10%)				
<b>Interim Income Effect</b>				<b>18</b>
<b>Income Multiplier Factor (standard )</b>	<b>1.2</b>			<b>4</b>
<b>TOTAL INCOME IMPACT</b>				<b>22</b>

The expected annual economic impact at seven target communes for demonstration activity 5 is thus expected to be \$ 22,000 per year. The results are below.

**Table 4.15 Project Economic Impact Projection**

<b>Measurements</b>	<b>Value</b>
1. Project Total Income Impact (15 Years)	\$0.15 -0.21 million <sup>42</sup>
2. Less Project Cost (as planned for 2013-14)	\$ 50.000
3. Net Present Value (1-2):	\$ 0.11 – 0.17 million
4. Internal Rate of Return:	56 %

<sup>42</sup> The lower figure is for NPV(10%); while the higher figure is for NPV(5%). The two rates (5-10%) signifies the range of interest discounted. Currently a rate near 5% p.a. is probably the one most synchronised to international interest rates.

## Analysis of Economic and Social Costs & Benefits

These returns are high and the investment is profitable. However, please note that the investment amount included (\$ 50,000), is only for the involved demonstration activities, which is the relevant decision platform for this assessment. The further overall project or component overheads for the CARP planning, management and administration is not included. And also not relevant for this calculation because at this stage the decision is about which demonstration activities to implement.

It appears that demonstration activity 5 is highly recommendable from an economic perspective.

### Sensitivity analysis

The objective is to calculate the effect of likely changes in the variables and the effects on the IRR of the base case. This sensitivity analysis focuses on 3 quantifiable variables that influence the activities' IRR (and success). The key variables identified are income pr. household, adoption rate and lateral spread. Table 4.16 shows what effects a decrease in these variables will have on the demonstration activities' IRR.

Table 4.16 Sensitivity Analysis for Demonstration Activity 5

Item/variable	Change	IRR
Base case	N/A	56%
Income/HH (\$)	-49	20%
Adoption Rate	-0.46	20%
Lateral Spread	-0,61	20%

This means that the *incremental income per household* can be reduced by \$ 49 and still comfortably retain an internal rate of return of 20%. It is very unlikely that the incremental income would be subject to such a reduction, and the calculations are therefore very robust to such changes.

For the adoption rate this can similarly be reduced by 46percentage points and still retain an IRR of 20%. This too, is a very unlikely scenario, and thus, the calculations are also very robust.

The same can be said for the lateral spread. The lateral spread can be reduced by 61 percentage points and retain an IRR of 20%. Again, this scenario is very unlikely and thus the calculations are very robust.

In the scenarios presented the returns remain relatively high, despite significant changes in the above variables. Thus, the demonstration activities do not show

## Analysis of Economic and Social Costs & Benefits

significant sensitivity to the above variables. In fact, demonstration activity 5 shows a large extent of robustness, considering an IRR of 20%.

### **Conclusion**

Demonstration activity 5 is profitable in economic terms for both the project and the participating households. The calculations are robust and likely to retain its high profitability even if assumed income levels and adoption rates become much lower than anticipated.

## 4.4 Summary of Other Considerations

### 4.4.1 Social Costs and Benefits

The proposed demonstration activities are all in line with the expressed priorities of community representatives and builds on their present coping strategies. There is, therefore, limited social costs but rather benefits associated with the proposed activities – exactly because the proposed activities support expressed community priorities.

It may be mentioned, however, that the proposed expansion of livestock (particularly smaller livestock) and vegetable production may put further stress on women's labour – because these activities are traditionally often considered to be women's responsibilities. This is an aspect that needs to be considered during implementation.

There are additional benefits, which are difficult to quantify. In brief these include:

For demonstration activity 1 in particular:

- The reduction of the strain on the environment as well as on animal and human health through the promotion of Integrated Pest Management (IPM) technologies, which demonstrably has led to reduction of pesticide usage of 70-90% in e.g. Bangladesh (Danida Impact Study 2003).
- The promotion of vegetable production with likely improved nutrition as well as income as result for the participating households.

For demonstration activity 3 in particular:

- Improved environmental management via sustainable measures for fodder development; for example aiming to avoid over-grazing.
- Improved nutrition of participating households via better access to livestock products.

All in all the above as well as the benefits estimated in sections 4.1-4.3 points to good prospect for achieving substantial improvements in the livelihood of the target households.

### 4.4.2 Adaptive Capacity

The adaptive capacity of communities in relation to climate change has already been considered in the "Vulnerability and Risk Assessment Report", CARP, July 2012. The proposed demonstration activities are in particular designed to fit closely to the adaptive capacity of the communities.<sup>43</sup>

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<sup>43</sup>The team was further informed that negotiations between an investor and the three new communes at Prey Nob may be ongoing concerning contract farming and dyke maintenance.

### **4.4.3 Institutional issues**

All proposed demonstration activities depend for their implementation on the smooth cooperation between CARP, MoE and other RGC institutions – notably institutions under MAFF; including the provincial Directorates of Agriculture, Fisheries and PDWRAM.

Such inter-ministerial cooperation in Cambodia has not always functioned as smoothly as could have been wished. However, it is imperative for the successful implementation in this context that such cooperation becomes both timely and appropriate.

There may be some functional capacity limitations within the mentioned institutions. The on-going consultation and negotiation of roles and responsibilities in regard to implementation is therefore of the utmost importance.

### **4.4.4 The short Implementation Time available**

It is already highlighted (section 4.1) that the CARP component is due to close by end of 1st quarter 2014; thereby allowing only one main growing season (the wet season 2013) for implementation of demonstration activities. This is not an ideal situation as all demonstration activities would benefit from the component's presence in terms of follow-up and consolidation of results and outcomes.

Of the five proposed activities subjected to economic analysis, the activity 1, 3 and 5 are considered least sensitive to the short support duration – because the prime vehicle (the farmer field schools) in any case usually runs intensively for only one season per locality.

Both activity 2 and 4 are more dependent on adequate follow-up and consolidation activities after the first implementation year. The Peam Krasaob income impact is thus only expected in full by year 5, while the Livestock Revolving Stock Scheme is expected to continue to take in new participants even for 10 years. Both of these activities 2 and 4 are therefore more risky because of this follow-up and consolidation demand.

The cost estimates for most activities do contain consideration of these follow-up and consolidation requirement by setting aside some funds per commune for such follow-up activities. This could be in the form of outright employment by the commune councils of commune extension workers for say 3 years – with subsequent fixed employment, if they prove their worth, and if this becomes affordable by the commune councils.

## 5. Conclusions and Recommendations

In economic terms the analysed demonstration activities compare as follows:

**Tabel 5.1 Comparison of Economic Benefits**

Demo Activity	Directly benefiting households	Internal Rate of Return	Net Present Value of Investment <sup>44</sup>	Benefit per household
1 and 3: FFS	1200	193 %	\$1.7 million	\$1417
2:Peam Krasaob	277	60%	\$0.5 million	\$1806
4: Livestock	600	31%	\$0.3 million	\$500
5: Water Harvesting	200	56%	\$0.1 million	\$500

It is thus clear that all five demonstration activities covered by the economic analysis is to be considered real candidates for implementation – because they are all profitable investments. In case of fund limitations, the combined demonstration activities 1 & 3 are the most highly recommended, followed by the Peam Krasaob Community Fisheries project in second place. And only if funds are available for further investment should demonstration activity 4 be implemented.

The foregoing, including other than economic considerations, leads to the following recommendations:

### 5.1 Recommendations

It is recommended to:

- 5. Implement the combination of Activity 1, 3 and 5: Climate Change and Integrated Farming, Demonstration of Short-Term Varieties, and demonstration of Water Harvesting as one demonstration activity but under separate contracts – with DAE/PDA, CARDI / PDA and PDWRAM respectively.**
- 6. Consider implementation of Activity 2: Peam Krasaob Fisheries Community Development – provided that guarantees can be obtained from the commune council as well as from the National**

<sup>44</sup> The lower value of the NPV (NPV(10%)) only is taken for this illustration

**Park Authority and the Fisheries Administration as regards follow-up and consolidation after 2014. This should include certain funding commitments from the Peam Krasaob community.**

- 7. Consider implementation of Activity 4 (Livestock Revolving Stock Scheme) only if a suitable NGO or similar agent for implementation and follow up can be found.**
- 8. Consider implementation of activities 6-7 only after further consultations with likely partner organisations.**

All of the above are presently being subjected to further consultations and negotiations with the intended partner institutions. It is, foreexample, clear that Activity 1 should start field implementation preferably no later than 1 January 2013 – in order to be ready for implementation of the main event (the Farmer Field Schools) by April 2013.

