Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

Report prepared for ISU-EDF

Draft report
August 2014
Executive Summary

The fishery

Indonesia's South Sulawesi blue swimming crab (BSC) fishery has been lucrative. Harvets predominantly supplying the North American market have risen eightfold over 20 years. However, crab fishers receive a small share of the export value of the catch due to the layers of intermediaries which appropriate much of the revenue. Table 1 summarises some key economic indicators for the fishing industry in the country. It can be seen that fisheries contributed 1.8 per cent to the total exports of the country and 2 per cent to GDP in 2010. Figure 1 shows the location of South Sulawesi in Indonesia.

Figure 1. Location of South Sulawesi in Indonesia is highlighted in red

Source: Google maps
Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

### Table 1. Key economic indicators for the fishing industry in Indonesia

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution of fisheries to Indonesia’s GDP (2010–12)</td>
<td>2 per cent</td>
</tr>
<tr>
<td>Total landings of BSC in south-east Sulawesi (2012)</td>
<td>US$3 million</td>
</tr>
<tr>
<td>Contribution of fisheries to total exports in 2010</td>
<td>1.8 per cent, 18th largest exporting sector</td>
</tr>
<tr>
<td>Price received by fisher for BSC</td>
<td>US$3 per kg (rising later)</td>
</tr>
<tr>
<td>Export price of BSC</td>
<td>$14–$37 per kg (free on board)</td>
</tr>
<tr>
<td>Contribution to total jobs in 2010</td>
<td>Less than 1 per cent</td>
</tr>
</tbody>
</table>

Source: Indonesia Marine And Climate Support (IMAC) project

High levels of historical catches have led to diminished productivity of the resource. The catch rates have declined by 66 per cent and the total annual catch has declined by 40 per cent over the last ten years, placing fishers on low incomes under greater financial pressure. The current catch rate is well below maximum sustainable yield and maximum economic yield.

The fishery will remain unproductive unless there is some management intervention. The fishery receives limited management intervention; however, although the stock is at high risk of further decline, it could be rebuilt rapidly with the right investment.

### Transition plan

The analysis in this report indicates that the stock reaches an optimum level after an investment of around US$7 million, establishing a fully effective management regime with a catch reduction in place for two to three years. After transition, additional expenditure of approximately US$1.7 million per year is required to maintain operations. Fisher incomes (individual earnings) would increase by an estimated 85 per cent, with further uplift from improved supply chain efficiency, raising the price received. The total annual sustainable catch would stabilise above recent catch levels while the number of fishers would be reduced, with enough increased income to improve outcomes for those who continue to fish and those who leave. In Figure 2 a heat map shows that under both slow and fast stock rebuilding options, differentiated by the level of total annual catch reduction, the catch and biomass will reach maximum sustainable yield levels by 2020 for all of the biological scenarios. Within each control path, results are provided for nine combinations of parameter values encompassing their plausible ranges. The catch heat map displays the combined catch level of the BSC fishery relative to MSY. The biomass heat map displays the biomass of BSC population relative to the biomass capable of delivering maximum sustainable yield (B_{msy}).
Figure 2. Transition of total annual catch and stock biomass

<table>
<thead>
<tr>
<th>Path</th>
<th>2012</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stab.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Path</th>
<th>2012</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stab.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Green shows optimum; red and yellow are below optimum level. There are nine biological scenarios within each of four plans: business as usual, stabilisation of current biomass, and slow rebuild and fast rebuild.

Source: MRAG

Financing the transition

The recovery plan creates an investment vehicle with envisaged participation from quasi-public bodies as well as the corporate sector. The model estimates the overall return on investment to be around 6 per cent (real) overall, 5 per cent for the debt portion, and 9 per cent for the equity portion, using an illustrative capital structure, described in Appendix 3. There is discussion of financial structures in Appendix 4. The present value of the increase in fisher income is US$17 million; this is expected to increase by 110 per cent, amounting to an increment of US$1,700 per fisher per year compared to US$1,570 in 2012. Various organisations such as a government management authority, a government-owned company, a community interest company, or a cooperative, might qualify as potential entities to manage the capital stock.

