Bern University of Applied Sciences

School of Agricultural, Forest and Food Sciences HAFL

# Cost Benefit Analysis of the Gulf of Mottama Project, Myanmar

**July 2018**

Implemented by

HELVETAS Swiss Intercooperation

Dominique **GUENAT**, PhD
Agricultural Economist,
Head of the Group "International Agriculture" HAFL
Zollikofen, Switzerland

Siham **BOUKHALI**, MBA,
Advisor Financial Sector Development and Business Management
Helvetas, Switzerland

Funded by

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

# Contents

# Abbreviations

| | |
|---|---|
| BANCA | Biodiversity and Nature Conservation Association |
| BCR | Benefit Cost Ratio (see also annex 2) |
| CBA | Cost Benefit Analysis |
| CEA | Cost Effectiveness Analysis |
| CHF | Swiss Franc |
| CNR | Coastal Natural Resources |
| CNRMP | Coastal Natural Resources Management Plan |
| GoM | Gulf of Mottama |
| GoMP | Gulf of Mottama Project |
| HAFL | Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften |
| INGO | International Non-Governmental Organisation |
| IRR | Internal Rate of Return (see also annex 2) |
| IUCN | International Union for Conservation of Nature |
| M&E | Monitoring and Evaluation |
| MMK | Myanmar Kyat (currency) |
| NAG | Network Activity Group |
| NPV | Net Present Value (see also annex 2) |
| RF | Revolving Fund |
| SBS | Spoon-billed Sandpiper |
| SDC | Swiss Agency for Development and Cooperation |
| ToR | Terms of References |
| USD | US Dollar |
| WASH | Water, sanitation and hygiene |
| YAU | Yezin Agriculture University |
| Yr | Year |

# Executive summary

The Gulf of Mottama (GoM) in Myanmar is one of the most important and unique intertidal mudflat ecosystems in the world. Nowadays, this system is heavily under pressure due to climate change and human activities: its biodiversity but also its productivity (agriculture, fishery) is threatened.

The cost benefit analysis of the Gulf of Mottama Project (GoMP) was elaborated during a field visit of the consultants in May 2018. In agreement with SDC, the objective of the mandate formulated by Helvetas was to examine the cost effectiveness of four specific components of the project, namely the rice value chain, the green gram value chain, the fishery value chain as well as the WASH sector.

The project interventions for **paddy** and **green gram** are essentially focusing on primary production, with the introduction of improved varieties and the promotion of better practices. These interventions are expected to improve the yield and quality of the crops.

In the **fishery** value chain, the project focuses on fishermen's activities, with emphasis on specific equipment (ice boxes, appropriate nets) and practices for improved quality of the fish, as well as some activities in fish processing. In addition, the project is involved in a policy dialogue that should contribute to reducing illegal fishery, which is a major cause of the depletion of fish stock in the Gulf.

The **WASH** sector was introduced in the project at the beginning of phase 2, and there is not yet much information on this component yet. The main issues addressed by the project are drinking water supply, awareness raising for hygiene and waste management.

The CBA was done separately for each component, starting at the lowest level of users (farmers, fishermen) and comparing the situation with and without the project. Then the data was aggregated according to the project plans (number of farmers / fishermen involved over time) and the project administrated funds were included at this level of analysis. As a final step, the project management costs were added in a third step to assess the overall performance of the project towards the funds invested by the project and by the local stakeholders. For the WASH sector analysis, the lack of reliable data especially for the quantification of benefits lead us to opt for a Cost Effectiveness Analysis instead of the planned CBA.

The **CBA for paddy** at individual farmers' level shows that the project interventions are profitable, i.e. for the farmers it is worthwhile investing in these improved practices and varieties. The CBA model assumes a substantial yield increase with the project, of +500 kg/ac in direct seeding systems and +650 kg/ac when transplanting the paddy. At project level (including related administrated funds), the performance remains positive (IRR of 20.2%) but this is reached if the number of farmers involved reaches 3'000 after 4 years. Along with the improved performance of farmers, the value chain will benefit from an increased quantity of paddy of higher quality.

Paddy is an important crop in Myanmar, and there is a State subsidy (minimum producer price, access to credit). In an economic analysis, it is likely that the profitability observed in the financial analysis would the challenged.

The **CBA for Green Gram** at individual farmer's level is also positive and encouraging. After aggregating the individual CBAs, the result including related project administrated funds is still highly positive. This is partly due to the modest inputs of the project in the Green Gram value chain. Unlike paddy, Green Gram is not subsidized by the State, therefore the financial analysis is likely to be closer to the result of the economic analysis. The sensitivity analysis shows that the green gram CBA is very robust: the CBA becomes negative if the yield increase with the project is +50kg/ac or less while we assumed a yield increase of +150kg/ac. Export markets seem to be secured for Green Gram, which is an additional asset for this value chain.

The **fishery sector** is very important for the peoples' livelihood in the Gulf. The declining fish stock was simulated in the CBA model when comparing the fishermen with and without the project. The analysis shows a clear advantage with the project, especially over time due to the assumption of a declining fish stock without the project and a stable fish stock with the project.

One problem observed while doing the analysis is that the "without – with" comparison shows positive results even if each option is unprofitable (e.g. very negative CBA for a fisherman without project, and a less negative CBA with the project) would result in a positive result for the project (as the situation has improved!).

Beyond the fishermen, we have also analysed the situation of fish collectors at village level. Here also, improved fish harvest (increased share of bigger, high quality fish and stable quantities) positively impact the fish collectors.

When aggregating the entire value chain, and adding the related administrated project costs, the result remains positive and acceptable with a highly positive NVP, an IRR of almost 38% and a BCR of 1.3. In the last CBA model for fishery, the related share of project management funds was added to the base option, and the result remained positive: highly positive NVP, IRR of almost 28%, and BCR of 1.22. The sensitivity analysis shows that the model is quite sensitive to fish price fluctuations, and to declining fish stock.

In the **WASH sector**, the CEA allows calculating a price per unit of drinking water with a given technology, in our case it was an open pond system. As soon as the information becomes available for other technologies, such as an open well or a deep well, these technologies can also be analysed and furnish similar information.

For the open pond water system, the cost for 1 m3 of drinking water is 1'170 MMK or 7'021 MMK per household for a period of 5 months. For the villagers, the alternative is to buy water from a neighbouring village. In that case they must pay between 1'000 and 1'500 MMK/m3, which is in the same price range as the water produced locally. From the perspective of the villagers, however, the water from the open pond is much cheaper because of the project subsidy allocated for the pond construction, and they have the control over the water, which may not be the case when depending from the neighbouring village.

In chapter 4 a set of recommendations is formulated and the economic analysis (impact of the project on Myanmar's economy) is discussed but not done because of the lack of reliable information.

# 1 Introduction

## 1.1 Background and objectives

Located in the southeast of Myanmar, the Gulf of Mottama (GoM) is one of the most important and unique intertidal mudflat ecosystems in the world. The coastline of the GoM spans 3’000 km; it links the Yangon and Bago Regions to Mon State and receives water and sediments from the Salween, Sittaung, and Yangon Rivers.

The extensive mudflat is home to at least 150’000 water birds, including the Critically Endangered Spoon-billed Sandpiper (SBS), as well as fishes, crustaceans, and other flora and fauna of ecological, conservation, and commercial importance. The floodplains, estuaries, and respective rivers represent spawning and nursery grounds for a wide range of commercially important fish species, like Hilsa, seabass, and croaker, among others. Overall, the ecosystem services of the GoM support the food security and livelihoods of many of the 1’500’000 people living in the eight targeted townships. As such, their current and potential role in poverty alleviation is substantial, especially for the most vulnerable people of the GoM, including landless households.

However, lack of management and uncoordinated governance of these coastal natural resources have led to overexploitation, resulting in massive decline of fisheries stocks, decrease in SBS populations, habitat destruction, and inland salinity intrusion. These multiple impacts and threats increase the vulnerability of coastal rural communities, especially fishers, who seek other livelihoods options and income generating opportunities. In addition, these communities generally lack access to essential services, such as basic infrastructure and domestic water supply. If no action is taken to sustainably manage natural resources and to build resilience of local communities, it is likely that the coastal economy will decline further, livelihood security will be at risk, the potential for conflicts over natural resources will intensify, and environmental degradation and biodiversity loss will further reduce the services provided by the Gulf’s ecosystems.

Recognizing the urgency of the situation, the Government of Myanmar has taken steps to address these issues. With support from the Swiss Agency for Development and Cooperation (SDC), the Gulf of Mottama Project (GoMP) was initiated in 2015, with a first phase running until April 2018, a second phase planned until December 2021, and a third phase expected until December 2024. This long-term initiative is implemented by a consortium comprising HELVETAS Swiss Intercooperation (HELVETAS), the International Union for Conservation of Nature (IUCN), the Network Activities Group (NAG) and as associate partner the Biodiversity and Nature Conservation Association (BANCA).

A major outcome of the Phase 1 project was the development of the Gulf of Mottama Coastal Natural Resources Management Plan (CNRMP), which was developed through a series of community and state/region consultations. The Gulf of Mottama CNRMP provides a framework for the sustained management of the natural resources of the GoM, beyond the activities and timeline of this project. Based on scientific evidence, the implementation of the CNRMP will trigger and support change towards a more sustainable and equitable use and management of the Gulf of Mottama’s coastal resources.

In this context, the project will pursue its interventions and focus Phase 2 on the implementation of the CNRMP, ensuring integrated management and coordinated governance of coastal resources, considering the needs, aspirations and interests of local communities and ultimately resulting in improving livelihoods and conserving biodiversity and ecosystem services.

The GoMP goal is defined as: “The unique biodiversity of the GoM is conserved and sustainably developed in order to benefit human communities that depend on it.” The project is about transforming a system of exploitation of natural resources to make it more sustainable and beneficial in the long term for local communities. Accordingly, the project reflects the global conservation value of the GoM and the opportunity to implement the GoM Coastal Natural Resources Management Plan.

The three outcomes of the project are:

1. Livelihoods are secured and diversified to build communities’ resilience
2. Coastal Natural Resources use is sustainable and well-managed, and biodiversity is conserved
3. Coastal Natural Resources Governance is coordinated and effective, and awareness on the GoM values is raised.

## 1.2 Theory of change

The Specific Objective of the project (or Project Impact) is to ensure the development of an enabling environment for the implementation of the GoM Coastal Natural Resources Management Plan (CNRMP) and support its implementation to result in an improved livelihood security for vulnerable women and men in targeted coastal areas of the GoM. To achieve this objective, the project will support a series of interrelated changes organised around the three major outcomes, building on the management strategies from the GoM CNRMP that refer to livelihoods security, integrated Coastal Natural Resources (CNR) management and coordinated CNR governance. Phase 2 will ensure the CNRMP is understood, locally owned and sustainably implemented.

The project intervention seeks to trigger a process of change and transformation, building people’s resilience, decreasing their vulnerability, and improving their livelihoods. This change will directly contribute to the sustainable use of coastal natural resources and to the implementation of the CNRMC. A general flowchart shows the theory of change for the GoMP (Annex 1). For the components addressed by the CBA, the theory of change looks as follows:

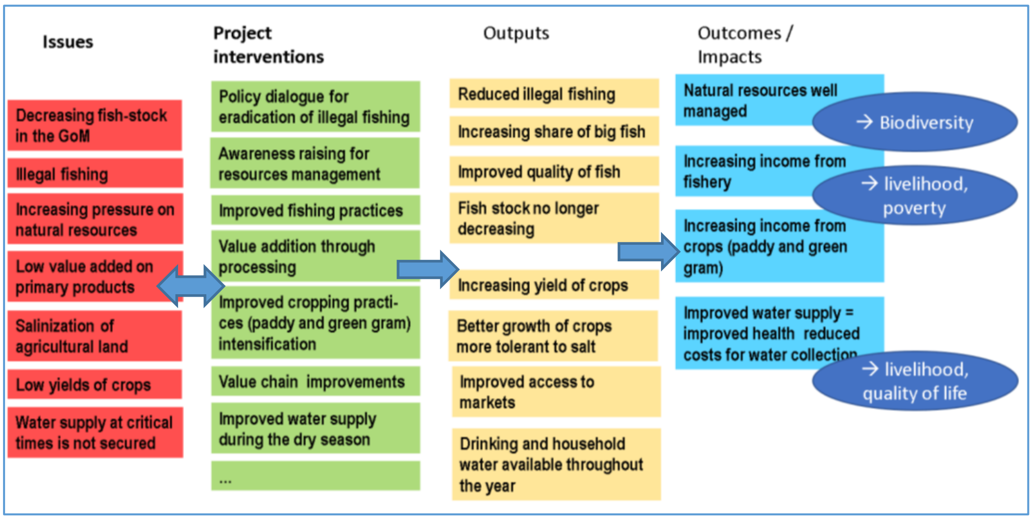


*Figure 1 Illustration of the links between issues, interventions, outputs and outcomes for the topics addressed by the cost benefit analysis (simplified, non-exhaustive)*

## 1.3 Why a cost-benefit analysis?

With a meaningful cost benefit analysis, the GoMP will have a useful tool for its communication with its donor and partners, and it will have a powerful additional tool for its monitoring during phase 2. The CBA provides quantitative information (and projections) that show the performance of a project in relation to the funds invested. The CBA is not only considering the project funds, but also takes into account the additional costs for the beneficiaries and other stakeholders, i.e. all the funds needed to implement the activities.

By promoting the wise use of natural resources in the Gulf of Mottama, and supporting the development of management plans and governance structures, the project contributes to the sustainability of these services in the long term. This is a precondition for sustainable livelihoods in the GoM. To establish detailed cost/benefit calculations for environmental services is known to be difficult, resource-intensive, and still relies on numerous assumptions. Therefore, the project has decided to focus on specific CBAs during Phase 2.