These consultations and negotiations may reveal needs for revision of certain aspects of the proposed demonstration activities – as per the perspectives, resources and recommendations of these potential partner institutions.

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NAPA follow-up project documents

### **Web-pages**

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<http://www.wepa-db.net/policies/state/cambodia/seaarea.htm>, 3/2-2012.

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### **Annexes**

Annex 1: TOR, Team Programme and Persons met

Annex 2: DATA

Annex 3: Economic Calculations (Cash flows) in Excel

## **Annex 1: TOR, Team Programme and Persons met**

### **Annex 1.1 Terms of Reference**

#### **Terms of reference – Livelihood Specialist**

#### **Vulnerability and risk assessment of community livelihoods in target districts**

#### **Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production**

The coastal zone plays an increasing role in Cambodia's development, and continues to provide important environmental services. Human activities in Cambodia's coastal zone include recreation, industry, agriculture, fishery and transport. These activities may have direct or indirect effects on changing the coast. Recreation and tourism is an important sector among others. The beaches and islands attract an increasing number of tourists. Agriculture activities in the coastal zone are also quite significant. For example, approximately 45% of the population in Koh Kong-Sihanoukville and 80% in Kampot are engaged in agricultural activities. These activities are concentrated mainly in low-lying coastal zones due to the fertility of the land.

The coastal zones of Cambodia are threatened by several natural hazards, such as storm surges, high tide, beach erosion and seawater intrusion. Successions and combinations of droughts and floods have already resulted in a significant number of fatalities and considerable economic losses. Losses arising from floods have been further exacerbated by deforestation. Nationally, floods have accounted for 70% of rice production losses between 1998 and 2002, while droughts accounted for 20% of losses. Due to the impact of climate change, sea level rise (SLR) may affect the 435-km long coastline and the frequency and intensity of floods may increase and cause severe damage to, amongst other things, rice harvests. Low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangroves forests, may be threatened by rises in sea levels.

The National Adaptation Programme of Action to climate change (NAPA, 2006) identified the agriculture, water resources, coastal zone, and human health sectors as requiring immediate and urgent attention in order to address climate-induced problems. This component on “Coastal Adaptation and Resilience

## Analysis of Economic and Social Costs & Benefits

Planning” (hereafter referred to as “the coastal component”) forms an integral part of the Cambodia Climate Change Alliance (CCCA). The development objective for the CCCA programme is “*climate change activities in Cambodia are nationally owned, led and aligned with Cambodia’s development priorities, and are effectively coordinated and implemented*”.

### **Brief Component Description**

The immediate objective of this component is ‘increased resilience of coastal communities and ecosystems to climate change through adaptation planning, demonstrated targeted local interventions and provision of practical learning experience in adaptation planning to the NCCC/CCD.’

There are 2 Outcomes of this component:

- Outcome 1: Improved climate change knowledge integrated into land use and coastal development plans.
- Outcome 2: Increased resilience of coastal communities and coastal ecosystem buffers to climate change and improved livelihoods.

### **Assignment**

The following assignment relates to outputs under Outcome 2. Activities to be performed for the present assignment are indicated and shortly described below:

#### **Vulnerability and risk assessment of community livelihoods in target districts – output expected end of June 2012 (activity 2.3 and identified sub-activities)**

1. Access current data on climatic conditions and projected trends
2. Access or construct likely scenarios for the 2 districts for:
  - a. 2.0: Very Short Term; e.g. 2012-2015.
  - b. 2.1: Short Term (ST); e.g. 2015-2020
  - c. 2.2: Medium Term (MT); e.g. 2020-2040
  - d. 2.3: Long Term (LT); e.g. 2040-75
  - e. 2.4: Very Long Term; e.g. 2075-2025
3. Evaluate most likely Scenarios.
4. Access /collect and group info/stats on community livelihoods in the two districts – preferably using a methodology similar to the Cambodia Socio-Economic Survey 2004 (example in attachment 1) – possibly supplemented by ‘poverty’ profiles and coping strategy illustration (examples in attachments 2-3).

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5. Combine and integrate results of above points (2-3) and (4) into a vulnerability and risk matrix - (matrix to be developed).
6. Highlight / summarise the matrix results.
7. Introduction to alternative livelihoods – based on above.

### **Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production – output expected end of June 2012 (activity 2.6 and sub-activities)**

1. Collect, procure and assemble relevant data on costs and benefits of above.
2. Calculate and analyse economic data on above – probably using the Gross Margin methodology – (possibly combined with cost/benefit ratios). Methodology may depend on data available.
3. Possibly elaborate results from (2) into financial and economic internal rates of return (IRR), if relevant and if data allows.
4. Consider intangible social costs and benefits, if any.
5. Summarise strategically and relate to the results of Activity 2.3.

### **Outputs**

The output should be in the form of two separate reports, and extensive input to two other outputs.

2.3 Vulnerability and risk assessment of community livelihoods in target districts – output expected end of June 2012

2.5 Analysis of economic and social costs and benefits of options for modified agricultural practices and fuel wood production – output expected end of June 2012

And extensive inputs to the outputs:

2.7 Development of a detailed implementation plan for community adaptation demonstrations (end of October 2012)

2.10 Establishment of a monitoring and evaluation format for assessing benefits of demonstration activities (end of October 2012).

### **Qualifications**

- Master degree in international development and livelihood improvement

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- A minimum of 15 years working experience mainly focused on sector programming, value chains, livelihood improvement and capacity development
- Experience in public participation development process in relation to livelihood development
- Experience from livelihood programmes
- Strong analytical skills
- Previous experience from Cambodia is an advantage

### **Contact person**

Contact person for the consultant will be Senior Technical Adviser Mr. Jens Erik Lyngby.

### **Duration**

The consultancy will be for a part-time 2 months work, with a starting date of around mid-April 2012 until end October 2012. Deadline for reporting will be end of June for the first two outputs and for inputs to the two remaining outputs end of October 2012.

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### Annex 3.2 Economic Assessment Team Programme

Date	Time	Activity
<b>Inception Period</b>		
<b>April 17 – May 4 2012</b>		
<b>2012</b>		<b>Week 16</b>
<b>April 16</b> <b>Monday</b>	Noon Afternoon	<ul style="list-style-type: none"> <li>Literature review and other preparations</li> </ul>
<b>April 17</b> <b>Tuesday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>International travel Denmark-Cambodia</li> <li><i>Arrival Phnom Penh</i></li> </ul>
<b>April 18</b> <b>Wednesday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>Internal Meeting with Local Livelihoods Consultant</li> <li>Planning and arrangements for field tour to coastal provinces</li> <li>Consultations and doc review<sup>45</sup> (<i>continuous</i>)</li> </ul>
<b>April 19-20</b> <b>Thursday / Friday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>Other meetings with MoE, and MAFF, Other Consultations, data collection and doc review (<i>continuous</i>)</li> </ul>
<b>April 21-22</b>		<i>Week-end</i>
<b>2012</b>		<b>Week 17</b>
<b>April 23</b> <b>Monday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>At Prey Nub area</li> </ul> <p>Mini-workshop with commune councillors at Prey Nub District office</p> <p>Visits to three commune sites</p>
<b>April 24-25</b> <b>Tuesday / Wednesday.</b>	Morning Afternoon	<p><b>Meeting s</b></p> <p>Travel to Koh Kong</p> <p>Meeting with provincial departments</p> <p>Mini-workshop with commune councillors</p>

<sup>45</sup> Consultations and reviews will be continuous throughout the assignment, and new meetings will continue to be added to the work plan.