A robust financial prospect might be created if existing parties come together and agree a long-term strategic plan with government. Central to the plan, an entity acting as a management authority or coordinator invests in control measures and enforcement. Government hypothecates revenue to the authority from an export levy, auction fee or some other source, allowing it to secure finance. The authority may benefit from recourse to government, which acts as guarantor, and intermediaries with political influence might further mitigate risk. The authority might solicit strategic financial partners locally or internationally, or both, securing political commitment and technical expertise to complement the resources it holds internally or contracts from third parties. The investors may agree to a future exit after the stock biomass reaches its optimum level, returning the company to fully local, government or community ownership as befits the political consensus.
The present value of the equity varies with the level of reduction in catches, the level of the capital grant and the required equity return. A large reduction in catch and larger capital grant lead to a higher valuation. A low estimate of the intrinsic rate of growth, within the possible range of plausible growth rates, for the fishery results in a negative present value. The level of illegal, unreported and unregulated (IUU) fishing also plays a role in investment returns by affecting the bio-economic estimates of sustainable biomass; a higher level of IUU fishing would delay the stock rebuild. Figure 3 presents a heat map showing an equity net present value (NPV) under different models; positive values are shown by green bars and negative values by red bars. The middle panel, which presents the equity NPV generated under the best bio-economic estimates, shows positive values at all discount rates only when the revenue sharing rate is set at 40 per cent, when a shallow cut to catches is applied. At a 30 per cent sharing rate, equity NPV is expected to be negative. The picture is the same when a deep cut in total catch option is pursued.

**Figure 3. Equity NPV heat map shows negative NPV when intrinsic growth rate is low**

<table>
<thead>
<tr>
<th>Path</th>
<th>Revenue sharing rate</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
<th>8%</th>
<th>9%</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
<th>8%</th>
<th>9%</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
<th>8%</th>
<th>9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% cut</td>
<td>25%</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
<td>40%</td>
<td>45%</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
<td>65%</td>
</tr>
<tr>
<td>50% cut</td>
<td>25%</td>
<td>20%</td>
<td>15%</td>
<td>10%</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
<td>40%</td>
<td>45%</td>
<td>50%</td>
<td>55%</td>
<td>60%</td>
<td>65%</td>
</tr>
</tbody>
</table>

**Note:** Equity NPV for various model parameters and assumptions. Central scenario is obtained by assuming best estimates for intrinsic growth rate and proportion of initial biomass of the carrying capacity (Model BB). It also assumes that catches are cut by 50 per cent, a levy rate of 25 per cent and a discount rate of 7 per cent.

**Source:** Vivid Economics
The equity rate of return is sensitive to the levels of fisher compensation and management costs. Figure 4 shows the range of equity returns under different assumptions relating to operating costs and prices. The highest level of uncertainty is for management costs, which can even reduce returns to zero. The equity rate of return is also sensitive to capital grants and/or tax breaks, which may enhance incentives to private investors. Fisher compensation is included, despite having only a modest impact on returns, because it may be crucial in unlocking the project’s political viability.

Risk management

Financial and management structures can be used to address critical risks. One issue of concern is that the BSC may not exhibit as fast a recovery rate as expected in the model, which would lead to lower than anticipated revenues. Another risk is the uncertainty regarding the cost and effectiveness associated with new capacity building. This second risk seems much greater and could be mitigated by transparent and effective governance and political commitment to achieving well-articulated long-term outcomes. To complement the fishery gains, potential improvements in market structure may require interventions to de-layer the supply chain and enhance logistics. A supply chain strategy could be drawn up in preparation for this. Indeed, opportunities to increase fisher incomes could be missed if supply chain reform does not materialise. There may also be market access and/or price benefits from sustainable certification of the fishery. Local political support is also necessary in order to reach an agreement on distributional instruments such as fisher compensation and a revenue sharing mechanism against which to secure the finance. In Indonesia the institutional requirements are particularly challenging because of the light regulatory touch currently in place and the geographical spread of the country. However, success in one fishery could bring great benefits to many other fisheries in the region by acting as an example of good practice.
# Contents