Consequently, the current analysis is an ex-ante analysis that took place at the onset of phase 2 (2018) and at the end of phase 2 (second half of 2021) an ex-post analysis will take place. Both analyses will give a deeper insight in the costs and benefits of these specific activities. At the end of the report, some additional thoughts are proposed regarding an economic analysis, i.e. looking at the impact of the project on the economy of the concerned regions.

Specific tasks and deliverables of the mandate are listed in annex 1 (ToR).

# 2 Methodology

The methodology for the application of CBA / CEA to the Gulf of Mottama project was discussed with the project team during the briefing meeting in Yangon on May 16.

It was agreed that the study would focus on three value chains (paddy, green gram and fishery) as well as on the WASH sector as was specifically agreed with SDC.

## 2.1 Paddy and Green Gram

For both crops, project interventions are focusing on production, with the introduction of improved varieties and the promotion of better practices, which correspond to an intensification of cropping leading to higher yields and better quality (see also figure 1).

In this case we considered the “average paddy farmer” and the “average green gram farmer”, and compared “project farmers” with “non-project farmers”. The average farmers are characterized with key parameters such as crop area, yield, producer price, etc. From the comparison, we can derive “additional costs” and “additional benefits” corresponding to the change induced by the project interventions at farmers’ level. The result is a CBA at the level of a single producer (CBA1). This CBA is then aggregated for all the producers in the project, based on the number of farmers involved in project activities (training, access to inputs, etc.) according to the project objectives over time (CBA2). In a last step, a share of project management costs is added to CBA2, which gives the picture of the project with all costs included (CBA3).

*Table 1 CBA for Paddy and Green Gram*

| CBA | Costs | Benefits | Comment |
| --- | --- | --- | --- |
| CBA1 at farmers' level, for "average farmer" | **Direct additional costs** for the farmers only | **Additional value** of production | This first CBA shows the profitability of the activity at farmers' level; this should correspond to the situation after the project if the activity is sustainable |
| CBA2 aggregated for all the farmers | **direct additional costs** for farmers + **project costs** attributable to crops | **Additional value** of production | The second CBA shows whether the activity is still profitable with project support costs. This is calculated for the entire project area and all the farmers involved |
| CBA3 aggregated for all farmers, including management costs | **direct additional costs** for farmers + **project administrated funds** attributable to crops + **project management costs** (share for crops) | **Additional value** of production | The third CBA shows whether the activity is strong enough to absorb the project management costs attributable to the activity |

As the project interventions towards other value chain stakeholders are not significant, there is no value added besides the increased production and possibly quality that is generated by the producers.

## 2.2 Fishery

The project intervention in the fishery value chain also focuses mainly on the primary production (fishermen). The aim is to at least maintain, if possible reverse the decreasing trend in fishing output and to improve the quality, thus contributing to increased income and to value addition in the fishery value chain.

As we did it in the CBA for crops, we also consider an individual fisherman with or without the project for the first level of CBA. To make it more understandable for non-specialist readers, we first looked at the fishery activity (including all the costs involved in the activity) without (CBA1) and with the project (CBA2), and then we compared the figures (delta CBA fisherman, the difference corresponding to the change induced by the project). The same was done for a village fish collector (CBA3 without the project and CBA4 with the project). Here again the difference between the two is the "delta CBA collector" showing the change induced by the project for the collector.

The "delta CBA fisherman" results were then multiplied by the number of fishermen and the "delta CBA collector" was multiplied by the number of collectors (according to project objectives over time, and the project costs (administrated funds) were added to the local costs in CBA5.

Finally, in CBA6, we have added a share of the project management costs to CBA5, proportional to the share of administrated funds.

*Table 2 CBA for Fishery*

| CBA | Costs | Benefits | Comment |
|---|---|---|---|
| **CBA1** at fisherman's level, for "average fisherman" **without project** | **Direct costs** for the fisherman only, including investment (boat, net, etc.) and operational costs | **Value** of fish caught | CBA1 shows the profitability of the activity at fisherman's level as it is without the project (this corresponds somehow to a baseline). |
| **CBA2** at fisherman's level, for "average fisherman" **with project** | **Direct costs** for the fisherman only, including investment (boat, net, etc.) and operational costs | **Value** of fish caught | CBA2 shows the profitability of the activity at fisherman's level with the project (improved situation). |
| **Delta CBA fisherman,** at fisherman's level, for "average fisherman", with-without comparison | **Additional costs** for the fisherman difference between with and without the project | **Additional benefits,** additional value of the fish caught with the project | This CBA is the difference between CBA2 and CBA1 (net difference between with project and without project) |
| **CBA3** at collector's level, for "average collector" **without project** | **Direct costs** for the collector only, including buying the fish from fishermen | **Value** of fish sold | CBA3 shows the profitability of the activity at collector's level, without the project (this corresponds somehow to a baseline). |
| **CBA4** at collector's level, for "average collector" **with project** | **Direct costs** for the collector only, including buying the fish from fishermen | **Value** of fish sold | CBA4 shows the profitability of the activity at collector's level, with the project (improved situation). |
| **Delta CBA collector,** at collector's level, for "average collector", with-without comparison | **Additional costs** for the collector difference between with and without the project | **Additional benefits,** additional value of the fish sold with the project | This CBA is the difference between CBA4 and CBA3 (net difference between with project and without project) |
| **CBA5** aggregated for all fishermen and collectors | **additional costs** for all fishermen<br>**+ additional costs** for all collectors<br>**+ administrated project** funds allocated to fishery | **Additional benefits** (all fishermen and all collectors) | CBA5 shows the profitability of the project including administrated funds allocated to fishery |
| **CBA6** aggregated for all fishermen and collectors | **additional costs** for all fishermen<br>**+ additional costs** for all collectors<br>**+ administrated project** funds allocated to fishery<br>+ share of **project management costs** | **Additional benefits** (all fishermen and all collectors) | CBA6 shows the profitability of the project including administrated funds allocated to fishery and a share of managements costs attributable to fishery |

**Note**: the future of fishery in the Gulf of Mottama will largely depend on the successful eradication of illegal fishing. It is part of the project outcomes to contribute to this objective. In the CBA models, this effect was simulated by decreasing fish catch over the years without the project, while the fish stock remains unchanged in the scenario with the project.

## 2.3 CEA for WASH

Initially it was planned to do a CBA for the WASH sector as well. However, considering the limited availability of data, the CBA model would have been based almost exclusively on assumptions, even more than for farmers and fishermen, especially in terms of benefits. Therefore, we decided, in agreement with the project team, to analyse the cost effectiveness of this component rather than the cost benefit.

The CEA for the WASH starts at the level of one water supply system (e.g. open pond) and the people (households) that are benefitting from the system. This will be aggregated for all the villages that are using the same system (within the project).

For the CEA the costs that are considered include the following:

- Investment costs (construction of the system)
- Management cost and operations (including maintenance, supervision, etc.)
- Financial costs

The calculation is done over 10 years (as we have done for the CBAs) and the net expenses per year are discounted. The costs may vary from one system to another (also from one village to another) and also over time, the costs may not be constant. These variations will allow comparing the systems under different conditions. The benefits are listed and the relevant indicators for the CEA are identified.

These indicators are categorized in production and consumption assuming that the quantities may differ (in case of overproduction vs needs and also considering the losses due to evaporation). In the model we may also simulate special years (e.g. dry year, not enough water to fill the systems or heavy rain damaging the system, more maintenance required). The calculated indicators are compared to a reference price (costs for the village if they have to buy water). The same calculation can be repeated for each system.

*Table 3 Indicators for the Cost Effectiveness Analysis in the WASH sector*

| | **Production** | **Consumption** | **Reference** |
|---|---|---|---|
| Drinking water | Costs per litre produced<br>Costs per household/yr | Costs per litre consumed<br>Costs per household/yr | Cost per litre bought<br>Costs per household/yr |
| Household water | Costs per litre produced<br>Costs per household/yr | Costs per litre consumed<br>Costs per household/yr | Cost per litre bought<br>Costs per household/yr |

# 3 Results

## 3.1 Paddy

The main crops in the project target areas (townships of Thaton, Bilin and Kyaito in Mon State and townships of Kawa and Thanatpin in Bago Region) are paddy and green gram. Paddy is the main crop for food security, but also for the households' income whereas green gram is grown primarily for sale. The main paddy season is the rainy season (monsoon), some farmers grow a second crop of paddy during the dry season. The area suitable for irrigated paddy is much smaller than the rainfed paddy area. The monsoon paddy is prone to risks – mainly floods, sometimes also draught. Snails and rats were also mentioned as a major threat for the paddy. Depending on the location, the farmers tend to invest more or less in the crop: in high risk areas, minimal investment, therefore intensification (transplanting, improved practices) is only done in low risk locations. Labour shortage is another constraint to crop production.

The project promotes new varieties, better use of fertilisers (organic and mineral) and best cropping practices. The farmers who participate in the project apply the package proposed by the project only on a limited share of their paddy area. The new knowledge is disseminated through farmers' field schools and extension activities. Other value chain stakeholders are also meant to be involved, but so far only limited activities have been done at their level.

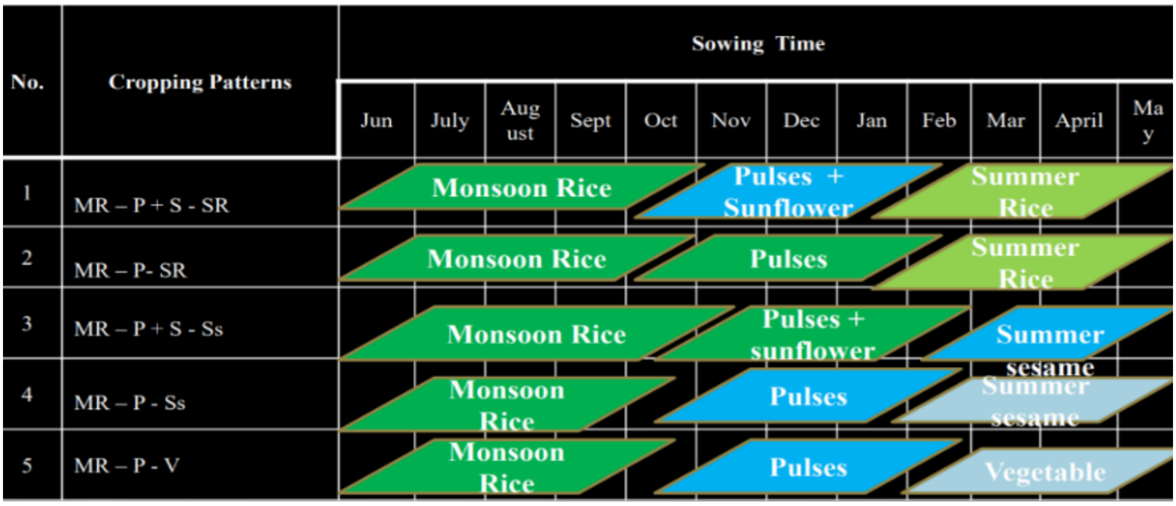


*Figure 2 Cropping pattern in the project area (source: http://ali-sea.org/wp-content/uploads/Crop-Management-in-Nyaung-Oo.pdf)*

The cropping pattern is illustrated in figure 2. This pattern is only applicable on land that can be irrigated. The lack of water is the main reason for not using paddy land after the main crop.

Most farmers get more income from pulses and vegetables grown in the paddy fields. However, agriculture contributes only about 50 – 60 % of the farmers' income. Livestock and off-farm activities are other important sources of revenue. Remittances were mentioned to play a limited role, but this should be further checked.

### 3.1.1 Paddy value chain

The value chain is illustrated in the project document of the GoMP. Figure 3 shows on the value chain chart, where the project interventions are located. In terms of impact on the value chain, if the production is improved, and the market linkages are functioning, then the entire value chain will generate more value.

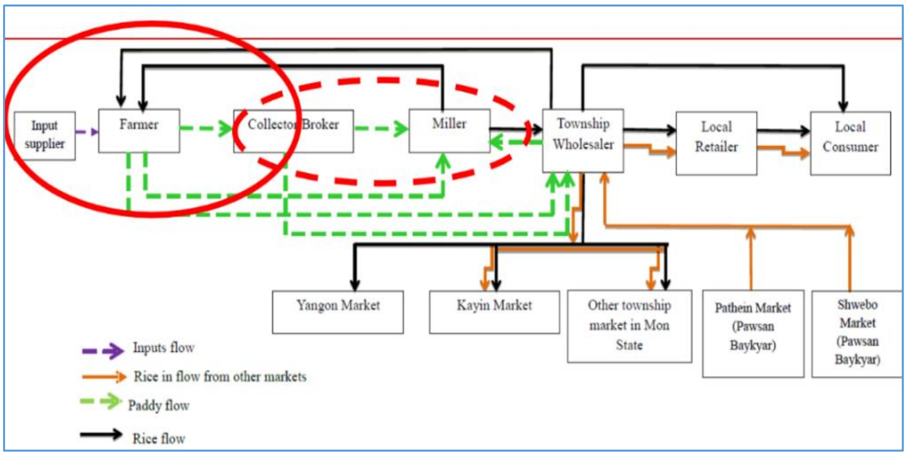


*Figure 3 Paddy value chain in Mon State. Focus of the project interventions are indicated (red and dotted red circles)*

### 3.1.2 Project key figures

The project plans to reach a certain number of farmers who should improve their practices in paddy production, thus achieving higher yield and income. As this activity has already started in phase 1, we integrated the (real) figures of phase 1 (table 4). Beyond phase 2, the number of farmers is kept constant, assuming that those who have adopted the new practices will continue to use them. We also assumed an average area per farmer of 2ac under improved management (from phase 2 onwards).