## Analysis of Economic and Social Costs & Benefits

<b>Date</b>	<b>Time</b>	<b>Activity</b>
		<b>Inception Period</b> <b>April 17 – May 4 2012</b>
<b>April 26</b> <b>Thursday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>Meeting at Peam Krasop Site visits to Peam Krasoab and Tol Kokir</li> </ul>
<b>April 27</b> <b>Friday</b>		<ul style="list-style-type: none"> <li><b>Meeting with provincial departments at Koh Kong</b></li> <li>Consultations and Reviews</li> </ul>
<b>April 28-29</b>		<i>Week-end</i> <i>Travel to Phnom Penh</i>
<b><u>2012</u></b>		<b>Week 18</b>
<b>April 30</b> <b>Monday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>More consultations and data collection in Phnom Penh</li> </ul>
<b>May 1-2</b> <b>Tuesday /</b> <b>Wednesday</b>	Morning Afternoon	<ul style="list-style-type: none"> <li>Combined Review of field tour, consultations etc</li> <li>Draft process and methodology to produce expected outputs due by end of June 2012.</li> </ul>
<b>May 3</b> <b>Thursday</b>	Morning Afternoon	Debriefing, discussions and presentation of work process for May-June 2012.
<b>May 4</b> <b>Friday</b>	Morning Afternoon	Departure and international travel Cambodia-Denmark

<b>Date</b>	<b>Time</b>	<b>Activity</b>
		<b>Data Collection Phase</b> <b>May 4 – June 10, 2012</b>
<b><u>2012</u></b>	<b>May 7-11</b>	<b>Week 19</b>
<b>Activity 2.3</b>		Remaining data gaps are to be filled by SS during the week 7 - 11 May 2012.
<b>Activity 2.6</b>		Remaining listings, data collections and data procurements are to be done by SS during the two weeks 7 - 11 May and 21-25 May 2012.
<b>May 12-13</b>		<i>Week-end</i>

## Analysis of Economic and Social Costs & Benefits

Date	Time	Activity
		<b>Data Collection Phase</b> <b>May 4 – June 10, 2012</b>
<b><u>2012</u></b>		<b>Week 20</b>
<b>May 14-20</b>		Mainly public holidays in Cambodia
<b><u>2012</u></b>	<b>21-25 May</b>	<b>Week 21</b>
<b>Activity 2.3</b>		<u>Sub-Activity (2) and (3): Construct and evaluate likely projections for climate change,</u> are to be accomplished by SS during the week 21 - 25 May <sup>46</sup> 2012.
<b>Activity 2.6</b>		Remaining listings, data collections and data procurements are to be done by SS during the week 21-25 May 2012.  Field data collection tour to the coast
<b>May 26-27</b>		<i>Week-end</i>
<b><u>2012</u></b>	<b>May 28-1 June</b>	<b>Week 22</b>
<b>Activity 2.3</b>		<u>Sub-Activity (5):Draft Vulnerability and Risk Matrix,</u> is to be accomplished by SS during the week 28-May - 1 June 2012.
<b>Activity 2.6</b>		<u>Sub-Activity (2.b); Assembly of data into formats</u> is to be accomplished by SS during the week 28 May- 1 June 2012,
<b>June 2-3</b>		<i>Week end</i>
<b><u>2012</u></b>	<b>June 4-8</b>	<b>Week 23</b>
<b>Activity 2.3</b>		<u>Sub-activity (7.1) “listing of alternative livelihoods’</u> , should be done by SS during the week 4-8 June 2012.
<b>Activity 2.6</b>		<i>First calculations</i> (re. sub-activity 3) by SS during the week 4-8 June 2012.
<b>June 9-10</b>		<i>Week-end</i>
<b><u>2012</u></b>	<b>June 11- 15</b>	<b>Week 24</b>
<b>June 11</b>		International Travel of International Experts

<sup>46</sup> The preceding week is mostly public holidays in Cambodia.



## Analysis of Economic and Social Costs & Benefits

Date	Time	Activity
<b>Assessment Phase</b> <b>(June 10-30 2012)</b>		
<b>June 22</b> <b>Friday</b>	Morning  Afternoon	<ul style="list-style-type: none"> <li>• AK accompanies Survey Team to Preah Sihanouk Province for collection of data (until June 25)</li> <li>• Final assembly of economic analysis</li> </ul>
<b>June 23-24</b>		<i>Week-end</i>
<b><u>2012</u></b>		<b>Week 26</b>
<b>June 25</b> <b>Monday</b>	Morning  Afternoon	<ul style="list-style-type: none"> <li>• Assessment and elaboration of economic calculations.</li> <li>• Assessment of intangible social costs &amp; benefits</li> </ul>
<b>June 26-27</b> <b>Tuesday-</b> <b>Wednesd.</b>	Morning  Afternoon	<ul style="list-style-type: none"> <li>• Summarise strategically – and first drafting of Output 2.6: Cost &amp; Benefits Report</li> </ul>
<b>June 28</b> <b>Thursday</b>	Morning  Afternoon	<ul style="list-style-type: none"> <li>• <b>Submission of Report 2.6</b></li> <li>• Action Plans for July- September 2012.</li> </ul>
<b>June 29</b> <b>Friday</b>	Morning  Afternoon	<ul style="list-style-type: none"> <li>• <b>Debriefing meeting at MoE</b></li> <li>• Departure and international travel Cambodia-Denmark</li> </ul>
<b><u>2012</u></b>		<b>Week 27</b>
<b>July 2-6</b>		<b><i>Preparation of the two FINAL Draft Reports</i></b>

### Annex 1.3 Persons Met

Name	Title, Organization
Dr Vann Monyneath	National Coordinator, Ministry of Environment
Mr. Meas Rithy	Deputy National Coordinator, Ministry of Environment
Mr Sreng Sophal	Project Administrator, Ministry of Environment
Dr. Heng Chan Thoeun	Deputy Director, Ministry of Environment
Mr Pieter Ypma	Senior Manager, CAVAC Innovation in Agriculture
Dr. Philip Charlesworth	IDE, Cambodia
Dr. Sovichi Kao	Deputy Director General, Fisheries Administration
Ms Hap Navy	Head Socio-Economist, Fisheries Administration
Ms Mao Mony Ratana	Senior Programme Officer, Danida

## Analysis of Economic and Social Costs & Benefits

<b>Name</b>	<b>Title, Organization</b>
Mr. Prak Visal	Deputy Director, Sihanoukville Province
Mr. Phay Phan	Deputy Governor, Sihanoukville Province
Dr. Mak Soeun	Director, Department of Agricultural Extension, MAFF
Mr Srey Vuthy	Deputy Director, Planning, MAFF
Mr Pelle Gatke	Technical Adviser, Fisheries Action Coalition Team (FACT)
Mr Chan Danith	Coordinator, Secretariat of the TWG-Fisheries
Mr Julian Abrams	Consultant, NCDD, Ministry of Interior / UNDP
Mr. Kong Chanthan	Chief of Office, NCDD, Ministry of Interior
Mr Liam Fee	Development Adviser, UN HABITAT
Mr Kosal Sar	National Sepcialist, LGCC, NCDD, UNCDF
Mr Meach Yady	Chief, Agricultural Marketing, MAFF
Ms Meas Sotheavy	Deputy Director, Planning and Statistics, MAFF
Dr Tue Kell Nielsen	Water Resources Management Adviser, CARP
Mr. Tuy Samran	Project Manager, EC-FAO Food Security Project
Mr. Soy Seung	Programme Assistant, FAO
Mr. Jeevanan Duraisamy	Climate Change Officer, FAO
Mr. Victor Jona	Deputy Director General, MIME
Mr. Meas Bunley	National Communication Officer, NAPA / UNDP
HE Veng Sakhon	Secretary of State, MOWRAM
Dr. Kesothea Nou	Researcher, Cambodia Development Resources Institute
Ms Kalyan Keo	Programme Manager, UNDP
Mr Pinreak Suos	National Advisor, NAPA Follow-Up Project, UNDP
Dr. Philippe Leperre	Senior Livestock Consultant, Laos
Dr. Dara Rat Moni Ung	Adviser, NAPA Follow-Up Project, UNDP and IFAD
Jens Erik Lyngby	Senior Adviser, CARP
Dr. Mamara	Director, Carmbodia Agricultural Research Institute

## **Annex 2: Data and Budgets**

### **2.1 FFS and IPM Impact Documentation from Cambodia**

### **2.2 Crop Budgets**

### **2.3 Livestock and Fisheries budgets**

## Analysis of Economic and Social Costs & Benefits

### Annex 2.1 FFS and IPM Impact Documentation from Cambodia

Source: Diagnostic Study, page 365, Agrifoodconsulting for AusAid, 2006.