1. **Introduction** ................................................................. 11  
2. **Description of fisheries in Indonesia** .................................. 12  
3. **Bio-economic model results** ........................................... 18  
4. **Financial model results** .................................................. 23  
5. **Conclusions and recommendations** .................................. 33  

References .................................................................................. 35  

Appendix 1: Fisheries institutions ............................................... 36  
Appendix 2: Bio-economic modelling ......................................... 37  
Appendix 3: Financial modelling ................................................ 41  
Appendix 4: The role of finance .................................................. 43
List of tables

Table 1. Key economic indicators for the fishing industry in Indonesia ........3
Table 2. Key economic indicators for Indonesia ......................................12
Table 3. Structure of vessels .................................................................17
Table 4. Financial model assumptions ..................................................24
Table 5. Parameter estimates of K and q for BSC ..................................38
Table 6. Menu of revenue sharing mechanisms .....................................48
Table 7. A classification of investors ......................................................51

List of figures

Figure 1. Location of South Sulawesi in Indonesia is highlighted in red.........2
Figure 2. Transition of total annual catch and stock biomass .......................4
Figure 3. Equity NPV heat map shows negative NPV when intrinsic growth rate is low .................................................................5
Figure 4. Equity returns are most sensitive to management operating costs ....6
Figure 5. The growth of fisheries has followed that of overall GDP since 200014
Figure 6. The share of fisheries in Indonesian exports has declined since 200014
Figure 7. The total annual catch of blue swimming crab in Indonesia grew eightfold between 1991 and 2011 ..............................................15
Figure 8. The productivity of fishing effort has been declining since 2001 ......15
Figure 9. Business as usual control path for BSC with the best parameter estimates for biological parameters .............................................19
Figure 10. Stabilisation control path for BSC with the best parameter estimates for biological parameters .................................................20
Figure 11. Shallow cut control path for BSC, with the best parameter estimates for biological parameters .................................................20
Figure 12. Deep cut control path for BSC, with the best parameter estimates for biological parameters .................................................21
Figure 13. Transition of catch and biomass ............................................22
Figure 14. Equity NPV heat map shows negative NPV when intrinsic growth rate is low.................................................................27

Figure 15. Heat map for equity NPV, for central scenario at different IUU levels and management options .................................................29

Figure 16. Opportunities to create an equity investment with adequate returns are limited ........................................................................31

Figure 17. Equity returns are most sensitive to management operating costs......32

Figure 18. The fit of the model to observed CPUE data for BSC ......................39

Figure 19. Effort from 2001 to 2014, in fisher days fished.................................39

Figure 20. The flow chart shows the link between management regime and investment revenues..........................................................41

Figure 21. Spreadsheet layout of cash flow statements..................................42

Figure 22. An illustrative control path for fishery transition.........................45

Figure 23. A mixed stack makes for a more efficient financial structure ..........49

Figure 24. Innovation path in fisheries finance.............................................52
1 Introduction

The role of finance and the integrated bio-economic and financial appraisal of blue swimming crab in Indonesia

This case study explores the potential returns on finance for the transition of the Blue Swimming Crab (BSC) fishery in Indonesia. It first describes the economic contribution of the fishery to the country and then presents the results from bio-economic and financial models analysing the outcomes of a transition project.

The work shows the length of time to complete transition, compares the catch control paths that could be followed, identifies which factors drive returns in the fishery, indicating the levels of return that may be available and the effect on the fleet size and fisher incomes. It explains a general, integrated approach to the biology, economics and finance of the fishery, which the authors believe to be new, useful and widely applicable. They offer the case study as a generic template for financial analysis of fisheries beyond Indonesia and as a vehicle for stimulating further discussion of fisheries policy within Indonesia itself.

In addition to the main chapters, there are appendices on bio-economic modelling, on financial modelling and an extended discussion on the role of finance. The last of these appendices is also published as a stand-alone discussion paper (Vivid Economics, 2014b).