*Table 4 Project key figures for paddy*

| | | units | --> 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| villages | | number | 27 | 27 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 |
| farmers | | number | 534 | 534 | 1500 | 2000 | 2500 | 3000 | 3000 | 3000 | 3000 | 3000 | 3000 |
| area | | ac | 748 | 748 | 3000 | 4000 | 5000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 |

### 3.1.3 Key parameters – paddy farmers

Table 5 shows the key parameters (what is changing with or without the project) that are used in the calculations. There are two main techniques for paddy production: either direct seeding or transplanting. For the farmers who are seeding directly, the production costs with project will increase by 80’000 MMK compared to the non-project farmers. The difference is due to the cost of improved seeds and improved fertilising. Transplanting is known to be more productive, however it implies a significant increase in workload (nursery, transplanting). Here also there is an increase of production costs of 80’000 MMK between with and without project. To get a more precise picture of the difference in production costs, more detailed data collection and observation will be needed.

*Table 5 Key parameters paddy producers*

| **Costs for average paddy farmer** | | | | |
|---|---|---|---|---|
| | *unit* | *without project* | *with project* | *additional costs considered* |
| **paddy production costs** | | | | |
| - direct seeding | MMK/ac | 70000 | 150000 | 80000 |
| - transplanting | MMK/ac | 120000 | 200000 | 80000 |
| - area per farmer | ac | 4.5 | 1.5** | 2*** |
| - interest rate on credit | % | 12% | 12% | |
| - working capital | MMK | 100000 | 200000 | |
| **yield of paddy** | | | | |
| - direct seeding | kg/ac | 700 | 1200 | 500 |
| - transplanting | kg/ac | 1150 | 1800 | 650 |
| - average yield increase | kg/ac | | | 575 |
| **price of paddy** | | | | |
| - farm gate price for paddy | MMK/kg | 250 | 250 | |
| - rice increase for better quality | MMK/kg | | 0 | |
| *"with project" includes improved varieties, combination of organic and mineral fertilizer, better crop management in gereral. Only monsoon paddy is considered because it covers a far larger area* | | | | |
| *** 1.5ac improved with project (out of 4.5ac)* | | | | |
| **** from the second year, 2ac improved (out of 4.5ac)* | | | | |

At the level of the miller (we visited one rice miller during the field trip in Bilin Township (Mon State) we did not get additional information on value added by the project, except the increased quantity of paddy produced. The CBA model is therefore focused on the primary production only.

### 3.1.4 CBA results

As explained in chapter 2, the first level of analysis is an individual "average" paddy farmer. Only monsoon paddy was considered, as summer paddy is very marginal and would not play a significant role in our model.

*Table 6 CBA for an individual paddy farmer in the project area. In this table the difference between the situations without and with the project are computed*

| **CBA 1 farmers** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **100 000** | **132 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** |
| additional working capital | 100 000 | | | | | | | | | | |
| additional production costs | | 120 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 |
| financial costs | | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **215 625** | **287 500** | **287 500** | **287 500** | **287 500** | **287 500** | **287 500** | **287 500** | **287 500** | **387 500** |
| additional paddy sales | | 215 625 | 287 500 | 287 500 | 287 500 | 287 500 | 287 500 | 287 500 | 287 500 | 287 500 | 287 500 |
| additional value of paddy | | - | - | - | - | - | - | - | - | - | - |
| recovery working capital | | | | | | | | - | | | 100 000 |
| | | | | | | | | | | | |
| **Cash flow** | -100 000 | 83 625 | 115 500 | 115 500 | 115 500 | 115 500 | 115 500 | 115 500 | 115 500 | 115 500 | 215 500 |
| | | | | | | | | | | | |
| **NPV** | 619 275 | | | | | | | | | | |
| **IRR** | 99.58% | | | | | | | | | | |
| **BCR** | 1.55 | | | | | | | | | | |

The result looks very positive (NPV > 600'000, IRR nearly 100% and BCR over 1.5), but we have to consider that in this calculation, only the additional costs at farmers' level are considered, no project costs included. *Note: The common terms used in the Cost Benefit Analysis are explained in annex 2*.

In CBA2 (annex 3), this average farmer is multiplied by the number of farmers expected to change their practices (see table 4). The result is very similar as for the individual farmer, but we have to consider that project costs are not included in CBA2 either:

| | |
|---|---|
| **NPV** | 1 283 870 215 |
| **IRR** | 98.24% |
| **BCR** | 1.46 |

**Why are CBA1 and CBA2 not exactly the same?** We could expect that by multiplying a single farmers' result by a larger number of farmers would result in the same result (IRR and BCR). However, the result is slightly different! This is due to the fact that there is a delay in time, the "new" farmers appear in the CBA model in years 3, 4, 5, etc., i.e. their initial investment appears later in the model, which changes the result of the CBA.

**What do these results tell?** The results show that for the farmers, under the given set of assumptions, it is worthwhile adopting the practices promoted by the project.

In CBA3 (annex 4), we test the robustness of the model by adding the project costs (administrated funds only) that can be attributed to "improvement of the paddy value chain in the Gulf of Mottama".

Here the result remains positive (for the given set of assumptions), but of course it is clearly lower than CBA2, because the benefits are not increasing, only are costs are higher:

| | |
|---|---|
| **NPV** | 367 345 414 |
| **IRR** | 20.21% |
| **BCR** | 1.10 |

When adding the project administrated funds, the CBA remains positive. From the perspective of the donor, this means that investing money in this component of the project is still ok, but should be observed carefully, because the profitability looks fragile. The sensitivity analysis will show how robust this result is, and what could be done to improve the result.

**Sensitivity analysis**

The following hypotheses are tested to assess the CBA model: smaller number of farmers involved from year 2019 onwards, more farmers involved from 2021 onwards, lower yield increase, higher yield increase, decreased area of improved paddy per farmer, increased area per farmer.

The results of these analyses are as follows:

*Table 7 Sensitivity analysis for paddy*

| | **NPV** | **IRR** | **BCR** |
|---|---|---|---|
| Basic scenario (for comparison) | 367 345 414 | 20.21% | 1.10 |
| **Number of farmers** | | | |
| only 2000 farmers from 2019 to 2026 | -22 309 072 | 9.19% | 0.99 |
| 3500 farmers from years 2021 to 2026 | 542 109 136 | 23.63% | 1.14 |
| **Yield increase** | | | |
| +525kg/ac (instead of 575kg/ac) | 23 894 700 | 10.68% | 1.01 |
| +625kg/ac (instead of 575kg/ac) | 710 796 128 | 29.39% | 1.19 |
| **Increased area per farmer** | | | |
| improved paddy per farmer (1.5ac instead of 2ac) | -58 948 848 | 8.29% | 0.98 |
| improved paddy per farmer (2.5ac instead of 2ac) | 793 639 676 | 31.23% | 1.19 |

The result shows that the project could not really afford a reduced number of farmers, e.g. below 2000. The scenario with 2000 farmers from year 2020 until 2026 (instead of 2500 in 2020 and 3000 beyond) has a negative NPV! Almost the same applies if the yield is lower by 50kg/ac than expected (NPV is slightly positive and IRR just above 10%). Finally, if the farmers reduce their paddy area under improved practices by 25% (1.5 ac instead of 2ac/farmer), then the NPV is strongly negative and the IRR is below 9%.

Note that these results were obtained without adding project management costs. Obviously, these could not be absorbed with the given set of assumptions.

## 3.2 Green Gram

### 3.2.1 Value chain

Green gram is grown in the paddy field after harvesting the paddy, as the winter crop. Green gram is essentially a cash crop and it contributes significantly to the household income. Another important difference between the two crops is that the green gram value chain is not controlled by the State, whereas there is a minimum producer price for paddy.

Black gram and green gram are consumed domestically and exported.

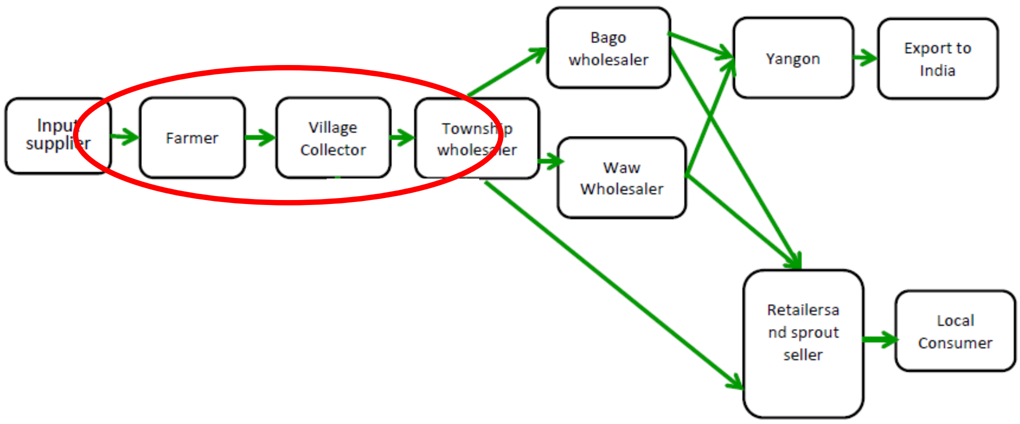


*Figure 4 Green Gram Value Chain Mapping in Mon State and Bago Region[1] with project intervention (focusing in the red circle)*

### 3.2.2 Farmers

Out of 1700 farmers (in 27 villages in phase 1 and 57 villages in phase 2) involved in paddy production, 50% of them are also involved in green gram production (mostly in Bago region); it is a seasonal activity using rice fields (also serving as soil preparation for rice). It is mainly exported to neighbouring countries (China, India, EU and Japan).

The area covered is the same as the paddy (i.e. 4.5 ac/farmers) and the yield is of 0.5t/ha without the project. With the project, farmers are increasing their production by 25% thanks to new techniques

[1] Source: Non-fishery Value Chain report

and introduction of new varieties. The quality of the green gram is also improved thanks to improved crop management, crop protection and post-harvest processing (sorting).

Unlike for paddy, the price of green gram is not regulated by the government.

From the meetings with the farmers, the producers' price for green gram at farm gate was mentioned to be 40,000MMK per basket (33kg) – approx. 1200 MMK per kilo (or 0.8 USD/kg). The selling price (wholesale market) was comprised between 900 and 1100 USD per T (0.9 - 1.1 USD/kg).

### 3.2.3 Collector of green gram

The mission met one green gram collector in Kawa Township. The green gram trade seems to be a profitable business especially in view of the strong international demand. This collector is also supplying inputs to farmers. He is working with some village collectors for green gram. The volume of sales of this collector reaches 7'000 to 9'000 tonnes per year. Collectors are important value chain stakeholders, but the project does not intervene directly at their level. Therefore, the value added for the value chain comes from improvements at the level of primary production.

### 3.2.4 CBA for green gram

From this initial data, a CBA for an average green gram producer was elaborated (CBA1).

The key parameters for a green gram farmer are based on many assumptions and data collected during the farmers' meetings as it appears in table 8.

*Table 8 Key parameters for green gram producers*

| **Key parameters for green gram farmers** | | | | |
|---|---|---|---|---|
| | *unit* | *without project* | *with project* | *additional costs with project* |
| **production costs** | | | | |
| - working capital | MMK | 100 000 | 200 000 | 100 000 |
| - direct seeding | MMK/ac | 80 000 | 120 000 | 40 000 |
| - labour | MMK/ac | 60 000 | 100 000 | 40 000 |
| - area per farmer | ac | 4.5 | 0.5** | 1.5*** |
| - interest rate on credit | % | 12% | 12% | |
| | | | total additional costs | 80 000 |
| **yield of green gram** | | | | |
| - direct seeding | kg/ac | 450 | 600 | |
| - average yield increase | kg/ac | | 150 | |
| **price of green gram** | | | | |
| - farm gate price for green gram | MMK/kg | 1 200 | 1 320 | |
| - price increase for better quality | % | | 10% | |
| "with project" includes improved varieties, combination of organic and mineral fertilizer, better crop management in general.<br>Note: In the Excel model, all the parameters with a yellow background can be modified.<br>** with project, 0.5ac (out of 4.5ac) will be improved in the first year<br>*** from the second year onwards, 1.5ac (out of 4.5ac) will be improved | | | | |

We assumed an increase of production costs of about 80'000 MMK/ac and a corresponding yield increase of 150kg/ac (+25%). We also assumed a price increase of 10% for better quality due to better crop management and sorting / cleaning after harvest.

Out of these key parameters, additional costs and benefits were calculated to conduct the CBA at the farmer's level (table 9).

*Table 9 CBA1 for green gram producers*

| **CBA 1 farmers - green gram** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **100 000** | **52 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** | **172 000** |
| additional working capital | 100 000 | | | | | | | | | | |
| additional production costs | | 40 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 |
| financial costs | | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **99 030** | **396 120** | **396 120** | **396 120** | **396 120** | **396 120** | **396 120** | **396 120** | **396 120** | **496 120** |
| additional green gram sales | | 99 000 | 396 000 | 396 000 | 396 000 | 396 000 | 396 000 | 396 000 | 396 000 | 396 000 | 396 000 |
| additional value of green gram | | 30 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| recovery working capital | | | | | | | | - | | | 100 000 |
| | | | | | | | | | | | |
| **Cash flow** | -100 000 | 47 030 | 224 120 | 224 120 | 224 120 | 224 120 | 224 120 | 224 120 | 224 120 | 224 120 | 324 120 |
| | | | | | | | | | | | |
| NPV | 1 154 684 | | | | | | | | | | |
| IRR | 125.52% | | | | | | | | | | |
| BCR | 2.10 | | | | | | | | | | |

With a positive NPV (calculated with a discount rate of 10%), an IRR of 126%, and a benefit cost ratio above 2, this is an excellent result, demonstrating that it is worthwhile for farmers to get involved in green gram production.

As we calculated for the paddy value chain, the next step (CBA2) is the aggregation of the farmers considering the number of farmers to be involved by the project during the coming phase. This data is presented in table 10.