**Table 1 Rice Yields Before and After Participating in PRASAC II FFS Program**

Intervention	Average Yield (kg/ha)	90% Confidence Interval	
		Lower	Upper
After FFS	2,252	1,816	2,688
Before FFS	1,402	1,085	1,718
Difference	850 (60%)		

Source: SAWAC (2003, pg. 47)

**Table 2 Comparison of Changes in Rice Yields by Explanatory Variables**

Explanatory Indicator		Average Yield Change (kg/ha)	90% Confidence Interval	
			Lower	Upper
Gender	Male	744	600	888
	Female	578	338	819
FFS participation	No	662	517	807
	Yes	841	593	1090
SRI participation	No	428	274	581
	Yes	998	808	1188
Vegetable Program participation	Yes	703	544	863
	No	724	521	928

Source: SAWAC (2003, Appendix Table 8)

**Table 3 Comparison of Changes in Rice Yields Due to Farmer Field Schools**

Explanatory Indicator		Average Yield Change (kg/ha)	90% Confidence Interval	
			Lower	Upper
Gender	Male	1369	1082	1656
	Female	1139	535	1743
SRI participation	No	1220	779	1661
	Yes	1391	1072	1709

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Vegetable Program participation	Yes	1225	912	1539
	No	1478	1032	1924

Source: SAWAC (2003, Appendix Table 14)

**Table 4 Yields and Farmer Returns Under IPM and FFS in Cambodia**

Program	Crop	Yields (kg/ha)			Income (\$/ha)		
		IPM / FFS	Non-Participating	Change	IPM / FFS	Non-Participating	Change
Rice Production, Kandal and Takeo Provinces	Wet Season	2473	2083	390	\$186.04	\$108.23	\$77.81
	Dry Season	3789	3099	690	\$154.54	\$91.17	\$63.37
Oxfam-GB Kampong Speu	Rice			586			
Danida IPM	Wet Season	3226	2089	1137	\$216.07	\$102.20	\$113.88
	Dry Season	4507	3110	1397	\$241.94	\$106.77	\$135.16
APIP/IPM	Wet Season	3308	2536	772			
	Dry Season	4124	3278	846			
National IPM	Wet Season	2747	2014	733			
	Dry Season	3114	2450	664			
FAO Vegetable	Yard Long Bean	9798	8307	1491	\$712.94	\$393.77	\$319.17
	Tomato	15425	13096	2329	\$2,900.97	\$1,816.00	\$1,084.97

Source: Adapted From (Ngin Chhay 2004)

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### Annex 2.2 Crop Budgets

Notes regarding all crop budgets:

- The economic analysis in all cases work from the Gross Margins – not from net return per household. The latter is only included as an illustration but is somewhat fictional in economic terms. This is because the real value of HH labour depends on its opportunity cost, which may differ substantially between households.
- All crop budget inform of the average land per farm holding of the concerned crop (e.g. paddy). However all other values tabulated are given per hectare.

#### **1. Paddy Budget for PRESENT Conditions at Prey Nob East<sup>48</sup> (Unit per ha) – ‘before project’**

Name of Crop	Unit	Quantity	Price (Riel)	Values (Riel)	Value US\$
<b>1. Wet Paddy</b>					
<i>Gross income</i>					
Farm income					
Land per holding	ha	(0.8)			
Yield Kg/ha	Kg	1570	960	1507200	367.61
Straw rice	kg	1570	50	78500	19.15
<b>Total Revenue</b>					<b>386.76</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	58	960	55680	13.58
Fertilizer	kg	70	3000	210000	51.22
Natural Fertilizer	ton	1	40000	40000	9.76
Pesticide			7000	7000	1.71
Hire Labour			392000	392000	95.61
Draft animal/ Machinery cost			200000	200000	48.78
Total Variable Cost					<u>220.65</u>
<b>GROSS MARGIN</b>					<b><u>166.10</u></b>
Labour Cost (HH manpower)	Person days	45	15000	675000	164.63
<b>Net Return Per Ha</b>					<b><u>1.47</u></b>
<b>Net Return Per HH</b>					<b><u>1.22</u></b>

<sup>48</sup> Prey Nob East are the 3 originally chosen communes of Tuek Thla, Tuek L'ak and Sameakki. These are all located to the east of the Kampong Smach River and adjacent to the Bokor Mountain and National Park.

## Analysis of Economic and Social Costs & Benefits

### 2. Paddy Budget for 'after project' in Prey Nob East (Unit per ha)

Name of Crop	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
<b>1. Wet Paddy</b>					
<i>Gross income</i>					
Farm income					
Land holding	ha	(0.8)			
Yield Kg/ha	Kg	2700	960	2592000	632.20
Straw rice	kg	2700	50	135000	32.93
<b>Total Revenue</b>					<b>665.12</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	15	2800	42000	10.24
Fertilize	kg	100	3000	300000	73.17
Natural Fertilizer		1	40000	40000	9.76
Pesticide			7000	7000	1.71
Hire Labour		45	15000	675000	164.63
Draft animal/ Machinery cost			200000	200000	48.78
Total Variable Cost					<u>308.29</u>
<b>GROSS MARGIN</b>					<b><u>356.83</u></b>
Labour Cost (HH manpower)	Persondays	45	15000	675000	164.63
<b>Net Return Per Ha</b>					<b><u>192.20</u></b>
<b>Net Return Per HH</b>					<b><u>159.52</u></b>

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### 3 Paddy Budget for present conditions at three of Prey Nob, Toul Totoeng and O Oknha Heng Commune, Prey Nob District – ‘before project’:

Name of Crop – Per hectare	Unit	Quantity	Price (Riel)	Values (Riel)	Value US\$
<b>Wet Paddy</b>					
Land holding	ha	(1.5)			
Yield Kg/ha	Kg	2900	950	2755000	671.95
Straw rice	kg	2900	50	145000	35.37
<b>Total Revenue</b>					<b>707.32</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	50	1000	50000	12.20
Fertilize	kg	90	3000	270000	65.85
Pesticide			50000	50000	12.20
Hire Labour			612500	612500	149.39
Draft animal/ Machinery cost			250000	250000	60.98
Threshing cost			200000	200000	48.78
Buying bag			36000	36000	8.78
Transportation cost			106400	106400	25.95
Membership fee for Polder community			50000	50000	12.20
Total Variable Cost					<u>396.32</u>
GROSS MARGIN					<u>311.00</u>
Labor Cost (HH manpower)	Persondays	20	15000	300000	73.17
<b>Net Return Per Ha</b>					<b><u>237.83</u></b>
<b>Net Return Per HH</b>					<b><u>356.74</u></b>

Note: The average land holding is 1.5ha/HH. Rice yield is between 2 to 4T/ha. Only wet paddy cultivation.