There is a sister case study on lobster and conch in Belize, which is contrasting in various aspects (Vivid Economics, 2014a). Both case studies are published as companions to and as illustrations of the discussion within a report on financing fisheries transition published by The Environmental Defense Fund, the Prince’s Charities and 50in10. The reader may refer to a useful glossary of terms in that report.

This case study is structured as follows:
- section 2 describes the contribution of fisheries to the economy of Indonesia;
- section 3 provides the results from bio-economic model;
- section 4 shows the results from the financial model;
- section 5 presents some conclusions and recommendations;
- appendix 1 lists the fisheries institutions in South Sulawesi;
- appendix 2 describes the bio-economic model;
- appendix 3 describes the financial model;
- appendix 4 contains a general discussion of the role of finance.
2 Description of fisheries in Indonesia

An export-focused industry contributing 2 per cent to GDP

2.1 Economy of Indonesia

Indonesia is a lower-middle income country, according to World Bank criteria. Its GDP is expected to grow at a rate of 5.4 per cent in the near future. Gross national income (GNI) per capita was US$3,580 in 2013, while GDP grew by 6.2 per cent in 2012 (see Table 2) and is forecast to grow at 5.4 per cent per annum in 2014, 2015 and 2016 (The World Bank, 2013).

The unemployment rate in Indonesia has been steadily declining after peaking in 2005. In 2013, it was 6 per cent compared with 11 per cent in 2005 (Bank of Indonesia, 2013). Unfortunately, unemployment among 15–24 age group is particularly high and was 21 per cent in 2010 (International Labour Organisation, 2012).

Indonesia has a volatile inflation rate which averaged 4.5 per cent in 2012 and its currency has weakened in recent years. Table 2 shows that between 2009 and 2011 inflation was around 8 per cent, whereas between 2005 and 2008 it averaged 15 per cent. Indonesia’s currency depreciated against the US$ by 26 per cent between 2012 and 2013, due to a widening current account deficit arising weak global and domestic demand (Bank of Indonesia, 2013).

Table 2. Key economic indicators for Indonesia

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2012</th>
<th>2011</th>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (current US$, billion)</td>
<td>878</td>
<td>846</td>
<td>709</td>
<td>540</td>
</tr>
<tr>
<td>GDP per capita (current US$)</td>
<td>3,557</td>
<td>3,471</td>
<td>2,947</td>
<td>2,272</td>
</tr>
<tr>
<td>GNI per capita (US$)</td>
<td>3,420</td>
<td>2,920</td>
<td>2,500</td>
<td>2,160</td>
</tr>
<tr>
<td>GDP growth (annual %)</td>
<td>6.2</td>
<td>6.5</td>
<td>6.2</td>
<td>5</td>
</tr>
<tr>
<td>Inflation, GDP deflator (annual %)</td>
<td>4.5</td>
<td>8</td>
<td>8.3</td>
<td>8.3</td>
</tr>
<tr>
<td>Population (millions)</td>
<td>247</td>
<td>244</td>
<td>241</td>
<td>237</td>
</tr>
<tr>
<td>Unemployment rate (%)</td>
<td>6.1</td>
<td>6.6</td>
<td>7.1</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Source: The World Bank

2.1.1 The economy of South Sulawesi

South Sulawesi’s domestic product grew faster than the national average between 2005 and 2010. This Indonesian province located on the southern peninsula of Sulawesi has a population of 8 million (according to the 2010 census). The GRDP or Gross Regional Domestic Product (constant prices) of South Sulawesi
increased from US$3 million in 2005 to US$4 million in 2010. The year-on-year GRDP growth between 2005 and 2010 ranged from 5.2 per cent in 2005 to 8 per cent in 2010. In comparison, Indonesia’s GDP growth rate was 5.7 per cent in 2005 and 5.9 per cent in 2010 indicating that the gap between the average growth rate of the province and country has increased in recent years. (The World Bank, 2012b).