*Table 10 Key figures for green gram*

| | **units** | ***--> 2016*** | ***2017*** | ***2018*** | ***2019*** | ***2020*** | ***2021*** | ***2022*** | ***2023*** | ***2024*** | ***2025*** | ***2026*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| villages | number | 27 | 27 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| farmers | number | 267 | 267 | 750 | 1000 | 1250 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |
| area | ac | 748 | 748 | 3000 | 4000 | 5000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 |
| additional green gram production | tonnes | 112.2 | 112.2 | 450 | 600 | 750 | 900 | 900 | 900 | 900 | 900 | 900 |
| additional farmers (yearly increase) | | | 267 | 483 | 250 | 250 | 250 | 0 | 0 | 0 | 0 | 0 |

The results of CBA2 (annex 5) are similar to CBA1, the differences between CBA1 and CBA2 are explained above in the paddy section.

| | |
|---|---|
| **NPV** | 1 194 823 804 |
| **IRR** | 140.73% |
| **BCR** | 1.78 |

For green gram, the project inputs are comparatively modest, therefore, even after adding the administrated costs, the CBA results remain very good (CBA3).

| | |
|---|---|
| **NPV** | 1 007 545 245 |
| **IRR** | 79.61% |
| **BCR** | 1.58 |

Testing the robustness of the model is the last step, with the sensitivity analysis. In the case of green gram, we decided to test the following parameters: reduced number of farmers (with only 1000 farmers from 2019 until 2026, then only 750 farmers and finally only 500 farmers). Lower yield increase (only +50kg/ac and then +100kg/ac instead of +150kg/ac). Finally, no price increase instead of the expected 10% increase.

*Table 11 Sensitivity analysis for the green gram value chain*

| | NPV | IRR | BCR |
|---|---|---|---|
| basic scenario (for comparison) | 1 007 545 245 | 79.61% | 1.58 |
| **number of farmers involved** | | | |
| only 1000 farmers 2019 - 2026 | 632 614 724 | 71.37% | 1.44 |
| only 750 farmers 2018 - 2026 | 383 372 263 | 58.58% | 1.31 |
| only 500 farmers 2018 - 2026 | 87 410 794 | 25.71% | 1.09 |
| **Yield increase** | | | |
| only +100kg/ac instead of 150kg/ac | 116 787 884 | 19.57% | 1.07 |
| only +50kg/ac | -773 969 477 | #NUM! | 0.55 |
| **Price increase** | | | |
| 0 instead of +10% | 763 820 104 | 64.71% | 1.44 |

The analysis shows that with decreasing yields, the profitability is drastically reduced, and at a level of about +50kg/ac, it becomes negative (NPV is negative, IRR cannot be calculated, BCR is below 1). The price of green gram is also an influential factor: without any price increase, the profitability is reduced (but still positive).

## 3.3 Fishery value chain

As explained in chapter 2.2, the first level of analysis compares a fisherman with and without the project. In this case we started by calculating the CBA for the fishery activity as a whole, and not only the difference (additional costs and additional benefits) between the situation with and without the project.

### 3.3.1 Key parameters for fishermen

*Table 12 Key parameters for fishermen in the project area*

| Caution: only yellow boxes should be modified for the sensitivity analysis; all other cells are calculated and the spreadsheet is likely to be corrupted if you modify other cells | | | | |
|---|---|---|---|---|
| **Costs for average fisherman** | *unit price (MMK)* | *lifespan (yrs)* | *number without project* | *number with project* |
| fishing boat | 700 000 | 6 | 0.6 | 1 |
| engine | 260 000 | 7 | 1 | 1 |
| net | 1 000 000 | 3 | 1 | 1 |
| box (fibre) | 120 000 | 4 | 0 | 1 |
| box (polystyrene) | 5 000 | 2 | 1 | 0 |
| | *MMK/year* | | | |
| ice | 160 000 | | 0.2 | 1 |
| fuel | 225 000 | | 1 | 1.25 |
| labour | 800 000 | | 0.8 | 1 |
| financial costs | 200 000 | | 1 | 1.2 |

**Assumptions regarding the costs**

Table 12 compares the costs for a “new” fisherman who wants to start the fishing activity. For that he needs the equipment (boat, engine, net, box). If the fisherman does it the traditional way, we assumed he would buy a cheaper boat (therefore 0.6 x 700’000MMK = 420’000MMK) whereas the fisherman under the project will buy a newer one (700’000MMK). Both need an engine, a net (most expensive item for them with 1’000’000MMK) and a box to keep the fish. The “non-project fisherman” will buy a cheap box and only a bit of ice, while the "project fisherman" will buy a fibre box (promoted by the project) and he will buy enough ice to keep the fish fresh.

**Assumptions regarding the benefits**

For the benefits, the basic assumption is that both fishermen will catch 1 tonne of fish during the first year, and a share of 10% big fish and 90% small fish. Without the project, i.e. without actively reducing illegal fishing, we assumed a yearly decrease in fish catch of 5%, while with the project, this would not happen (we assumed 0% decrease). In addition, without the project, the share of large fish would remain 10% of total fish catch, while with the project, this share would increase due to improved practices, adapted nets, and as a positive consequence of the control of illegal fishing.

The fish price would also change with the project, because of improved conditions of fishing (fibre boxes and ice). We assumed a (producer) price of 4'500MMK/kg and 1'800MMK/kg respectively for large and small fish, and an increase of these prices with the project of respectively 10% and 15% (table 13).

*Table 13 Assumptions for fishermen, with and without the project*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Caution: only yellow boxes should be modified for the sensitivity analysis, all other cells are calculated and the spreadsheet is likely to be corrupted if you modify other cells | | | | | | | | | | | | | |
| **Costs for average fisherman** | | | | | | | | | | | | | |
| | *unit price (MMK)* | *lifespan (yrs)* | *number without project* | *number with project* | | | | | | | | | |
| fishing boat | 700 000 | 6 | 0.6 | 1 | | | | | | | | | |
| engine | 260 000 | 7 | 1 | 1 | | | | | | | | | |
| net | 1 000 000 | 3 | 1 | 1 | | | | | | | | | |
| box (fiber) | 120 000 | 4 | 0 | 1 | | | | | | | | | |
| box (polystyrene) | 5 000 | 2 | 1 | 0 | | | | | | | | | |
| | *MMK/year* | | | | | | | | | | | | |
| ice | 160 000 | | 0.2 | 1 | | | | | | | | | |
| fuel | 225 000 | | 1 | 1.25 | | | | | | | | | |
| labour | 800 000 | | 0.8 | 1 | | | | | | | | | |
| financial costs | 200 000 | | 1 | 1.2 | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Fishing results** | *units* | | *number without project* | *number with project* | | | | | | | | | |
| total fish catch | kg/year | 1000 | *2017 - 26* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| big fish catch | % | | 10% | 10% | 11.2% | 12.5% | 14.0% | 15.7% | 17.6% | 19.7% | 22.1% | 24.8% | 27.7% |
| % increase | % | | 0% | 12% | | | | | | | | | |
| small fish catch | % | | 90% | 90% | 88.8% | 87.5% | 86.0% | 84.3% | 82.4% | 80.3% | 77.9% | 75.2% | 72.3% |
| evolution fish catch without project | %/year | -5% | | *1000* | *950* | *903* | *857* | *815* | *774* | *735* | *698* | *663* | *630* |
| evolution fish catch with project | %/year | 0% | | *1000* | *1000* | *1000* | *1000* | *1000* | *1000* | *1000* | *1000* | *1000* | *1000* |
| sales price big fish | MMK/kg | 4 500 | 4 500 | 4 950 | | | | | | | | | |
| sales prce small fish | MMK/kg | 1 800 | 1 800 | 2 070 | | | | | | | | | |
| price increase with project (high value fish) | | | | 10% | | | | | | | | | |
| price increase with project (low value fish) | | | | 15% | | | | | | | | | |

### 3.3.2 CBA fisherman

Based on these key parameters and assumptions above, the CBA (annex 7) for the average fisherman with and without the project were calculated. The results are the following.

| **CBA1** | **Without the project** | **CBA2** | **With the project** |
|---|---|---|---|
| **NPV** | 43 319 | **NPV** | 2 152 394 |
| **IRR** | 10.99% | **IRR** | 30.36% |
| **BCR** | 1.00 | **BCR** | 1.16 |

The result shows that the fisherman without the project is at the limit of profitability, with an IRR just above the discount rate. With the project, the situation is clearly better, the NPV is highly positive and the IRR is much higher (30.36%). The BCR is also clearly above 1. However, these results do not include any project cost at this stage.

To assess the impact of the project, we have to look at additional costs and additional benefits, i.e. the difference between CBA2 and CBA1. This gives the following picture:

| Delta CBA for fishermen (with – without project) | |
|---|---|
| **NPV** | 2 109 075 |
| **IRR** | 58.57% |
| **BCR** | 1.74 |

In this table, the NPV delta is the difference between NPV CBA2 – NPV CBA1. This IRR is much higher because, with comparatively small additional costs, high benefits can be achieved. In other words, for the fishermen, it is clearly profitable to adopt the project practices.

### 3.3.3 Village fish collector

The village fish collectors play an important role for the fish value chain. They provide advance payments to the fishermen, buy their fish and sell them to their market partners. The project does not directly intervene at fish collectors' level, their benefits from the project are therefore indirect: increased benefits because of the higher share of big fish, because of the maintained volume of fish catch, and because of improved quality due to better boxes and ice. This is a business where the collectors are also involved: supply of ice to the fishermen.

### 3.3.4 Key parameters for fish collectors

*Table 14 Key parameters for village fish collector, with and without project*

| Projected situation for average village fish collector (with project vs without project) | *unit* | *0* |
|---|---|---|
| working capital (without project) | MMK | 10 000 000 |
| working capital with project | MMK | 15 000 000 |
| share of high value fish | % | 10% |
| increase with project | %/year | 5% |
| share of low value fish | % | 90% |
| fish volume (at the beginning) | t/year | 12 |
| evolution (without project) | %/year | -5% |
| evolution (with project) | %/year | 0% |
| ice volume | t/year | 20 |
| buying price high value fish (without project) | MMK/kg | 4 500 |
| buying price high value fish (with project) | MMK/kg | 4 950 |
| selling price high value fish (without project) | MMK/kg | 5 300 |
| selling price high value fish (with project) | MMK/kg | 5 936 |
| price increase with project (buying) | % | 10% |
| price increase with project (selling) | % | 12% |
| buying price low value fish (without project) | MMK/kg | 1 800 |
| buying price low value fish (with project) | MMK/kg | 2 070 |
| selling price low value fish (without project) | MMK/kg | 2 100 |
| selling price low value fish (with project) | MMK/kg | 2 520 |
| price increase with project (buying) | % | 15% |
| price increase with project (selling) | % | 20% |
| buying price ice | MMK/100kg | 6 000 |
| selling price ice | MMK/100kg | 7 500 |
| storage & marketing | MMK/year | 400 000 |
| advance to fishermen | MMK/year | 3 000 000 |
| financial costs | MMK/year | 0 |

The key parameters used as assumptions for the CBA (table 14) are connected to the key parameters for fishermen. The fish buying price (collector) corresponds to the fish selling price (fishermen). Along the parameters for fishermen, the share of big fish and its evolution follow the same trend. The selling price of the fish was set 1'000 MMK/kg higher than the buying price (margin of the collector).

Here also we have calculated a "delta CBA fish collector" corresponding to CBA4 – CBA3.

### 3.3.5 CBA village fish collector

For the fish collector without project (**CBA3,** annex 8) the result is poor and it reflects the statements of the people we met about the negative trend in fishing. The mentioned influence of illegal fishing seems to play a crucial role. With such a poor CBA result, it would not be a surprise to see many fish collectors leaving the activity and look for a better livelihood option.

**CBA4** (with the project, annex 8) looks much better! This is not a surprise as the collectors have more fish of better quality for sale. Improving the fishermen's and the collectors' situation seems to go hand in hand. This will have to be verified in the field!

| **CBA3** | **Without the project** | **CBA4** | **With the project** |
|---|---|---|---|
| **NPV** | 8 212 347 | **NPV** | 28 134 642 |
| **IRR** | 30.33% | **IRR** | 40.12% |
| **BCR** | 1.06 | **BCR** | 1.14 |

Finally, the **delta CBA for fish collectors** looks pretty good:

| **Delta CBA for fish collectors (with – without project)** | |
|---|---|
| **NPV** | 15 200 528 |
| **IRR** | 51.10% |
| **BCR** | 1.24 |

Note that the number of fish collectors is not important in this calculation: the volume and the value of the fish is the determining factor.

### 3.3.6 CBA with administrated project funds

The next step consists in aggregating all the additional costs (fishermen, fish collectors **and project administrated funds for fishery**) and additional benefits for all the involved fishermen and fish collectors in the coming 10 years. The result of CBA5 (annex 9) is the following:

| **CBA5 adding project administrated funds** | |
|---|---|
| **NPV** | 8 849 612 425 |
| **IRR** | 37.97% |
| **BCR** | 1.30 |

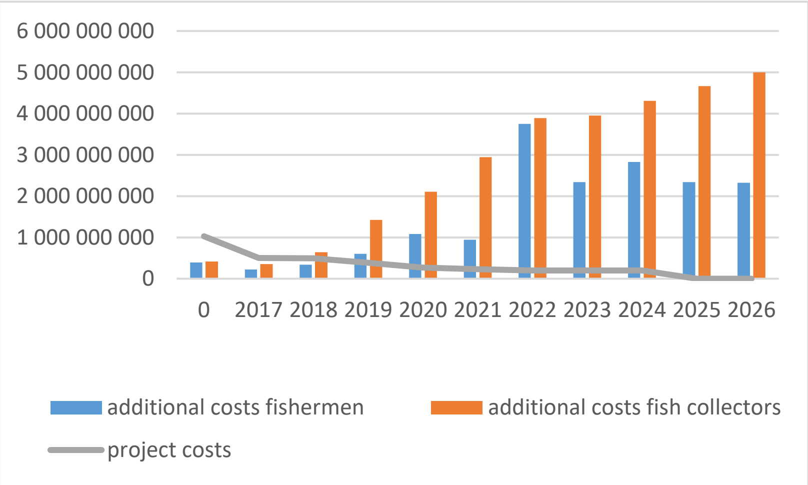


*Figure 5 Evolution of project costs during the project and beyond*

The first observation concerns the NPV: the amount is rather large (6.5 million USD)! This is because with the project contribution, significant private investments (by the fishermen and collectors) have been encouraged, and the fishing activity (with improvements promoted by the project) is profitable. This is illustrated in figure 5. Then the IRR is rather high (37.97%), explained by the high volume of fish and the high value added. Finally, the BCR is also excellent with a ratio of 1.3.