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### 4 Paddy Budget for 'After Project at three 'new commuens' of Prey Nob, Toul Totoeng and O Oknha Heng Commune, Prey Nob District

Name of Crop – Per hectare	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
<b>Wet Paddy</b>					
Land holding	ha	(1.5)			
Yield Kg/ha	Kg	3500	950	3325000	810.98
Straw rice	kg	3500	50	175000	42.66
<b>Total Revenue</b>					<b>853.64</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	15	2800	42000	10.24
Fertilize	kg	100	3000	3000000	73.17
Pesticide			10000	10000	2.43
Hire Labour		45	15000	675000	164.63
Draft animal/ Machinery cost			250000	250000	60.98
Threshing cost			200000	200000	48.78
Buying bag			36000	36000	8.78
Transportation cost			106400	106400	25.95
Membership fee for Polder community			50000	50000	12.20
Total Variable Cost					<u>407.16</u>
GROSS MARGIN					<u>446.48</u>
Labor Cost (HH manpower)	Persondays	20	15000	300000	73.17
<b>Net Return Per Ha</b>					<b><u>373.31</u></b>
<b>Net Return Per HH</b>					<b><u>559.97</u></b>

## 5 Vegetable and Supplementary crop budgets

### 5.1 Crop Budget in Prey Nob, Peam Krasob and Toul Korki

#### 5.1.1 Crop Budget of Present Condition in Prey Nob (Unit per ha)

Name of Crop	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
<b>2. Vegetable</b>					
Land holding	ha	0.1			
Yield Kg/ha	Kg	770	1667	1283590	313.07
<b>Total Revenue</b>					<b>313.07</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	8	7500	60000	14.63
Fertilize	kg	0	0	0	0.00
Pesticide		0	0	0	0.00
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>14.63</u>
GROSS MARGIN					<u>298.44</u>
Labor Cost (HH manpower)	Persondays	14	15000	210000	51.22
<b>Net Return per Ha</b>					<b><u>247.22</u></b>
<b>Net Return Per HH</b>					<b><u>24.72</u></b>
<b>3. Supplementary Crop (Corn)</b>					
Land holding	ha	0.1			
Yield Kg/ha	Kg	4000	1600	6400000	1,560.98
<b>Total Revenue</b>					<b>1,560.98</b>
Gross Outgoing					
Production cost					

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Seed	kg	15	8500	127500	31.10
Fertilize	kg	0	0	0	0.00
Pesticide		0	0	0	0.00
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>31.10</u>
GROSS MARGIN					<u>1,529.88</u>
Labor Cost (HH manpower)	persondays	14	15000	210000	51.22
<b>Net Return Per Ha</b>					<b><u>1,478.66</u></b>
<b>Net Return Per HH</b>					<b><u>147.87</u></b>

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### 5.1.2. Crop Budget of Present Condition in Peam Krasob (Unit per ha)

Name of Crop	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
<b>1. Wet Paddy</b>					
Land holding	ha	0.5			
Yield Kg/ha	Kg	1770	1100	1947000	474.88
Straw rice	kg	1770	50	88500	21.59
<b>Total Revenue</b>					<b>496.46</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	69	1667	114456	27.92
Fertilize	kg	50	2700	135000	32.93
Pesticide			16000	16000	3.90
Hire Labour			720000	720000	175.61
Draft animal/ Machinery cost			348000	348000	84.88
Total Variable Cost					<u>325.23</u>
GROSS MARGIN					<u>171.23</u>
Labor Cost (HH Manpower)	persondays	68	15000	1020000	248.78
<b>Net Return Per Ha</b>					<b><u>-77.55</u></b>
<b>Net Return Per HH</b>					<b><u>-38.78</u></b>
<b>2. Vegetable</b>					
Land holding	ha	N/A			
Yield Kg/ha	Kg	800	1687	1349600	329.17
<b>Total Revenue</b>					<b>329.17</b>
Seed	kg	8	15000	120000	29.27
Fertilize	kg	81	2700	219375	53.51
Pesticide		0	0	37125	9.05
Hire Labour		0	0	0	0.00

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Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>91.83</u>
GROSS MARGIN					<u>237.34</u>
Labor Cost (HH Manpower)	persondays	40	15000	600000	146.34
<b>Net Return per Ha</b>					<b><u>91.00</u></b>
<b>3. Supplementary Crop (Corn)</b>					
Land holding	ha	N/A			
Yield Kg/ha	Kg	200	1000	200000	48.78
<b>Total Revenue</b>					<b>48.78</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	3	5500	16500	4.02
Fertilize	kg	20	3500	70000	17.07
Pesticide		0	0	0	0.00
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>21.10</u>
GROSS MARGIN					<u>27.68</u>
Labor Cost (HH Manpower)	persondays	15	15000	225000	54.88
<b>Net Return Per Ha</b>					<b><u>-27.20</u></b>
<b>4. Fruit (Watermelon)</b>					
<i>Gross income</i>					
Farm income					
Land holding	ha	N/A			
Yield Kg/ha	Kg	1875	1500	2812500	685.98
<b>Total Revenue</b>					<b>685.98</b>
Seed	kg	1	7000	7000	1.71

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Fertilize	kg	0	0	0	0.00
Pesticide		0	0	70000	17.07
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>18.78</u>
GROSS MARGIN					<u>667.20</u>
Labor Cost (HH Manpower)	persondays	15	15000	225000	54.88
<b>Net Return Per Ha</b>					<b><u>612.32</u></b>

### 5.1.3. Crop Budget of Present Condition in Toul Korki (Unit per ha)

Name of Crop	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
<b>1. Wet Paddy</b>					
Land holding	ha	0.50			
Yield Kg/ha	Kg	1200	1000	1200000	292.68
Straw rice	kg	1200	50	60000	14.63
<b>Total Revenue</b>					<b>307.32</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	130	1000	130000	31.71
Fertilize	kg			0	0.00
Pesticide				0	0.00
Hire Labour			0	356700	87.00
Draft animal/ Machinery cost				0	0.00
Total Variable Cost					<u>118.71</u>
GROSS MARGIN					<u>188.61</u>
Labor Cost (HH Manpower)	persondays	92.5	15000	1387500	338.41

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<b>Net Return Per Ha</b>					<b><u>-149.80</u></b>
<b>Net Return Per HH</b>					<b><u>-74.90</u></b>
<b>2. Supplementary Crop (Corn)</b>					
<i>Gross income</i>					
Farm income					
Land holding	ha	0.50			
Yield Kg/ha	Kg	200	1000	200000	48.78
<b>Total Revenue</b>					<b>48.78</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	2	7000	14000	3.41
Fertilize	kg	20	3500	70000	17.07
Pesticide		0	0	70000	17.07
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>37.56</u>
GROSS MARGIN					<u>11.22</u>
Labor Cost (HH Manpower)	persondays	15	15000	225000	54.88
<b>Net Return Per Ha</b>					<b><u>-43.66</u></b>
<b>3. Fruit (Watermelon)</b>					
Average Land per HH	ha	0.50			
Yield Kg/ha	Kg	1500	1500	2250000	548.78
<b>Total Revenue</b>					<b>548.78</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	1	70000	70000	17.07
Fertilizer	kg	70	2800	196000	47.80

## Analysis of Economic and Social Costs & Benefits

Pesticide		0	0	70000	17.07
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Total Variable Cost					<u>81.95</u>
GROSS MARGIN					<u>466.83</u>
Labor Cost (HH Manpower)	persondays	15	15000	225000	54.88
<b>Net Return Per Ha</b>					<b><u>411.95</u></b>

## 5.2 Crop Production Budget s for Prey Nob, Toul Totoeng and O Oknha Heng Commune, Prey Nob District :Other Crops

### 5.2.1 Prey Nob Commune

<b>1. Vegetable (Cucumber)</b>					
Land holding	ha	0.3			
Yield Kg/ha (45d/season)	Kg	3330	1000	3330000	812.20
<b>Total Revenue</b>					<b>812.20</b>
<i>Gross Outgoing</i>					
Production cost					
Seed	kg	2	9000	15030	3.67
Fertilize (natural fertilizer)	kg	200	450	90000	21.95
Pesticide		0	90000	90000	21.95
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>176.84</u>
GROSS MARGIN					<u>635.36</u>
Labor Cost (HH manpower)	Persondays	15	15000	225000	54.88
<b>Net Return per Ha</b>					<b><u>580.48</u></b>
<b>Net Return Per HH</b>					<b><u>174.14</u></b>
<b>2. Vegetable (Long Bean)</b>					
Land holding	ha	0.1			
Yield Kg/ha (60d/season)	Kg	3000	1000	3000000	731.71
<b>Total Revenue</b>					<b>731.71</b>
Production cost					
Seed	kg	5	30000	150000	36.59
Fertilize (natural fertilizer)	kg	200	450	90000	21.95
Pesticide		0	90000	90000	21.95

## Analysis of Economic and Social Costs & Benefits

Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>209.76</u>
GROSS MARGIN					<u>521.95</u>
Labor Cost (HH manpower)	Persondays	30	15000	450000	109.76
<b>Net Return per Ha</b>					<b><u>412.20</u></b>
<b>Net Return Per HH</b>					<b><u>41.22</u></b>
<b>3. Vegetable (Yard Long)</b>					
Land holding	ha	0.1			
Yield Kg/ha (60d/season)	Kg	3000	1000	3000000	731.71
<b>Total Revenue</b>					<b>731.71</b>
Production cost					
Seed (own seed)	kg			0	0.00
Fertilize (natural fertilizer)	kg	200	450	90000	21.95
Pesticide		0	90000	90000	21.95
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>173.17</u>
GROSS MARGIN					<u>558.54</u>
Labor Cost (HH manpower)	Persondays	30	15000	450000	109.76
<b>Net Return per Ha</b>					<b><u>448.78</u></b>
<b>Net Return Per HH</b>					<b><u>44.88</u></b>

Note: People normally plant 3 times of crop per year by using the water regulation from O Oknha Heng reservoir.