The unemployment rate in South Sulawesi has declined faster than the national average. The unemployment rate is higher than that of the country as a whole, although in South Sulawesi it fell from 19 per cent in 2005 to 8 per cent in 2010. In the same period, unemployment in Indonesia as a whole fell from 10 per cent to 7 per cent (The World Bank, 2012b).

### 2.2 Role of the fishing industry in the economy

The fishing industry accounts for a small proportion of the economy of Indonesia. The average contribution of fisheries to GDP was around 2 per cent between 2000 and 2012. Its average annual rate of fisheries GDP growth between 2000 and 2012 was 6 per cent, closely tracking the economy’s GDP which grew at 5 per cent during the same period. (see Figure 5). The industry employed approximately 3 million fishers and 900 other employees in the country in 2009, around 1.6 per cent of the total population(Directorate of Planning for Agribusiness, 2011).

The share of fisheries in Indonesia’s total exports has declined since 2000 (see Figure 6). It was on average 1.8 per cent between 2000 and 2013. In 2010, fisheries accounted for 1.3 per cent of exports, and was ranked 18th among the exporting sectors.

The BSC in Indonesia contributed 0.1 per cent to total exports and 7 per cent to the fisheries exports in 2012. The export value of BSC was US$368 million in 2012 (USAID & Indonesia Marine and Climate Support, 2014). Figure 7 shows that the catch of the BSC grew eightfold between 1991 and 2011; it was 40,000 tonnes in 2012, but only 5,000 tonnes in 1977.

South-east Sulawesi accounts for between 5 and 10 per cent of the national export of BSC. This amounted to US$18 to US$37 million in 2012 (USAID & Indonesia Marine and Climate Support, 2014). In 2012, there were approximately 2,000 boats below 20 gross tonnage (GT) and fishers in South Sulawesi (USAID & Indonesia Marine and Climate Support, 2013).
Figure 5. The growth of fisheries has followed that of overall GDP since 2000

Source: Bank of Indonesia, UN COMTRADE

Figure 6. The share of fisheries in Indonesian exports has declined since 2000

Source: UN COMTRADE
Figure 7. The total annual catch of blue swimming crab in Indonesia grew eightfold between 1991 and 2011

Source: UN Forestry and Agriculture Organization

Figure 8. The productivity of fishing effort has been declining since 2001

Source: Indonesia Marine and Climate Support (IMACS) Programme
Indonesia’s fisheries and coral reef systems are under threat from overfishing, uncontrolled and illegal destructive fishing methods. There are no direct controls on the Indonesian BSC harvest. Some catch reports in recent years indicate that the average carapace size of landed BSC is becoming smaller and that the total annual catch level has exceeded annual level of recruitment (The World Bank, 2012a; USAID & Indonesia Marine and Climate Support, 2013). Figure 8 shows that the productivity per unit of fishing effort has been declining since 2001. While the number of traps has risen between 2001 and 2012, the catch per trap per year is falling.

2.3 Market structure

Crab fishing in Indonesia is largely carried out by small-scale operators. They mainly use large bottom-set gillnets and collapsible traps; some also use the now-outlawed shallow-bottomed trawls. Table 3 shows that 76 per cent of crab fishing is accounted for by collapsible trap gear, with the remainder mostly caught by gill net gear. There is great variation in catch size within and between gear types (The World Bank, 2012a).

Around 95 per cent of BSC caught in Indonesia is exported, more than half of it to the United States. BSC exports began in 1994 due to overseas demand; before that the consumption was largely domestic and prices were low. In terms of export destinations, the United States is followed by Singapore at 17 per cent, Malaysia at 10 per cent, Taiwan at 7 per cent, the European Union at 6 per cent, China at 5 per cent, and Japan at 2 per cent (The World Bank, 2012a).

The value of BSC exports to the United States increased between 2007 and 2008. In 2008, the total United States crab import from Indonesia was 9,372 tonnes, a decrease of 15 per cent from 2007. However, the average price increased by 21 per cent from US$14.5 per kilo in 2007 to US$17.5 per kilo in 2008, leading to a 6 per cent increase by value (The World Bank, 2012a).