In figure 5, it appears that the fishermen have a peak of additional costs in 2022, this is because in the model, for the sake of simplification, we have planned a replacement of the fishing boats in that year.

### 3.3.7 CBA with administrated and management costs

Finally, the last step consists of integrating the corresponding share of project management costs. For the fishery, we included about 2.1 million USD over the entire project period. The result of CBA6 is the following:

| CBA6 adding project management costs | |
|---|---|
| **NPV** | 6 770 160 848 |
| **IRR** | 27.92% |
| **BCR** | 1.22 |

The good news: the result remains positive, it looks even rather good! The sensitivity analysis will tell how solid the model for the fishery value chain is.

### 3.3.8 Sensitivity analysis fishery value chain

The sensitivity analysis should be done in several steps because the CBA model is rather complex. In a first step, we will start again at the level of the individual fisherman, with the following parameters tested: fish catch per year (kg/year); buying price of big fish and small fish

***CBA1: what factors are likely to push fishermen out of business?***

| **Scenario** | Base | 10% reduced catch per year | Buying price big fish -500/kg | Buying price small fish -300/kg | Lower negative trend in fish stock (-3%/year instead of -5%) |
|---|---|---|---|---|---|
| | **CBA1** | **CBA1** | **CBA1** | **CBA1** | **CBA1** |
| **NPV** | 43 319 | -1 018 123 | -213 068 | -1 341 171 | 824 901 |
| **IRR** | 11% | #NUM! | 5% | #NUM! | 23% |
| **BCR** | 1.00 | 0.90 | 0.98 | 0.87 | 1.08 |

This analysis is very clear! Catching 10% less fish would make the activity unprofitable. The model is also very much price sensitive, as a reduction of 500MMK/kg for big fish would make the NPV negative, and a reduction of 300MMK/kg for small fish would also have a very negative consequence. If the negative trend in fish stocks (estimated at 5% per year in the base CBA model) would be less drastic (here we have tested -3%/year) then the fishermen would be a bit better off, even without the project (or the project doing only policy dialogue to reduce illegal fishing).

***CBA2: what reduces the attractiveness of project interventions for individual fishermen?***

For this analysis, we have examined the same parameters as for CBA1. We have also checked the influence of "no price increase for project fish" (rewarding the better quality), and a scenario where the policy dialogue has no effect (trend of reduced fish stock same as without the project).

| Scenario | Base | 10% reduced catch per year | Selling price big fish - 500/kg | Selling price small fish - 300/kg | Selling price for fish same as without the project | Illegal fishing not under control, -5% fish stock/year |
|---|---|---|---|---|---|---|
| | CBA2 | CBA2 | CBA2 | CBA2 | CBA2 | CBA2 |
| NPV | 2 152 394 | 596 157 | 1 609 437 | 373 101 | 315 666 | -2 057 181 |
| IRR | 30% | 16% | 26% | 14% | 13% | #NUM! |
| BCR | 1.16 | 1.04 | 1.12 | 1.03 | 1.02 | 0.85 |

The results are interesting! The "project fishermen" are in general more resilient to external shocks (fish catch, price). But if illegal fishing cannot be reduced with the project, then the fishermen will be in a situation that is worse than non-project fishermen, because they have invested more in the activity.

***CBA3 and CBA4, what are the factors that determine the success of fish collectors?***

A fish collector is a trader at village level. The activity depends logically on the volume, on the prices and on the margin. There parameters are checked at the level of an "average fish collector".

| Scenario | Base | | 8 t instead of 12 t per year | | Margin on fish sales (-50%) | | Share of big fish 20% instead of 10% | |
|---|---|---|---|---|---|---|---|---|
| | CBA3 | CBA4 | CBA3 | CBA4 | CBA3 | CBA4 | CBA3 | CBA4 |
| NPV | 8 212 347 | 28 134 642 | 1 373 695 | 15 479 326 | -5 464 957 | -1 536 366 | 11 143 198 | 32 919 929 |
| IRR | 30% | 40% | 14% | 27% | -8% | 8% | 37% | 45% |
| BCR | 1.06 | 1.14 | 1.01 | 1.11 | 0.94 | 0.99 | 1.07 | 1.14 |

The result shows that fish collectors with the project are a bit better off than those without the project, but there is no big difference. Nevertheless, the NPV is always much higher for the "project collector" compared to the "non-project collector". An increase of the share of big fish has a positive effect on the collectors.

***CBA5, CBA6 including administrated costs, and project management costs***

Having aggregated all the fishermen and collectors, the model englobes the entire value chain (at least the elements of it that we could capture). The sensitivity analysis is looking at similar parameters as above, but in addition the project dimension becomes an important issue. The following factors were tested in the sensitivity analysis at this level: fish stock reduction; number of fishermen, volume of fish marketed (fish catch per fisherman), share of big fish, sales' price of fish.

| Scenarios | CBA5 incl. administrated project costs | | | CBA6, incl. administrated + management costs | | |
|---|---|---|---|---|---|---|
| | NPV | IRR | BCR | NPV | IRR | BCR |
| Base | 8 849 612 425 | 38% | 1.30 | 6 770 160 848 | 28% | 1.22 |
| Fish stock reduction only 2%/year* | 1 293 666 007 | 16% | 1.06 | -785 785 570 | 7% | 0.97 |
| Number of fishermen (-50%) | 3 054 854 512 | 24% | 1.19 | 975 402 935 | 14% | 1.05 |
| No fish price increase with project | 962 574 427 | 13% | 1.04 | -1 116 877 150 | 7% | 0.96 |

* fish stock reduction is estimated to be 5% per year without the project (ref. 3.3.4), and 0% with the project. This scenario tests partly successful policy dialogue leading to a reduction of -3% per year with the project as compared to -5% without the project

The sensitivity analysis shows the importance of the policy dialogue. Successful policy dialogue is expected to stop the declining trend in fish catch, and an increasing share of big fish. If this is only partly successful, then the results of CBA5 become much lower (but still acceptable) while the CBA6 results show a negative NPV. Reducing the number of fishermen by 50% - which also means a reduction of the fish volume in the value chain – has a clear impact on the CBA5 and CBA6 results, but not enough to "kill the model". Finally, if the average fish price does not increase with the project (this is expected to be the case because of improved quality of the fish and less waste due to improved ice boxes), then the CBA5 and CBA6 results are low, respectively negative.

## 3.4 Water, sanitation and hygiene (WASH)

In the WASH sector, some activities have been initiated during phase 1, but the sector will be really integrated in the project from phase 2. Therefore, there was only very limited data available, and also the intentions of the project about what exactly will be the activities are not very clear.

From the field visit (to the village of Koe Tae Sue in Mon State), we got the following information: the main livelihood activities in this village are mud crabs collection, fishery and livestock. The village is a resettlement area, where people from another village that was destroyed by the sea have been resettled. This created some conflicts with the residents of this village, especially due to a shortage of drinking water. The local practice for water supply consists of collecting water from the roof and storing it in a tank near the house. This water is sufficient for the household needs for 8 months. The remaining 4 months, they have to buy water from a neighbouring village. They have two ponds in the village, but with the arrival of the resettlers, this has become insufficient. The project response to this situation was the construction of 2 new open pond water systems.

### 3.4.1 Open pond water system in Mon State

The open pond water system is filled with rain water only, there is no other water inflow. The pond size is 1’100 m2 with a depth of 1,8 m, i.e. a capacity of about 2’000 m3.

The costs of construction of the pond were 4 million MMK, of which the project paid 80%, the local community the remaining 20%. Maintenance costs were estimated to be 1 million MMK/year and management costs 0.5 million/year. The system is meant to supply enough water for 200 households during the 5 driest months.

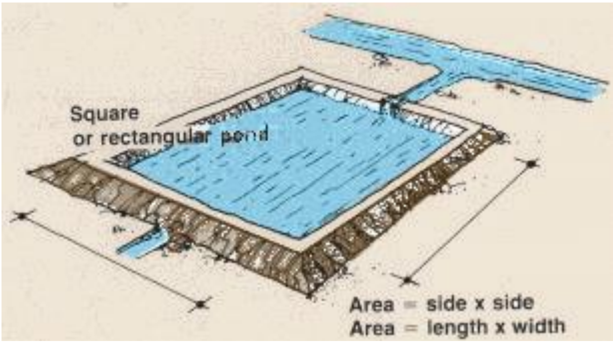


*Figure 6 Open pond system from the literature (source: http://www.fao.org/fishery/static/FAO_Training/FAO_Training/General/x6705e/x6705e02.htm)*

### 3.4.2 Open well for household water

Another system existing in the project area is the open well. This system provides only household water, no drinking water. Technically, this system consists of superposed rings that form the well. In Myanmar, each ring costs 50’000 MMK, i.e. for a well that requires 10 rings, the material costs will be 0.5 million MMK. Adding labour costs and other construction work will lead to an investment of about 1 million MMK. Unfortunately, we do not have any information about the functioning of the well: inflow sources, capacity, water supply volume.

### 3.4.3 Deep well for drinking water

The deep well is the most expensive of the three systems that were mentioned within the framework of the GoMP. There is an example of a deep well that required an investment of 7 million MMK, of which 3 million MMK were for the construction of the well itself, the remaining 4 million MMK were for a small water tower, and distribution network. Here also we have no information about the output and capacity of the well.

### 3.4.4 Water needs

In the project area, the people make a clear distinction between drinking water and household water. The open pond system is meant to supply drinking water; however, this is not always possible. The quantity of water needed in the project area per household was estimated as follows:

- ➔ 40 litres drinking water per hh per day
- ➔ 250 litres household water per hh per day

The quantity of household water may seem high, however the people said that due to the high salt content of the water, more water is needed, e.g. rinsing water for washing clothes.

### 3.4.5 Cost calculation for drinking water from the open pond system

For the open pond in Koe Tae Sue, the following calculation can be made:

*Table 15 Unit costs for the open pond water system in Koe Tae Sue, Mon State*

| **CEA1 for water supply system** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | *0* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* | |
| **Total costs** | **4 000 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | **1 500 000** | |
| Project contribution to construction | 3 600 000 | | | | | | | | | | |
| Village contribution to construction | 400 000 | | | | | | | | | | |
| Maintenance | | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | 1 000 000 | |
| Management | | 500 000 | 500 000 | 500 000 | 500 000 | 500 000 | 500 000 | 500 000 | 500 000 | 500 000 | |
| **Outputs (total available water in m3)** | | **1 378** | **1 378** | **1 378** | **1 378** | **1 378** | **1 378** | **1 378** | **1 378** | **1 378** | 12 402 |
| Drinking water supplied (m3) | | 1 200 | 1 200 | 1 200 | 1 200 | 1 200 | 1 200 | 1 200 | 1 200 | 1 200 | 10 800 |
| Residual water supplied (m3) | | 178 | 178 | 178 | 178 | 178 | 178 | 178 | 178 | 178 | 1 602 |
| **Net present value** | **12 638 536** | | | | | | | | | | |
| | | | | | | | | | | | |
| **KEY CEA INDICATORS** | | | | | | | | | | | |
| **Cost per m3 drinking water supplied (MMK/m3)** | **1 170** | | | | | | | | | | |
| **Cost per household (5 months) (MMK/hh)** | **7 021** | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| **Water stand in open pond over time** | | | | | | | | | | | |
| **Total outputs** | | **December** | **January** | **February** | **March** | **April** | **May** | | | | |
| Water storage in pond (end rainy season) | m3 | 2 000 | | | | | | | | | |
| Water loss by seepage | m3 | | 10 | 10 | 10 | 10 | 10 | | | | |
| Water loss by evaporation | m3 | | 71 | 93 | 130 | 149 | 129 | | | | |
| Water available for distribution | m3 | 2 000 | 1 919 | 1 576 | 1 196 | 797 | 418 | | | | |
| Number of households | hh | | 200 | 200 | 200 | 200 | 200 | | | | |
| Drinking water per hh | l/hh/day | | 40 | 40 | 40 | 40 | 40 | | | | |
| Drinking water consumption per month | m3 | | 240 | 240 | 240 | 240 | 240 | **1 200** | | | |
| **Theoretically available after drinking water extraction** | **m3** | | **1 679** | **1 336** | **956** | **557** | **178** | **178** | | | |

#### Cost of water when buying from a neighbour village

The price of drinking water indicated when buying it from a neighbour village was the following:

- ➔ 200-300 MMK/container of 20litres, i.e. 10- 15 MMK/l including transport
- ➔ For a family consuming 2 containers per day, i.e. 400- 600 MMK/day or 1'200 to 1'800 MMK/month. Over a period of 5 months, this is an amount of 6'000 to 8'400 MMK/hh.

### 3.4.6 Clustering WASH interventions by type

In the second phase of the GoMP, the project will probably support the construction of a few types of water systems. These systems can be clustered by type and compared. This comparison will tell under which conditions each type is the most appropriate and generate the best performance. This comparison will be based on the unit cost calculations done with the CEA.