## Analysis of Economic and Social Costs & Benefits

### 5.2.2 Toul Totoeng Commune

<b>1. Vegetable( Long Bean)</b>					
Land holding	ha	0.1			
Yield Kg/ha (40d/season)	Kg	2000	1800	3600000	878.05
<b>Total Revenue</b>					<b>878.05</b>
Production cost					
Seed (own seed)	kg	7	43000	301000	73.41
Fertilize	kg	100	3000	300000	73.17
Pesticide		0	75000	75000	18.29
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>294.15</u>
GROSS MARGIN					<u>583.90</u>
Labor Cost (HH manpower)	Persondays	30	15000	450000	109.76
<b>Net Return per Ha</b>					<b><u>474.15</u></b>
<b>Net Return Per HH</b>					<b><u>47.41</u></b>
<b>2. Crop (Corn)</b>					
Land holding	ha	0.2			
Yield Kg/ha (60d/season)	Kg	3000	1000	3000000	731.71
Supplementary yield kg/ha (young corn)	kg	1000	1500	1500000	365.85
<b>Total Revenue</b>					<b>1,097.56</b>
Production cost					
Seed (own seed)	kg	20	7000	140000	34.15
Fertilize	kg	100	3000	300000	73.17
Pesticide		0	75000	75000	18.29

## Analysis of Economic and Social Costs & Benefits

Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>254.88</u>
GROSS MARGIN					<u>842.68</u>
Labor Cost (HH manpower)	Persondays	30	15000	450000	109.76
<b>Net Return per Ha</b>					<b><u>732.93</u></b>
<b>Net Return Per HH</b>					<b><u>73.29</u></b>
<b>3. Fruit (Water melon)</b>					
Land holding	ha	0.1			
Yield Kg/ha (60d/season)	Kg	3000	2000	6000000	1,463.41
<b>Total Revenue</b>					<b>1,463.41</b>
Production cost					
Seed (own seed)	kg	7	7000	49000	11.95
Fertilize	kg	100	3000	300000	73.17
Pesticide		0	75000	75000	18.29
Hire Labour		0	0	0	0.00
Draft animal/ Machinery cost		0	0	0	0.00
Water regulation cost (Irrigation)	L	100	5300	530000	129.27
Total Variable Cost					<u>232.68</u>
GROSS MARGIN					<u>1,230.73</u>
Labor Cost (HH manpower)	Persondays	30	15000	450000	109.76
<b>Net Return per Ha</b>					<b><u>1,120.98</u></b>
<b>Net Return Per HH</b>					<b><u>112.10</u></b>

Note: People normally plant 3 times of crop per year by using the water regulation from O Oknha Heng reservoir.

### Annex 2.3 Partial Livestock Budgets

The livestock budgets, which follow below, are calculated based on accessed information from own mini-surveys at the target communities on the Coast. The budgets are considered partial mainly because they appear to be far too profitable compared to e.g. crop production. Communities meanwhile consider crop production their main occupation, but this appears to be doubtful, if these highly profitable livestock budgets were correct.

We therefore consider that these livestock budgets need further investigation, among other as regards: (a) opportunity costs and (b) associated semi-fixed cost for equipments, pen construction and financing – before they could be used in economic assessments.

However, a valuable beginning has been done in a field not otherwise much investigated in Cambodia. Such data as we have, has been collected by own efforts, and do not otherwise appear to be readily available in Cambodia. They are included here in order to preserve them for possible future use.

#### 3.1 Livestock budget in Prey Nob

1. Buffalo	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
Weight increase/year per buffalo	kg	100			
Average Buffalo/HH (1.5 years old)		<u>2.9</u>			
Selling price		<u>290</u>	10000	2900000	707.32
Calf's per adult female/year		0.33	1500000	495000	120.73
Draught cost	Riel/ha			100000	24.39
Income from Natural fertilizer	kg	3132	40	125280	30.56
<b>Total Revenue</b>					<b>883.00</b>
<b>Production Cost</b>					
Purchase feed (Straw)	kg	3596.76	100	359676	87.73
Fodder		0	0	0	0.00
Medicine		5.8	500	2900	0.71
Total Variable Cost					<u>88.43</u>

## Analysis of Economic and Social Costs & Benefits

GROSS MARGIN					<u>794.56</u>
<b>Net Return Per HH or flock</b>					<b>794.56</b>
<b>2. Cattle</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Weight increase/year	kg	75			
Average cattle/HH (1.5 years old)		<u>2.9</u>			
Selling price		<u>217.5</u>	10000	2175000	530.49
Calf's per adult female/year		0.33	1500000	495000	120.73
Draught cost	Riel/ha			100000	24.39
Income from Natural fertilizer	kg	3132	40	125280	30.56
<b>Total Revenue</b>					<b>706.17</b>
<b>Production Cost</b>					
Purchase feed (Straw)	kg	3225.96	100	322596	78.68
Fodder		0	0	0	0.00
Medicine		5.8	500	2900	0.71
Total Variable Cost					<u>79.39</u>
GROSS MARGIN					<u>626.78</u>
<b>Net Return Per HH or Flock</b>					<b>626.78</b>
<b>2. Pig</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Weight increase/year	kg	80			
Average pig/HH		<u>10</u>			
Selling price		<u>800</u>	8000	6400000	1560.98
Young animal/ Female pig		10	200000	2000000	487.80
Income from Natural fertilizer	kg	2700	40	108000	26.34
<b>Total Revenue</b>					<b>2075.12</b>
<b>Production Cost</b>					
Purchase feed	kg	870	3667	3190290	778.12

## Analysis of Economic and Social Costs & Benefits

Durst rice	kg	1950	1000	1950000	475.61
Rice wine	kg	1050	1000	1050000	256.10
Medicine		4	3000	12000	2.93
Total Variable Cost					<u>1512.75</u>
GROSS MARGIN					<u>562.37</u>
<b>Net Return Per HH</b>					<b>562.37</b>
<b>3. Hens</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Average Hens & Chickens per HH/year		20			
Average young /animal/ Year		<u>16</u>			
Average Yield/Chicken (6 months)	kg	1.5			
Selling price		<u>54</u>	12000	648000	
<b>Total Revenue</b>				<b>648000</b>	<b><u>158.05</u></b>
<b>Production Cost</b>					
Purchase feed (rice)	kg	252	960	241920	59.00
Fodder		0	0	0	0.00
Medicine		0	0	0	0.00
Total Variable Cost					<u>59.00</u>
GROSS MARGIN					<u>99.04</u>
<b>Net Return Per animal</b>					<b>99.04</b>
<b>4. Duck</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Average ducks per HH/year		28			
Average young /animal/ Year		<u>10</u>			
Average Yield/animal	kg	1.8			
Selling price	Riel	<u>68.4</u>	8000	547200	133.46
Egg yield	Unit	<u>3360</u>	500	1680000	409.76
<b>Total Revenue</b>				<b>4032000</b>	<b><u>543.22</u></b>

## Analysis of Economic and Social Costs & Benefits

Production Cost					
Purchase feed	kg	342	960	328320	80.08
Fodder		0	0	0	0.00
Medicine					0.00
Total Variable Cost					<u>80.08</u>
GROSS MARGIN					<u>463.14</u>
<b>Net Return Per animal</b>					<b>463.14</b>

### Note:

- Fodder for buffaloes or cattle: There is no budget for fodder (grazing) because buffaloes or cattle have been released at the field and all grass fields are free for them. There may, however be opportunity costs.
- The production system for buffaloes and cattle: Normally, female buffaloes or cattle give 2 calves in 3 years. People use the calf buffaloes or cattle for the next generation and they sell the old buffaloes or cattle when the calves grow up to 1 and half years.
- Production System for pig: The production cycle of pig is 6 months. People will sell all the pig except some piglets for the next production. In this budget we calculate annual budget for the pigs of one household.