Six stakeholder groups are involved in the BSC fishery value chain. These are fishers; collectors or middlemen; mini plants or peelers; processors or exporters; distributors or the central market; and retail, supermarkets or seafood restaurants (The World Bank, 2012a). In 2007, the Association of Indonesian BSC Processors (Asosiasi Pengelolaan Rajungan Indonesian, APRI) was formed, aiming at sustainable procurement from healthy stocks. It currently has 11 leading processors, accounting for over 90 per cent of Indonesian crab exported to the United States (The World Bank, 2012a).
Table 3. Structure of vessels

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of mean catch of trap (collapsible trap)</td>
<td>3.22kg/trip–8kg/trip</td>
</tr>
<tr>
<td>Range of mean catch (gill net)</td>
<td>5.4kg/trip–12.6kg/trip</td>
</tr>
<tr>
<td>Range of mean catch (mini-trawl)</td>
<td>0.6–6kg/trip</td>
</tr>
<tr>
<td>Range of trap number per boat (collapsible trap)</td>
<td>400–700</td>
</tr>
<tr>
<td>Range of trap number per fisher (collapsible trap)</td>
<td>100–200</td>
</tr>
<tr>
<td>Number of fishers per boat during fishing season</td>
<td>1–7</td>
</tr>
<tr>
<td>Harvest during October–December, June</td>
<td>5–15kg/trip</td>
</tr>
<tr>
<td>Harvest during July–September</td>
<td>&lt;5kg/trip</td>
</tr>
<tr>
<td>Fraction of catch accounted for by collapsible trap</td>
<td>76%</td>
</tr>
</tbody>
</table>

Source: Bogor University, USAID/Indonesia Marina and Climate Support (IMACS) Programme

2.4 Management options

Management measures to control BSC fishing in Indonesia target improvements in data collection, season closures and legal minimum carapace sizes. In 2009, a Marine Stewardship Council (MSC) pre-assessment of Indonesian BSC fisheries was conducted. This study highlighted the paucity of reliable data on stock status and the absence of fishery management. A work plan has been devised to address data and fishery management gaps identified by the study. Management options suggested by stakeholders include an incremental legal minimum size of 10 cm carapace width and not catching gravid females. If caught, they are to be returned to the sea or kept in a net cage until the female releases her ova into the sea. Selective traps with an escape vent size of 35 x 50 mm must be used. In addition, the season for BSC is closed for select periods to protect the spawning adult population. The measures also aim to limit effort by not issuing additional licences. Other measures include hatchery projects, spatial protection, such as efforts to protect nursery and spawning grounds, and registration and licensing of fishers and purchasers of crabs to improve data collection (USAID & Indonesia Marine and Climate Support, 2014).

Further management options can be considered. Best practice in fisheries management involves scientific data collection, monitoring of harvesting, control of methods and total catch, secure tenure or other rights based management and robust monitoring. The core elements are described in Appendix 4 within the discussion of financing.
3 Bio-economic model results

The bio-economic outcomes of the transition project are estimated in this section, under various scenarios and sensitivities.

3.1 Choice of bio-economic model

Bio-economic models are needed in fisheries policy work in order to quantify the dynamics of the stock over time. That dynamics can be represented in a number of ways mathematically, and the choice of model in this case was influenced by the data available. In a fishery such as Indonesia where management systems are nascent, there is no stock assessment is currently available but there is limited time series data on catches and fishing effort. Appendix 2 explains how this data was translated into a model of the stock which allows the estimation of its maximum sustainable yield and associated biomass and intrinsic growth rate.

3.2 Control paths

Bio-economic model runs were undertaken for a range of values for biological parameters (carrying capacity, intrinsic growth rates and initial stock status). These ranges were chosen to reflect the plausible range given available information for the stock and species (see Appendix 2).