In a later stage, all the water systems can be aggregated to obtain an overall picture of the investments in the WASH sector and of the performance in terms of people reached, and unit costs as explained above.

# 4 Discussion & recommendations

In the discussion we address some issues that were not taken up so far, and we propose some deeper interpretation of the CBA / CEA results.

The CBAs and CEA that are presented in the present report cover about 69% of the administrated funds of the GoMP during phase 2, which is substantial. Some activities were excluded from the CBA / CEA because they have only a very indirect link to the activities analysed here, and they are not suitable for a quantitative analysis.

## 4.1 Crops value chains

### 4.1.1 Paddy

Paddy is the most important crop in Myanmar in terms of number of producers, cropped area and production. However, the crop is regulated by the State (minimum producer price), which may reduce its attractiveness for intermediary stakeholders. The main threats on paddy are the changing climatic patterns, and the salinization of the coastal land.

The CBA for paddy shows that the project support is relevant, and that farmers who adopt those improved practices have a clear advantage. But for the farmers, intensifying their paddy crop only makes sense where the agro-climatic risks are bearable. And in many places, this is not the case.

**Recommendations for paddy**

- ➔ In its expansion plans, the project must consider the risk factor. Farmers should not be encouraged to invest additional resources if the risks are too high
- ➔ We recommend proposing packages that are site specific, as there is no “1 size fit all” in paddy. Some farmers need salt tolerant varieties, others need shorter duration varieties, and depending on the water regime and season, best practices may differ.
- ➔ Supporting the paddy value chain beyond primary production may be difficult as it is a regulated market, and it is exposed to the international market.
- ➔ The factors that need to be monitored carefully in paddy are the actual yield increase and value added with the project
- ➔ The number of farmers involved must be increased to keep the CBA results on the safe side.

### 4.1.2 Green gram

Green gram is an important crop in the crop rotation, and beyond its economic value, we should not forget its value, as a legume crop, for the soil fertility. Those farmers who are growing green gram know about its value, and they make good money with the crop.

From the project perspective, considering the CBA results, the most important parameters that should be carefully monitored is the yield increase with the project (do the introduced varieties and practices really increase the yield? If yes by how much?) These seem to be the most influential factors for green gram.

**Recommendations for green gram**

- ➔ Green gram is a good crop in the paddy cropping system, but not everywhere. This should be considered when encouraging farmers to grow this crop.

- ➔ Green gram is just one source of cash for the farmers, but not the only one. Assessing livelihood improvement cannot be done by analysing the green gram or the paddy alone. The entire farming system, and off-farm revenue and remittances are equally important to assess the farmers' livelihood.
- ➔ The yield is the most sensitive factor for green gram. The success of the project is very much depending on the yield improvement compared to non-project farmers.
- ➔ There is more scope to support stakeholders along the green gram value chain as this crop is not regulated by the State and there are several options for export.
- ➔ The project monitoring should focus on yield increase and prices

## 4.2 Fishery value chain

In the Gulf of Mottama, fishing is a widespread source of income for the population. A major difficulty for this sector is the gradual reduction of fish stocks in the gulf, largely due to illegal fishing. This is the reason why some fishermen have abandoned their activity, breaking up with an old family tradition. The project has initiated activities that are highly appreciated by the public, and that have a big potential to contribute to improving the fishermen's livelihood.

The project intervention at the policy and governance level is very interesting: this factor (successful control of illegal fishing and expected quick improvement of the natural balance in the GoM) is a key in this project. Interestingly this specific issue is more important than all the others, because any success will not only impact the "project fishermen". It will improve the situation for all the fishermen in the GoM.

About the CBA, it is worthwhile making the following comment: as the CBA measures the difference between the situation with and without the project, this may lead to unrealistic cases. For instance, if the situation without the project is extremely bad, and the situation with the project is just a little better but still bad, the difference between the two options will still be positive, even if both situations have negative CBA results. This calls for careful interpretation!

**Recommendations for fishery**

- ➔ Pay highest attention to the policy aspect, illegal fishing is the most critical and influential factor
- ➔ Fishing is a seasonal activity, most fishermen have other livelihood relevant activities, with a too strong focus on the value chain approach, this aspect may get lost.
- ➔ For a single fisherman, it is important to catch at least 1 tonne of fish per year, as the profitability of the investment is strongly reduced when the quantity decreases. In project support terms, focus on professional fishing rather than encouraging "too small" fishermen who will not be able to make their activity profitable.
- ➔ For the fish collectors, who play a key role in the value chain, their situation is improving with increasing quality, share of big fish, and increased margin. A close interaction between the fishermen and the collectors is important, and should be strengthened.
- ➔ For the CBA, the project monitoring should focus on the performance of the fishermen and the collectors, the volumes of catch and trade, the quality aspects, and the prices. It is key to capture adequately these parameters to upgrade the CBA over time.

## 4.3 WASH

The calculations proposed in the WASH section are preliminary and propose a methodology for a close follow up and monitoring of these activities.

**Recommendations for WASH**

- ➔ Develop a format to calculate unit costs for the different types of water systems. This will provide a basis for comparison.
- ➔ Prepare a standard form for the collection of the important data regarding:
    - The construction of a water system
    - The operation of the water system, including water distribution
    - Keep track of the different costs involved by source
- ➔ Beyond purely quantitative aspects, the systems should also be compared considering other factors such as the governance of the system, the quality of the maintenance, the management system, gender and equity aspects when assessing access to water and influence on the system operations
- ➔ The quality of the water supplied in the different systems
- ➔ To compare the unit costs of water, it is recommended to search for international reference studies providing similar results (unit costs for different systems) as a basis for a careful assessment.

## 4.4 Economic analysis

The economic analysis is looking at the impact of the project on the local economy. While the results presented up to this point reflect (more or less) a financial perspective (the profitability of the activities from the point of view of the entrepreneurs), based on actual market prices (so-called financial prices) the economic analysis considers shadow prices for all inputs and outputs, excludes financial transfers, etc. We do not have sufficient information for a complete economic analysis at this stage, but we still suggest some issues that need to be considered for such an analysis.

### 4.4.1 Economic analysis of the paddy value chain

Paddy production in Myanmar is supported by the State, with specific measures (minimum price, credit facilities, input supply, etc.) that positively impact the profitability of the crop for the farmers. The economic analysis requires to get a full picture of State interventions in the sector, and to calculate the CBAs with the real costs of paddy production to the society. It is likely that the profitability will be reduced if the farmers do not get a minimum price but the prevailing market price, have more financial costs on their credit, or have to pay more for the fertilisers and seeds. These corrections have to be done to assess the economic impact of the project on the paddy value chain.

### 4.4.2 Economic analysis of the green gram value chain

Green gram is much less in the focus of Myanmar's agricultural policy. There is no minimum price, and no specific support programme. Therefore, it is likely that the green gram value chain as it is assessed in the present report is not too far from a full economic analysis. In the case of green gram, there are State intervention from outside, such as the Indian ban on imports, that significantly influence the market. In early May 2018, the headlines in Myanmar were "Myanmar's bean prices pick up as India lifts import ban" (http://www.xinhuanet.com/english/2018-05/07/c_137160971.htm).

### 4.4.3 Economic analysis of the fishery value chain

Adding value to the fishery sector, this is what the GoMP aims at. The following measures are likely to contribute to this goal: policy dialogue to reduce, prevent, if possible even eradicate illegal fishery is a powerful measure to increase the value of the GoM in the long term. Illegal fishery is extracting value in a short-term perspective, but this is a threat to the long-term productivity of the ecosystem.

Therefore, in the case of the fishery value chain, there is potentially a major economic impact in the long-term, while there are other measures promoted by the project that are potentially increasing the economic value of the fishery sector in the short-term. These measures include the improved handling of the fish (ice boxes for improved conservation), processing (fish paste), but also improved fishing practices (increasing share of big fish, less wastes).

There is also a State support in the fishery and livestock sector (mainly investment facility). For an economic analysis, the real costs of investments should be considered to assess the economic value of fishery to society.

### 4.4.4 Economic analysis of WASH sector support

Improving access to drinking and household water has a clear impact on the local economy. This was not considered in the CEA on WASH, because of a lack of reliable data. The benefits that should be looked at are:

- Reduced burden to access water (→ free time for productive work)
- Reduced costs of water (→ more purchasing power for the villagers)
- Improved health from improved water quality (less diarrhoea, etc.) (→ more free time for productive work)

# 5 Annexes

## 5.1 Annex 1 TOR

**Objective(s) of the consultancy**

The overall objective is to conduct an ex-ante cost benefit analysis (CBA) of the GoMP at the start of phase 2, followed by an ex-post CBA towards the end of phase 2, the second half of 2021.

Specific objectives of the CBA are:

a) To conduct a cost benefit analysis for selected agriculture and fisheries value chains (rice and green gram value chains for farmers and post-harvesting for fisheries) at the farmer's/fisher's level and the Water Sanitation and Hygiene (WASH) initiatives that will be conducted during phase 2 of the project.
b) To overview both the ex-ante and ex-post analysis for the project, having a more supervisory role after the ex-ante analysis.

The first objective will contribute to compare and identify the most effective farming and post-harvest technologies for rice, green gram and fisheries products at the level of the smallholder farmers/fishers in the Gulf of Mottama and how these interventions affect their income. The main task of the consultant is the ex-ante calculations at the beginning of phase 2 but some time will be available for advisory to the HELVETAS collaborator, who will complete the CBA at the end of phase 2 (second half 2021). HELVETAS Myanmar / Terms of Reference Consultancy contract 3.

**3. Expected results of the consultancy**

a) A comprehensive CBA analysis in line with the SDC "How-to Note CBA_CEA"2
b) An EXCEL spreadsheet allowing later application/modification of assumptions and further sensitivity analysis throughout phase 2 by HELVETAS.
c) An explicit description on how cost and benefits were derived, the underlaying assumptions and how the attributions of the project have been modelled.
d) A presentation of the preliminary key results to project staff, HELVETAS YPO and SDC-Yangon.
e) A draft ex-ante CBA report of max. 15 pages (plus annexes) to be submitted by 08.06.2018, 2018.
f) Overview the Ex-post CBA analysis and ensure that both studies (ex-ante and ex-post) properly correspond with each other.

**4. Main tasks and activities of the consultant**

a) Analyse GoMP project logframe, indicators, Monitoring and Evaluation framework and achievements during phase 1 (the Baseline review report Ko Lwin).
b) Study the Farmer's and Fisher's income books that have been produced during phase 1 and evaluate how relevant the data are for the CBA analysis and identify shortcomings. One of the M.Sc. Students from YAU at present @HAFL will study the farmer's logbook as part of her thesis (Ms. No No Aung) and these results can be used for the CBA.
c) Analyse and select, together with project team, the most relevant value chains, including post-harvest options, and WASH options to be included in the CBA.
d) Design a workable CBA model in discussion with the project team, quantifying the most relevant cost and benefits for the selected VC and WASH initiatives.
e) Establishment of a result chain to illustrate the attributions.
f) Calculate the ex-ante CB ratios, including a sensitivity analysis for the financial analysis considering different VC and WASH scenarios.
g) Provide a three hour "crash course" for project staff how to interpret major results and future use of the CBA model established in the Yangon Office of HELVETAS Myanmar.
h) Provide recommendations regarding improvements of the M&E framework in order to provide reliable data for future CBA (financial and economic analysis).
i) Present preliminary findings of the study to the project and SDC (?) at the end of the mission.
j) Report writing, including analysis, explanations and recommendations.

4. **Time Frame of the assignment**

The total duration of the CBA assignment is 14 working days (including 2 days travelling) in the period of May 7-June 8, 2018. The mission will consist of preparation (1 day), field mission, including travel (10 days) and report writing/coaching (3 days).

## 5.2 Annex 2 Glossary of terms used in CBA

The CBA methodology and its application in the context of development projects is explained in details in the e-learning tool of SDC that can be found under http://deza-pcmi-lernbuch-3.prod2.lernetz.ch/module-6-en/5-glossary#Ti365

The most important terms are explained here:

**NPV = Net Present Value**

The sum of all discounted costs and benefits is called the net present value (NPV). This sum reflects how much the project will earn. NPV is usually calculated by adding the present value of future cash flows, residual values, and interest less investment costs, operational costs and future expenses. NPV is dependent on the value of the discount rate used to calculate these costs since the discount rate is used to calculate values over time (see also discounted costs, discounted benefits). The NPV method is used for evaluating the desirability of investments or projects.

The minimum condition for accepting a project is a positive NPV.

**IRR = Internal Rate of Return**

IRR is the rate (similar to an internal interest rate) that is generated by a project or an enterprise. It is an indicator of the profitability of the project / enterprise. If the IRR is equal to the discount rate then the discounted costs equal the discounted benefits, that is it would just break-even at that particular rate (see also discounting). The IRR is the discount rate at which the NPV (see NPV) for a project equals zero. This rate means that the present value of the cash inflows for the project would equal the present value of its outflows.

The condition for a project to be acceptable is that the IRR exceeds the discount rate.

**Discount rate**

The discount rate refers to the interest rate used in discounted cash flow (DCF) analysis to determine the present value of future cash flows. The discount rate in DCF analysis takes into account not just the time value of money but also the risk or uncertainty of future cash flows; the greater the uncertainty of future cash flows the higher the discount rate. High discount rates tend to penalise long-term projects, such as environmental protection, and to favour short-term projects and projects with quick-benefits.

In the case of Tanzania, the discount rate considered is 12% based on information from the Central Bank

**BCR Benefit Cost Ratio**

Ratio of (discounted) costs to benefits: total discounted benefits divided by total discounted costs.