### 1. Livestock budget in Peam Krasob

1. Cattle	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
Weight increase/year	kg	62.5			
Average cattle/HH (1.5 years old)		<u>2</u>			
Selling price		<u>125</u>	10000	1250000	304.88
Calf's per adult female/year		0.33	1500000	495000	120.73
Draught cost	Riel/ha			100000	24.39
Income from Natural fertilizer	kg	2160	40	86400	21.07
<b>Total Revenue</b>					<b>471.07</b>
<b>Production Cost</b>					
Purchase feed (straw)	kg	2224.8	100	222480	54.26

## Analysis of Economic and Social Costs & Benefits

Fodder		0	0	0	0.00
Medicine		2	1000	2000	0.49
Total Variable Cost					<u>54.75</u>
GROSS MARGIN					<u>416.32</u>
<b>Net Return Per HH or Flock</b>					<b>416.32</b>
<b>2. Pig</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Weight increase/year	kg	80			
Average pig/HH		4			
Selling price		<u>320</u>	8500	2720000	663.41
Young animal/ Female pig		16	200000	3200000	780.49
Income from Natural fertilizer	kg	540	40	21600	5.27
<b>Total Revenue</b>					<b>1449.17</b>
<b>Production Cost</b>					
Purchase feed	kg	528	1967	1038576	253.31
Durst rice	kg	960	1000	960000	234.15
Rice wine	kg	420	1000	420000	102.44
Medicine		2	3000	6000	1.46
Total Variable Cost					<u>591.36</u>
GROSS MARGIN					<u>857.81</u>
<b>Net Return Per HH</b>					<b>857.81</b>
<b>3. Hens</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Average Hens &Chickens per HH/year		<u>12</u>			
Average young /animal/ Year		<u>16</u>			
Average Yield/Chicken (in 6 months)	kg	1.4			
Selling price		<u>39.2</u>	16000	627200	
<b>Total Revenue</b>				<b>627200</b>	<b><u>152.98</u></b>

## Analysis of Economic and Social Costs & Benefits

<b>Production Cost</b>					
Purchase feed (Own feed)	kg	122	2500	306000	74.63
Fodder					0.00
Medicine					0.00
Total Variable Cost					<u>74.63</u>
GROSS MARGIN					<u>78.34</u>
<b>Net Return Per animal</b>					<b>78.34</b>
<b>4. Duck</b>	<b>Unit</b>	<b>Quantity</b>	<b>Price (Riel)</b>	<b>Values (Riel)</b>	<b>Value U\$</b>
Average ducks/HH		<u>40</u>			
Average young /animal		0			
Average Yield/animal		1.8			
Selling price		<u>72</u>	7000	504000	122.93
Egg yield ( HH consumption)		4800			
Selling price			500	2400000	585.37
<b>Total Revenue</b>				<b>2904000</b>	<b><u>708.29</u></b>
Production Cost					
Purchase feed (Own feed)	kg	360	960	345600	84.29
Fodder					0.00
Medicine					0.00
Total Variable Cost					<u>84.29</u>
GROSS MARGIN					<u>624.00</u>
<b>Net Return Per animal</b>					<b>624.00</b>

### **Note:**

- a) Fodder for buffaloes or cattle: There is no budget for fodder (grazing) because buffalos or cattle have been released at the field and all grass fields are free for them. There may, however, be opportunity costs involved.

## Analysis of Economic and Social Costs & Benefits

- b) The production system for buffaloes and cattle: Normally, female buffaloes or cattle give 2 calves in 3 years. People use the calf buffaloes or cattle for the next production and they sell the old buffaloes or cattle when the young grow up to 1 and half years.
- c) Production System for pig: The production cycle of pigs is 6 months. People will sell all the pigs except some pig for the next production. In this budget we calculate annual production per household.

### 2. Livestock budget in Toul Korcki

1. Buffalo	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
Weight increase/year per buffalo	kg	<u>125</u>			
Average Buffalo/HH (1.5 years old)		3.6			
Selling price		<u>450</u>	10000	4500000	1097.56
Calf's per adult female/year		0.66	1500000	990000	241.46
Draught cost	Riel/ha			100000	24.39
Income from Natural fertilizer	kg	3888	40	155520	37.93
<b>Total Revenue</b>					<b>1401.35</b>
<b>Production Cost</b>					
Purchase feed (straw)	kg	4787.84	100	478784	116.78
Fodder		0	0	0	0.00
Medicine		12	1000	12000	2.93
Total Variable Cost					<u>119.70</u>
GROSS MARGIN					<u>1281.64</u>
<b>Net Return Per HH or flock</b>					<b>1281.64</b>
2. Chicken	Unit	Quantity	Price (Riel)	Values (Riel)	Value U\$
Average Hens & Chickens per HH/year		<u>14</u>			
Average young /animal/ Year		<u>20</u>			
Average Yield/Chicken (in 6 months)	kg	1.3			

## Analysis of Economic and Social Costs & Benefits

Selling price		<u>44.2</u>	16000	707200	
<b>Total Revenue</b>				<b>707200</b>	<b><u>172.49</u></b>
<b>Production Cost</b>					
Purchase feed (Own feed)	kg	256	2500	639000	155.85
Fodder					0.00
Medicine					0.00
Total Variable Cost					<u>155.85</u>
GROSS MARGIN					<u>16.63</u>
<b>Net Return Per HH</b>					<b>16.63</b>

### **Note:**

- a) Fodder for buffaloes or cattle: There is no budget for fodder (grazing) because buffalos or cattle have been release at the field and all grass fields are free for them.
- b) The production system for buffaloes and cattle: Normally, female buffaloes or cattle give 2 calves in 3 years. People use the young buffaloes or cattle for the next generation and they sell the old buffaloes or cattle when the young grow up to 1 and half years.
- c) Production System for pig: The production cycle of pig is 6 months. People will sell all the pigs except some young pigs for the next production. In this budget we calculate annual production per household.

### Annex 2.4 Partial Fisheries Budgets

The fisheries budgets, which follow below, are calculated based on accessed information from own mini-surveys at the target communities on the coast. The budgets are considered partial mainly because they appear to be far too profitable compared to e.g. crop production. Communities meanwhile consider crop production their main occupation, but this appears to be doubtful, if these highly profitable fishries budgets were correct.

We therefore consider that the these fisheries budgets need further investigation, among other as regards (a) opportunity costs and (b) associated semi-fixed cost for equipments, cage construction and financing – before they could be used in economic assessments.

However, a valuable beginning has been done in a field not otherwise much investigated in Cambodia. Such data as we have, has been able to collected by own efforts and do not otherwise appear to be readily available in Cambodia. They are included here in order to preserve them for possible future usage.