For each combination of parameter values, four control paths were implemented. With business as usual, the effort is set at the average level from 2008 to 2012. With fishery stabilisation, catch limits are set for 2015 onwards to stabilise the BSC population at 2014 levels. The shallow cut path implements a 25 per cent reduction in catches from 2015 (compared with 2014 levels) until the BSC stock biomass has recovered to levels capable of delivering maximum sustainably yield (B_{msy}), after which catch limits are set to maximum sustainable yield (MSY). The deep cut path is the same as the shallow cut, but with a 50 per cent reduction in catches from 2015 to allow for a faster recovery to B_{msy}. These ‘bang-bang’ controls have been chosen for the illustrative modelling here. In practice, the catch could be adjusted over time, which might lead to higher net present values.

Business as usual results in a gradual decline in BSC population, leading to a risk of recruitment failure (see Figure 9). Catch per unit effort (CPUE) decreases in line with the stock biomass, resulting in increasing levels of effort required to make ever-decreasing catches. The stock is depleted for all parameter combinations.

Stabilisation of the stocks in 2015 results in the stock remaining at 25 per cent of B_{msy}, with catches corresponding to 40 per cent of MSY (see Figure 10). This level of stock status would result in an elevated risk of recruitment failure. Catch rates remain low due to suppressed biomass.

A shallow cut (25 per cent) in TAC from 2015 allows the BSC stock to recover relatively quickly to B_{msy} for all parameter combinations, taking between three and six years. Despite low stock status in 2014, 20 per cent of B_{msy}, with the best parameter estimates, the BSC stock recovers to B_{msy} in five years (see Figure 11). Once the BSC stock has recovered to B_{msy}, it can support catches of MSY with five times the catch rate and 90 per cent of the effort of 2014 levels.

A deep cut (50 per cent) in TAC from 2015 allows the BSC stock to recover rapidly to B_{msy}, slightly faster than the shallow cut (25 per cent). With the most likely parameter estimates, the BSC population recovers to B_{msy} in four years (see Figure 12).
As with the shallow cut in TAC, a deep cut enables the stock to support catches of MSY with five times the catch rate estimated for 2014, once the stocks have recovered to $B_{\text{msy}}$. Due to the relatively fast rate of population increase, the recovery period for all parameter combinations for the deep cut in TAC (an average of four years) is only marginally quicker than the shallow cut (an average of four years and four months).

**Figure 9.** Business as usual control path for BSC with the best parameter estimates for biological parameters

Note: Catch and effort data for the BSC stock were available up until 2012. Anecdotal evidence suggests that effort decreased by 50 per cent from 2012 to 2014, that is, 50 per cent of fishers exited the fishery during this time. That there is no TAC today and therefore there is none under BAU. This is a fast growing and reproducing species where the catch can be close to the tonnage of the biomass.

Source: MRAG
Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

Figure 10. Stabilisation control path for BSC with the best parameter estimates for biological parameters

Source: MRAG

Figure 11. Shallow cut control path for BSC, with the best parameter estimates for biological parameters

Source: MRAG
3.3 Biological scenarios

Heat map charts are presented for both catches and biomass (see Figure 13). For each heat map, results are grouped by control path. Within each control path, results are provided for nine combinations of parameter values encompassing their plausible ranges.

The catch heat map displays the combined catch level of the BSC fishery relative to the MSY. The colour ranges from green, which denotes catches equal to the MSY, through to red, where catches are approaching zero.

The biomass heat map displays the biomass of the BSC population relative to the biomass capable of delivering maximum sustainable yield ($B_{msy}$). The colours range from green, where biomass is equal to or greater than $B_{msy}$, to red, where biomass is approaching zero. CPUE is directly proportional to stock biomass (see Appendix 2), so the biomass heat map also displays the relative change in CPUE.
3.4 Summary of bio-economic model results

The projections for the business as usual control path for the South Sulawesi BSC fishery highlight the need for increased management control to ensure long-term sustainable fishing. Effective management will result in increased catches and reduce the risk of recruitment impairment.

The stabilisation of the stock at 2015 levels would result in low biomass levels, while retaining a high risk of recruitment failure. Estimated catch volumes and catch rates would be maintained at a low level.