The condition for a project to be acceptable is a ratio >1

## 5.3 Annex 3 CBA2 Paddy value chain

| CBA 2 paddy producers | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **53 400 000** | **169 656 000** | **326 000 000** | **418 000 000** | **510 000 000** | **552 000 000** | **552 000 000** | **552 000 000** | **552 000 000** | **552 000 000** | **552 000 000** |
| additional working capital | 53 400 000 | 96 600 000 | 50 000 000 | 50 000 000 | 50 000 000 | - | - | - | - | - | - |
| additional production costs | | 64 080 000 | 240 000 000 | 320 000 000 | 400 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 |
| financial costs | | 8 976 000 | 36 000 000 | 48 000 000 | 60 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **115 143 750** | **431 250 000** | **575 000 000** | **718 750 000** | **862 500 000** | **862 500 000** | **862 500 000** | **862 500 000** | **862 500 000** | **1 162 500 000** |
| additional paddy sales | | 115 143 750 | 431 250 000 | 575 000 000 | 718 750 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 |
| additional value of paddy | | - | - | - | - | - | - | - | - | - | - |
| recovery working capital | | | | | | | | | | | 300 000 000 |
| | | | | | | | | | | | |
| **Cash flow** | -53 400 000 | -54 512 250 | 105 250 000 | 157 000 000 | 208 750 000 | 310 500 000 | 310 500 000 | 310 500 000 | 310 500 000 | 310 500 000 | 610 500 000 |
| | | | | | | | | | | | |
| **NPV** | 1 283 870 215 | | | | | | | | | | |
| **IRR** | 98.24% | | | | | | | | | | |
| **BCR** | 1.46 | | | | | | | | | | |

## 5.4 Annex 4 CBA3 Paddy value chain with administrated project funds

**Aggregated CBA for paddy value chain**

| | 0 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total costs** | **161 670 000** | **261 861 000** | **601 724 000** | **642 424 000** | **639 654 000** | **668 964 000** | **660 000 000** | **660 000 000** | **660 000 000** | **552 000 000** | **552 000 000** |
| additional working capital | 53 400 000 | 96 600 000 | 50 000 000 | 50 000 000 | 50 000 000 | - | - | - | - | - | - |
| additional production costs | | 64 080 000 | 240 000 000 | 320 000 000 | 400 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 | 480 000 000 |
| financial costs | | 8 976 000 | 36 000 000 | 48 000 000 | 60 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 |
| project contribution | | | | | | | | | | | |
| phase 1 | 108 270 000 | 92 205 000 | - | | | | | | | | |
| phase 2 output 1.1 | | | 218 700 000 | 167 400 000 | 66 150 000 | 62 100 000 | | | | | |
| phase 2 output 3 | | | 57 024 000 | 57 024 000 | 63 504 000 | 54 864 000 | | | | | |
| phase 3 | | | | | | | 108 000 000 | 108 000 000 | 108 000 000 | | |
| | | | | | | | | | | | |
| **Total benefits** | | **115 143 750** | **431 250 000** | **575 000 000** | **718 750 000** | **862 500 000** | **862 500 000** | **862 500 000** | **862 500 000** | **862 500 000** | **1 162 500 000** |
| additional paddy sales | | 115 143 750 | 431 250 000 | 575 000 000 | 718 750 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 | 862 500 000 |
| additional value of paddy | | - | - | - | - | - | - | - | - | - | - |
| recovery working capital | | | | | | | | | | | 300 000 000 |
| | | | | | | | | | | | |
| **Cash flow** | -161 670 000 | -146 717 250 | -170 474 000 | -67 424 000 | 79 096 000 | 193 536 000 | 202 500 000 | 202 500 000 | 202 500 000 | 310 500 000 | 610 500 000 |
| | | | | | | | | | | | |
| **NPV** | 367 345 414 | | | | | | | | | | |
| **IRR** | 20.21% | | | | | | | | | | |
| **BCR** | 1.10 | | | | | | | | | | |

## 5.5 Annex 5 CBA2 Green gram value chain aggregated

**Aggregated CBA 2 green gram producers**

| | 0 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total costs** | **26 700 000** | **67 956 000** | **181 000 000** | **233 000 000** | **285 000 000** | **312 000 000** | **312 000 000** | **312 000 000** | **312 000 000** | **312 000 000** | **312 000 000** |
| additional working capital | 26 700 000 | 48 300 000 | 25 000 000 | 25 000 000 | 25 000 000 | - | - | - | - | - | - |
| additional production costs | | 10 680 000 | 120 000 000 | 160 000 000 | 200 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 |
| financial costs | | 8 976 000 | 36 000 000 | 48 000 000 | 60 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **26 441 010** | **297 090 000** | **396 120 000** | **495 150 000** | **594 180 000** | **594 180 000** | **594 180 000** | **594 180 000** | **594 180 000** | **744 180 000** |
| additional sales | | 26 433 000 | 297 000 000 | 396 000 000 | 495 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 |
| additional value of green gram | | 8 010 | 90 000 | 120 000 | 150 000 | 180 000 | 180 000 | 180 000 | 180 000 | 180 000 | 180 000 |
| recovery working capital | | | | | | | | | | | 150 000 000 |
| | | | | | | | | | | | |
| **Cash flow** | -26 700 000 | -41 514 990 | 116 090 000 | 163 120 000 | 210 150 000 | 282 180 000 | 282 180 000 | 282 180 000 | 282 180 000 | 282 180 000 | 432 180 000 |
| | | | | | | | | | | | |
| **NPV** | 1 194 823 804 | | | | | | | | | | |
| **IRR** | 140.73% | | | | | | | | | | |
| **BCR** | 1.78 | | | | | | | | | | |

## 5.6 Annex 6 CBA3 Green gram with administrated costs

**Aggregated CBA for green gram value chain with project costs**

| | 0 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total costs** | **53 767 500** | **91 007 250** | **235 675 000** | **274 850 000** | **301 537 500** | **327 525 000** | **339 000 000** | **339 000 000** | **339 000 000** | **312 000 000** | **312 000 000** |
| additional working capital | 26 700 000 | 48 300 000 | 25 000 000 | 25 000 000 | 25 000 000 | - | - | - | - | - | - |
| additional production costs | | 10 680 000 | 120 000 000 | 160 000 000 | 200 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 | 240 000 000 |
| financial costs | | 8 976 000 | 36 000 000 | 48 000 000 | 60 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 | 72 000 000 |
| project contribution | | | | | | | | | | | |
| phase 1 | 27 067 500 | 23 051 250 | - | | | | | | | | |
| phase 2 output 1.1 | | | 54 675 000 | 41 850 000 | 16 537 500 | 15 525 000 | | | | | |
| phase 3 | | | | | | | 27 000 000 | 27 000 000 | 27 000 000 | | |
| | | | | | | | | | | | |
| **Total benefits** | | **26 441 010** | **297 090 000** | **396 120 000** | **495 150 000** | **594 180 000** | **594 180 000** | **594 180 000** | **594 180 000** | **594 180 000** | **744 180 000** |
| additional sales | | 26 433 000 | 297 000 000 | 396 000 000 | 495 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 | 594 000 000 |
| additional value of green gram | | 8 010 | 90 000 | 120 000 | 150 000 | 180 000 | 180 000 | 180 000 | 180 000 | 180 000 | 180 000 |
| recovery working capital | | | | | | | | | | | 150 000 000 |
| | | | | | | | | | | | |
| **Cash flow** | -53 767 500 | -64 566 240 | 61 415 000 | 121 270 000 | 193 612 500 | 266 655 000 | 255 180 000 | 255 180 000 | 255 180 000 | 282 180 000 | 432 180 000 |
| | | | | | | | | | | | |
| **NPV** | 1 007 545 245 | | | | | | | | | | |
| **IRR** | 79.61% | | | | | | | | | | |
| **BCR** | 1.58 | | | | | | | | | | |

## 5.7 Annex 7 CBA1, CBA2 Fisherman without and with project

| CBA 1 fishermen (without project) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **1 835 000** | **1 257 000** | **1 262 000** | **1 590 333** | **1 595 333** | **1 590 333** | **1 682 000** | **1 517 000** | **1 262 000** | **1 257 000** | **1 262 000** |
| working capital | 150 000 | | | | | | | | | | |
| fishing boat | 420 000 | | | | | | 420 000 | | | | |
| engine | 260 000 | | | | | | | 260 000 | | | |
| net | 1 000 000 | | | 333 333 | 333 333 | 333 333 | | | | | |
| box (polystyrene) | 5 000 | | 5 000 | | 5 000 | | 5 000 | | 5 000 | | 5 000 |
| ice | | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 | 32 000 |
| fuel | | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 | 225 000 |
| labour | | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 |
| financial costs | | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 | 200 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **2070000** | **1966500** | **1868175** | **1774766.25** | **1686027.94** | **1601726.54** | **1521640.21** | **1445558.2** | **1373280.29** | **1454616.28** |
| selling high value fish | | 450 000 | 427 500 | 406 125 | 385 819 | 366 528 | 348 201 | 330 791 | 314 252 | 298 539 | 283 612 |
| selling low value fish | | 1 620 000 | 1 539 000 | 1 462 050 | 1 388 948 | 1 319 500 | 1 253 525 | 1 190 849 | 1 131 306 | 1 074 741 | 1 021 004 |
| working capital recovery | | | | | | | | | | | 150 000 |
| | | | | | | | | | | | |
| **Cash flow** | -1 835 000 | 813 000 | 704 500 | 277 842 | 179 433 | 95 695 | -80 273 | 4 640 | 183 558 | 116 280 | 192 616 |
| | | | | | | | | | | | |
| **NPV** | 43 319 | | | | | | | | | | |
| **IRR** | 10.99% | | | | | | | | | | |
| **BCR** | 1.00 | | | | | | | | | | |

| CBA 2 fishermen (with project) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***0*** | ***2017*** | ***2018*** | ***2019*** | ***2020*** | ***2021*** | ***2022*** | ***2023*** | ***2024*** | ***2025*** | ***2026*** |
| **Total costs** | **2 230 000** | **1 481 250** | **1 481 250** | **1 814 583** | **1 934 583** | **1 814 583** | **2 514 583** | **2 074 583** | **1 934 583** | **1 814 583** | **1 814 583** |
| working capital | 150 000 | | | | | | | | | | |
| fishing boat | 700 000 | | | | | | 700 000 | | | | |
| engine | 260 000 | | | | | | | 260 000 | | | |
| net | 1 000 000 | | | 333 333 | 333 333 | 333 333 | 333 333 | 333 333 | 333 333 | 333 333 | 333 333 |
| box (polystyrene) | 120 000 | | | | 120 000 | | | | 120 000 | | |
| ice | | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 | 160 000 |
| fuel | | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 | 281 250 |
| labour | | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 | 800 000 |
| financial costs | | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 | 240 000 |
| | | | | | | | | | | | |
| **Total benefits** | | **2 358 000** | **2 392 560** | **2 431 267** | **2 474 619** | **2 523 174** | **2 577 554** | **2 638 461** | **2 706 676** | **2 783 077** | **3 018 647** |
| selling high value fish | | 495 000 | 554 400 | 620 928 | 695 439 | 778 892 | 872 359 | 977 042 | 1 094 287 | 1 225 602 | 1 372 674 |
| selling low value fish | | 1 863 000 | 1 838 160 | 1 810 339 | 1 779 180 | 1 744 281 | 1 705 195 | 1 661 419 | 1 612 389 | 1 557 476 | 1 495 973 |
| working capital recovery | | | | | | | | | | | 150 000 |
| **Cash flow** | -2 230 000 | 876 750 | 911 310 | 616 684 | 540 036 | 708 590 | 62 971 | 563 878 | 772 093 | 968 494 | 1 204 063 |
| | | | | | | | | | | | |
| **NPV** | 2 152 394 | | | | | | | | | | |
| **IRR** | 30.36% | | | | | | | | | | |
| **BCR** | 1.16 | | | | | | | | | | |
| | | | | | | | | | | | |
| **additional costs** | 395 000 | 224 250 | 219 250 | 224 250 | 339 250 | 224 250 | 832 583 | 557 583 | 672 583 | 557 583 | 552 583 |
| **additional benefits** | | 288 000 | 426 060 | 563 092 | 699 853 | 837 146 | 975 828 | 1 116 821 | 1 261 118 | 1 409 797 | 1 564 030 |
| **Net cash flow increase** | -395 000 | 63 750 | 206 810 | 338 842 | 360 603 | 612 896 | 143 245 | 559 237 | 588 535 | 852 214 | 1 011 447 |
| NPV | 2 109 075 | | | | | | | | | | |
| IRR | 58.57% | | | | | | | | | | |
| **BCR** | 1.74 | | | | | | | | | | |