#### 3.2.1 Fishing budget in Prey Nob

Margin and Cost	Unit	Quantity	Price (Riel)	Value (Riel)	Value (U\$)
<b>1. Catching Crab (open sea)</b>					
Selling Price (Market Price) kg	kg	1	12000		
Average annual Yield per HH (kg)	kg	600			
Total Revenue				<u>7200000</u>	<u>1756.10</u>
Purchase feed /1kg	kg	600	1500	900000	219.51
Transportation /1kg	kg	600	3530	2118000	516.59
Equipment (net, boat)				2500000	609.76
Total Expense				<u>5518000</u>	<u>1345.85</u>
<b>Gross Margin</b>				<b><u>1682000</u></b>	<b><u>410.24</u></b>
Hire Labor/1kg (HH manpower)	kg	600	5000	3000000	731.71
<b>Net Return</b>				<b>-1318000</b>	<b>-321.46</b>
<b>2. Catching Fish (Open sea)</b>					
Selling Price (Market Price) kg	kg	1	6000		

## Analysis of Economic and Social Costs & Benefits

Average Annual Yield per HH (kg)	kg	800			
Total Revenue				<u>4800000</u>	<u>1170.73</u>
Purchase feed /1kg	kg	200	6000	1200000	292.68
Transportation /1kg	kg	800	1325	1060000	258.54
Equipment (net, boat)				120000	29.27
Repair boat				100000	24.39
Total Expense				<u>2380000</u>	<u>580.49</u>
<b>Gross Margin</b>				<b><u>2420000</u></b>	<b><u>590.24</u></b>
Hire Labor/1kg (HH manpower)	kg	800	3750	3000000	731.71
<b>Net Return</b>				<b><u>-580000</u></b>	<b><u>-141.46</u></b>
<b>3. Rice- fish (fish)</b>					
Average farm size (Ha)		0.5			
Annual Yield (kg)		30			
Average annual yield/ha (kg/ha)	kg	60			
Selling Price (Market Price) kg	kg	1	8000		
Total Revenue				<u>480000</u>	<u>117.07</u>
Purchase feed /1kg	kg	0	0	0	0.00
Transportation /1kg	kg	5	5300	26500	6.46
Equipment (net, boat)				0	0.00
Total Expense				<u>26500</u>	<u>6.46</u>
<b>Gross Margin</b>				<b><u>453500</u></b>	<b><u>110.61</u></b>
Hire Labor (HH manpower)		0	0	0	0.00
<b>Net Return</b>				<b><u>453500</u></b>	<b><u>110.61</u></b>

## Analysis of Economic and Social Costs & Benefits

### 3.2.2 Fishing budget in Peam Krasob

Activities	Unit	Quantity	Price (Riel)	Value (Riel)	Value (U\$)
<b>1. Catching Crab (Open sea)</b>					
Selling Price (Market Price) kg	kg	1	5000		
Annual Yield (kg)/HH	kg	780			
Total Revenue				<u>3900000</u>	<u>951.22</u>
Purchase feed /1kg	kg	780	1000	780000	190.24
Transportation /1kg	kg	780	2400	1872000	456.59
Equipment (net, boat)				395000	96.34
Total Expense				<u>3047000</u>	<u>743.17</u>
<b>Gross Margin</b>				<b><u>853000</u></b>	<b><u>208.05</u></b>
Hire Labor/1kg (HH manpower)	Riel/kg	780	1000	780000	190.24
<b>Net Return</b>				<b>73000</b>	<b>17.80</b>
<b>2. Mari-Culture -Feeding Fish in Cage (m3)</b>					
Average Annual Yield per cage (m3)	kg	400			
Selling Price (Market Price) kg	kg	1	12000		
Total Revenue				<u>4800000</u>	<u>1170.73</u>
Purchase feed /1kg	kg	2376	1000	2376000	579.51
Fingerling	Unit	400	3000	1200000	292.68
Transportation /1kg	kg	0	0	0	0.00
Equipment				95000	23.17
Total Expense				<u>3671000</u>	<u>895.37</u>
<b>Gross Margin</b>				<b><u>1129000</u></b>	<b><u>275.37</u></b>
Hire Labor (HH manpower)	persondays	90	15000	1350000	329.27
<b>Net Return per Cage (m3)</b>				<b>-221000</b>	<b>-53.90</b>

### Analysis of Economic and Social Costs & Benefits

<b>3. Mari-culture (Green Mussel)</b>					
<b>Average Annual Yield per Ha</b>		<b>15000</b>			
Selling Price (Market Price) kg	kg	1	850		
Total Revenue				<u>12750000</u>	<u>3109.76</u>
Purchase feed /1kg	kg	0	0	0	0.00
Transportation	days	180	5300	954000	232.68
Equipment (pole)				8400000	2048.78
Total Expense				<u>9354000</u>	<u>2281.46</u>
<b>Gross Margin</b>				<b><u>3396000</u></b>	<b><u>828.29</u></b>
Hire Labor for collecting (200Riel/Pole)	Pole	15000	200	3000000	731.71
<b>Net Return</b>				<b>396000</b>	<b>96.59</b>

### Annex 3: Economic Calculations (Cash Flows)

#### Demostration Activity 1 and 3

<u>YEAR:</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>NPV</u> 10%	<u>IRR</u>	<u>NPV</u> 5%
Households/year	1200																	
HH (Cumulative)	0	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200			
Income/HH	100	236	236	236	236	236	236	236	236	236	236	236	236	236	236			
Income Increment/year	120000	283200	283200	283200	283200	283200	283200	283200	283200	283200	283200	283200	283200	283200	283200	<b>\$2.005.678</b>		<b>\$2.784.091</b>
Adoption Rate Adj.	0,5	0,7	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75			
Lateral Spread Adj.	1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1			
Income Multiplier	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2			
<b>Income Impact</b>	<b>72000</b>	<b>261676,8</b>	<b>280368</b>	<b>\$1.927.629</b>		<b>\$2.694.725</b>												
<b>Demo Activity 1</b>	<b>-155000</b>	<b>-70000</b>														<b>(\$198.760)</b>		<b>(\$211.111)</b>
<b>Demo Activity 3</b>	<b>-32000</b>															<b>(\$29.091)</b>		
<b>Net Annual Cash Flow</b>	<b>-115000</b>	<b>191676,8</b>	<b>280368</b>	<b>\$1.699.777</b>	193%	<b>\$2.176.671</b>												



## Demonstration Activity 4

																<u>NPV</u>	<u>IRR</u>	<u>NPV</u>	
<u>YEAR:</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	10%		5%	
Households/year	100	50	50	50	50	50	50	50	50	50	50								
HH (Cumulative)	200	150	200	250	300	350	400	450	500	550	600	600	600	600	600				
Income/HH	-50	200	200	200	200	200	200	200	200	200	200	200	200	200	200				
Income Increment/year	-5000	30000	40000	50000	60000	70000	80000	90000	100000	110000	120000	120000	120000	120000	120000	<b>\$504.459</b>		<b>\$766.096</b>	
Adoption Rate Adj.	0,5	0,7	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75				
Lateral Spread Adj.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
Income Multiplier	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2				
<b>Income Impact</b>	<b>-3000</b>	<b>25200</b>	<b>36000</b>	<b>45000</b>	<b>54000</b>	<b>63000</b>	<b>72000</b>	<b>81000</b>	<b>90000</b>	<b>99000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>\$453.889</b>		<b>\$689.283</b>	
<b>Demo Activity 4</b>	<b>-105.000</b>	<b>-70000</b>																<b>(\$153.306)</b>	<b>(\$163.492)</b>
<b>Net Annual Cash Flow</b>	<b>-108000</b>	<b>-44800</b>	<b>36000</b>	<b>45000</b>	<b>54000</b>	<b>63000</b>	<b>72000</b>	<b>81000</b>	<b>90000</b>	<b>99000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>108000</b>	<b>\$300.583</b>	31%	<b>\$525.791</b>	

### Demonstration Activity 5

																<b>NPV</b>	<b>IRR</b>	<b>NPV</b>
<b>YEAR:</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>	<b>2024</b>	<b>2025</b>	<b>2026</b>	<b>2027</b>	<b>10%</b>		<b>5%</b>
Households/year	200																	
HH (Cumulative)	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200			
Income/HH	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90			
Income Increment/year	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	<b>\$136.909</b>		<b>\$186.834</b>
Adoption Rate Adj.	0,5	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9			
Lateral Spread Adj.	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1			
Income Multiplier	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2			
<b>Income Impact</b>	<b>11880</b>	<b>21384</b>	<b>\$154.008</b>		<b>\$212.907</b>													
<b>Demo Activity 5</b>	<b>-50.000</b>															<b>(\$45.455)</b>		<b>(\$47.619)</b>
<b>Net Annual Cash Flow</b>	<b>-38120</b>	<b>21384</b>	<b>\$108.554</b>	<b>56%</b>	<b>\$165.288</b>													