## 5.8 Annex 8 CBA3, CBA4 Fish collector without and with project

| CBA 3 average village fish collector (without project) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **10 000 000** | **25 240 000** | **23 998 000** | **22 818 100** | **21 697 195** | **20 632 335** | **19 620 718** | **18 659 683** | **17 746 698** | **16 879 364** | **16 055 395** |
| working capital | 10 000 000 | | | | | | | | | | |
| buying high value fish | | 5 400 000 | 5 130 000 | 4 873 500 | 4 629 825 | 4 398 334 | 4 178 417 | 3 969 496 | 3 771 021 | 3 582 470 | 3 403 347 |
| buying low value fish | | 19 440 000 | 18 468 000 | 17 544 600 | 16 667 370 | 15 834 002 | 15 042 301 | 14 290 186 | 13 575 677 | 12 896 893 | 12 252 049 |
| buying ice | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| storage & marketing | | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 |
| financial costs | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| **Total benefits** | | **29 040 000** | **27 588 000** | **26 208 600** | **24 898 170** | **23 653 262** | **22 470 598** | **21 347 069** | **20 279 715** | **19 265 729** | **28 302 443** |
| selling high value fish | | 6 360 000 | 6 042 000 | 5 739 900 | 5 452 905 | 5 180 260 | 4 921 247 | 4 675 184 | 4 441 425 | 4 219 354 | 4 008 386 |
| selling low value fish | | 22 680 000 | 21 546 000 | 20 468 700 | 19 445 265 | 18 473 002 | 17 549 352 | 16 671 884 | 15 838 290 | 15 046 375 | 14 294 057 |
| selling ice | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| working capital recovery | | | | | | | | | | | 10 000 000 |
| | | | | | | | | | | | |
| Cash flow | -10 000 000 | 3 800 000 | 3 590 000 | 3 390 500 | 3 200 975 | 3 020 926 | 2 849 880 | 2 687 386 | 2 533 017 | 2 386 366 | 12 247 048 |
| | | | | | | | | | | | |
| **NPV** | 8 212 347 | | | | | | | | | | |
| **IRR** | 30.33% | | | | | | | | | | |
| **BCR** | 1.06 | | | | | | | | | | |

| CBA 4 average village fish collector (with project) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **15 000 000** | **29 896 000** | **30 068 800** | **30 250 240** | **30 440 752** | **30 640 790** | **30 850 829** | **31 071 371** | **31 302 939** | **31 546 086** | **31 801 390** |
| working capital | 15 000 000 | | | | | | | | | | |
| buying high value fish | | 5 940 000 | 6 237 000 | 6 548 850 | 6 876 293 | 7 220 107 | 7 581 112 | 7 960 168 | 8 358 177 | 8 776 085 | 9 214 890 |
| buying low value fish | | 22 356 000 | 22 231 800 | 22 101 390 | 21 964 460 | 21 820 682 | 21 669 717 | 21 511 202 | 21 344 763 | 21 170 001 | 20 986 501 |
| buying ice | | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 | 1 200 000 |
| storage & marketing | | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 | 400 000 |
| financial costs | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| **Total benefits** | | **35 839 200** | **36 044 160** | **36 259 368** | **36 485 336** | **36 722 603** | **36 971 733** | **37 233 320** | **37 507 986** | **37 796 385** | **53 099 205** |
| selling high value fish | | 7 123 200 | 7 479 360 | 7 853 328 | 8 245 994 | 8 658 294 | 9 091 209 | 9 545 769 | 10 023 058 | 10 524 211 | 11 050 421 |
| selling low value fish | | 27 216 000 | 27 064 800 | 26 906 040 | 26 739 342 | 26 564 309 | 26 380 525 | 26 187 551 | 25 984 928 | 25 772 175 | 25 548 783 |
| selling ice | | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 | 1 500 000 |
| working capital recovery | | | | | | | | | | | 15 000 000 |
| | | | | | | | | | | | |
| **Cash flow** | **-15 000 000** | **5 943 200** | **5 975 360** | **6 009 128** | **6 044 584** | **6 081 814** | **6 120 904** | **6 161 950** | **6 205 047** | **6 250 299** | **21 297 814** |
| NPV | 28 134 642 | | | | | | | | | | |
| IRR | 40.12% | | | | | | | | | | |
| BCR | 1.14 | | | | | | | | | | |
| | | | | | | | | | | | |
| **additional costs** | 5 000 000 | 4 656 000 | 6 070 800 | 7 432 140 | 8 743 557 | 10 008 454 | 11 230 111 | 12 411 688 | 13 556 241 | 14 666 723 | 15 745 995 |
| **additional benefits** | | 6 799 200 | 8 456 160 | 10 050 768 | 11 587 166 | 13 069 342 | 14 501 135 | 15 886 252 | 17 228 271 | 18 530 656 | 24 796 762 |
| **Net cash flow increase** | -5 000 000 | 2 143 200 | 2 385 360 | 2 618 628 | 2 843 609 | 3 060 887 | 3 271 024 | 3 474 564 | 3 672 030 | 3 863 934 | 9 050 767 |
| NPV | 15 200 528 | | | | | | | | | | |
| IRR | 51.10% | | | | | | | | | | |
| BCR | 1.24 | | | | | | | | | | |

## 5.9 Annex 9 Fishery

### CBA5 Fishery with administrated funds

### CBA6 Fishery with administrated and management funds

| Aggregated CBA for fishery with administrated project costs | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **1 838 126 250** | **1 110 636 750** | **1 527 551 000** | **2 515 556 820** | **3 625 593 325** | **4 372 402 853** | **8 194 326 207** | **6 888 440 790** | **7 772 034 219** | **7 475 202 875** | **7 831 948 242** |
| additional costs for fishing | 395 000 000 | 224 250 000 | 342 100 000 | 605 475 000 | 1 080 412 500 | 941 850 000 | 3 751 287 500 | 2 341 850 000 | 2 824 850 000 | 2 341 850 000 | 2 320 850 000 |
| additional costs for collection | 415 000 000 | 386 448 000 | 692 080 000 | 1 526 438 820 | 2 277 300 325 | 3 197 434 853 | 4 240 538 707 | 4 344 090 790 | 4 744 684 219 | 5 133 352 875 | 5 511 098 242 |
| project costs | | | | | | | | | | | |
| outcome 1 phase 1 | 881 651 250 | 411 513 750 | 43 875 000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| outcome 3 phase 1 | 146 475 000 | 88 425 000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| output 1.1 phase 2 | 0 | 0 | 273 375 000 | 209 250 000 | 82 687 500 | 77 625 000 | 0 | 0 | 0 | 0 | 0 |
| activity 2.2.2 phase 2 | 0 | 0 | 35 950 500 | 53 500 500 | 52 150 500 | 38 650 500 | 0 | 0 | 0 | 0 | 0 |
| activity 2.2.3 phase 2 | 0 | 0 | 33 250 500 | 13 972 500 | 13 972 500 | 13 972 500 | 0 | 0 | 0 | 0 | 0 |
| activity 3.1.2 | 0 | 0 | 28 350 000 | 36 450 000 | 36 450 000 | 36 450 000 | 0 | 0 | 0 | 0 | 0 |
| output 3.2 | 0 | 0 | 78 570 000 | 70 470 000 | 82 620 000 | 66 420 000 | 0 | 0 | 0 | 0 | 0 |
| fishery phase 3 | 0 | 0 | 0 | 0 | 0 | 0 | 202 500 000 | 202 500 000 | 202 500 000 | 0 | 0 |
| | | | | | | | | | | | |
| **Total benefits** | | **852 333 600** | **1 356 888 000** | **2 736 304 974** | **4 496 715 578** | **6 652 122 867** | **9 173 874 264** | **10 250 835 064** | **11 326 590 619** | **12 406 877 439** | **15 247 794 314** |
| additional benefits for fishing | | 288 000 000 | 511 272 000 | 1 098 029 790 | 1 889 603 138 | 2 888 152 452 | 4 098 477 029 | 4 690 647 023 | 5 296 695 778 | 5 921 147 828 | 6 568 927 697 |
| additional benefits for collection | | 564 333 600 | 845 616 000 | 1 638 275 184 | 2 607 112 440 | 3 763 970 415 | 5 075 397 235 | 5 560 188 041 | 6 029 894 841 | 6 485 729 611 | 8 678 866 618 |
| | | | | | | | | | | | |
| **Cash flow** | **-1 838 126 250** | **-258 303 150** | **-170 663 000** | **220 748 154** | **871 122 253** | **2 279 720 014** | **979 548 057** | **3 362 394 274** | **3 554 556 400** | **4 931 674 564** | **7 415 846 073** |
| NPV | 8 849 612 425 | | | | | | | | | | |
| IRR | 37.97% | | | | | | | | | | |
| BCR | 1.30 | | | | | | | | | | |

| Aggregated CBA for fishery with administrated project costs and management costs (30%) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *0* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* |
| **Total costs** | **2 405 126 250** | **1 394 136 750** | **1 811 051 000** | **2 799 056 820** | **3 909 093 325** | **4 655 902 853** | **8 477 826 207** | **7 171 940 790** | **8 055 534 219** | **7 475 202 875** | **7 831 948 242** |
| additional costs for fishing | 395 000 000 | 224 250 000 | 342 100 000 | 605 475 000 | 1 080 412 500 | 941 850 000 | 3 751 287 500 | 2 341 850 000 | 2 824 850 000 | 2 341 850 000 | 2 320 850 000 |
| additional costs for collection | 415 000 000 | 386 448 000 | 692 080 000 | 1 526 438 820 | 2 277 300 325 | 3 197 434 853 | 4 240 538 707 | 4 344 090 790 | 4 744 684 219 | 5 133 352 875 | 5 511 098 242 |
| project costs | | | | | | | | | | | |
| outcome 1 phase 1 | 881 651 250 | 411 513 750 | 43 875 000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| outcome 3 phase 1 | 146 475 000 | 88 425 000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| output 1.1 phase 2 | 0 | 0 | 273 375 000 | 209 250 000 | 82 687 500 | 77 625 000 | 0 | 0 | 0 | 0 | 0 |
| activity 2.2.2 phase 2 | 0 | 0 | 35 950 500 | 53 500 500 | 52 150 500 | 38 650 500 | 0 | 0 | 0 | 0 | 0 |
| activity 2.2.3 phase 2 | 0 | 0 | 33 250 500 | 13 972 500 | 13 972 500 | 13 972 500 | 0 | 0 | 0 | 0 | 0 |
| activity 3.1.2 | 0 | 0 | 28 350 000 | 36 450 000 | 36 450 000 | 36 450 000 | 0 | 0 | 0 | 0 | 0 |
| output 3.2 | 0 | 0 | 78 570 000 | 70 470 000 | 82 620 000 | 66 420 000 | 0 | 0 | 0 | 0 | 0 |
| fishery phase 3 | 0 | 0 | 0 | 0 | 0 | 0 | 202 500 000 | 202 500 000 | 202 500 000 | 0 | 0 |
| project management costs | 567 000 000 | 283 500 000 | 283 500 000 | 283 500 000 | 283 500 000 | 283 500 000 | 283 500 000 | 283 500 000 | 283 500 000 | | |
| | | | | | | | | | | | |
| **Total benefits** | | **852 333 600** | **1 356 888 000** | **2 736 304 974** | **4 496 715 578** | **6 652 122 867** | **9 173 874 264** | **10 250 835 064** | **11 326 590 619** | **12 406 877 439** | **15 247 794 314** |
| additional benefits for fishing | | 288 000 000 | 511 272 000 | 1 098 029 790 | 1 889 603 138 | 2 888 152 452 | 4 098 477 029 | 4 690 647 023 | 5 296 695 778 | 5 921 147 828 | 6 568 927 697 |
| additional benefits for collection | | 564 333 600 | 845 616 000 | 1 638 275 184 | 2 607 112 440 | 3 763 970 415 | 5 075 397 235 | 5 560 188 041 | 6 029 894 841 | 6 485 729 611 | 8 678 866 618 |
| | | | | | | | | | | | |
| **Cash flow** | **-2 405 126 250** | **-541 803 150** | **-454 163 000** | **-62 751 846** | **587 622 253** | **1 996 220 014** | **696 048 057** | **3 078 894 274** | **3 271 056 400** | **4 931 674 564** | **7 415 846 073** |
| NPV | 6 770 160 848 | | | | | | | | | | |
| IRR | 27.92% | | | | | | | | | | |
| BCR | 1.22 | | | | | | | | | | |

## 5.10 Annex 10 WASH Cost effectiveness analysis

**CEA2 for water supply systems aggregated, including administrated project costs**

this sheet assumes that all the water systesm are similar to CEA1, the numbers come from "project figures"

| | *0* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* | *2026* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total costs** | **32 000 000** | **103 000 000** | **234 800 000** | **272 700 000** | **115 500 000** | **102 000 000** | **102 000 000** | **102 000 000** | **102 000 000** | **102 000 000** | |
| Project contribution to construction | 28 800 000 | 57 600 000 | 72 000 000 | 86 400 000 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Village contribution to construction | 3 200 000 | 6 400 000 | 8 000 000 | 9 600 000 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Maintenance | | 8 000 000 | 24 000 000 | 44 000 000 | 68 000 000 | 68 000 000 | 68 000 000 | 68 000 000 | 68 000 000 | 68 000 000 | |
| Management | | 4 000 000 | 12 000 000 | 22 000 000 | 34 000 000 | 34 000 000 | 34 000 000 | 34 000 000 | 34 000 000 | 34 000 000 | |
| Administrated funds | | | | | | | | | | | |
| Water assessment (WASH technical) | | 27 000 000 | | | | | | | | | |
| Awareness (including waste management) | | | 91 800 000 | 83 700 000 | 13 500 000 | | | | | | |
| Additional contribution water systems | | | 27 000 000 | 27 000 000 | | | | | | | |
| **Outputs (total available water in m3)** | | **11 024** | **33 072** | **60 632** | **93 704** | **93 704** | **93 704** | **93 704** | **93 704** | **93 704** | 666 952 |
| Drinking water supplied (m3) | | 9 600 | 28 800 | 52 800 | 81 600 | 81 600 | 81 600 | 81 600 | 81 600 | 81 600 | 580 800 |
| Residual water supplied (m3) | | 1 424 | 4 272 | 7 832 | 12 104 | 12 104 | 12 104 | 12 104 | 12 104 | 12 104 | 86 152 |
| **Net present value** | **867 551 704** | | | | | | | | | | |
| | | | | | | | | | | | |
| **KEY CEA INDICATORS** | | | | | | | | | | | |
| **Cost per m3 water supplied (MMK/m3)** | **1 301** | | | | | | | | | | |
| **Cost per household (5 months) (MMK/hh)** | **7 088** | | | | | | | | | | |
| | | | | | | | | | | | |
| **Without administrated funds** | | | | | | | | | | | |
| Cost per m3 water supplied (MMK/m3) | **978** | | | | | | | | | | |
| Cost per household (5 months) (MMK/hh) | **5 330** | | | | | | | | | | |