The introduction of a shallow cut control path, reducing catches by 25 per cent relative to 2014 levels, would allow the stocks to rapidly recover to B_{msy} levels, taking three to six years. Following recovery, the fishery would deliver MSY with catch rates five times higher than 2014.

A further reduction in catches to 50 per cent relative to 2014 would allow the stock to recover faster, but not appreciably so.

Similar to the Belize case study, the presence of IUU fishing could trigger deeper reductions in catch in the legal fishery required to allow the stock to recover. The removal of IUU would allow larger catches in the legal fishery without impacting the time required to enable the stocks to reach optimal levels.
4 Financial model results

Investment returns may be attractive if circumstances are favourable

4.1 Central investment scenario

4.1.1 Biomass and catch

The best estimates of the bio-economic model indicate that it may take three to four years for the biomass to return to a sustainable level. The biomass is expected to be four times as large as its 2012 level at MSY. If the TAC is reduced by 50 per cent, the best estimate is that the fishery might take three years to return to MSY, while it might take four years if the TAC were reduced by 25 per cent. The maximum sustainable yield is estimated to be 1,710 tpa compared with a catch of 1,040 t in 2012. MSY biomass is expected to be 2,850 t for the BSC compared with 730 t in 2012. The fishery can be stabilised such that the biomass is maintained at its 2012 level if catches are limited to 750 tpa. Catch per unit effort is predicted to increase by 270 per cent compared to 2012 level.

Depending on the range of model parameter values, the time it takes to rebuild the biomass ranges from two to six years if catches were reduced by 25 per cent, and from two to five years if catches were reduced by 50 per cent. MSY estimates also differ substantially from the best estimates, with minimum BSC catches of 1,480 tpa and maximum catches of 2,030 tpa. Correspondingly, the MSY biomass ranges from 1,800 t to 4,870 t. The improvement in CPUE ranges between 220 per cent and 380 per cent, depending on model estimates.

4.1.2 Management costs and financial model assumptions

The central financial scenario assumes management operating costs of US$1.7 million per year. The total implementation cost of the reform programme is estimated to be US$3 million. The financing of the reform programme covers implementation costs and all operating losses that are incurred during the transition phase. Management operating costs are based on the Philippine BSC management plan, and there is a high degree of uncertainty in estimating these costs. A range of estimates was used to gauge the sensitivity of the financial performance of the project to management costs. The management costs are intended to cover scientific data collection and analysis, a licensing regime, total allowable catch system, and monitoring and enforcement. Table 4 lists the financial model’s assumptions. Fish prices are assumed to be constant at their current levels, while a mark-up of 20 per cent is applied in the reformed fishery to reflect some benefit from greater market access associated with certification for sustainable management and improved carapace size.

4.1.3 Financial structure and return on investment

The illustrative financial structure employed has a gearing ratio of 50 per cent, and the equity investment is enhanced by a US$1 million capital grant. Equity investment is needed to attract stakeholders with strong incentives for the success of the reform programme, as well as technical and managerial skills. A level of debt is needed to reduce the burden of corporate tax and to provide a diversified
source of funding, some of which can be international development funding with a low required rate of return. The capital grant is included to provide a cushion against biological and timing risk of the biomass rebuilding.

### Table 4. Financial model assumptions

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Values</th>
<th>Inputs</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Constant at 3 ($/kg)</td>
<td>Gearing ratio</td>
<td>50 per cent</td>
</tr>
<tr>
<td>Price mark-up in reform scenario</td>
<td>20 per cent</td>
<td>Guaranteed debt interest rate</td>
<td>4 per cent (real)</td>
</tr>
<tr>
<td>Levy on revenue</td>
<td>40 per cent</td>
<td>Interest rate</td>
<td>6 per cent (real)</td>
</tr>
<tr>
<td>Tax rate</td>
<td>25 per cent</td>
<td>Debt guarantees</td>
<td>US$1 million</td>
</tr>
<tr>
<td>Management operating costs</td>
<td>US$1.6 million</td>
<td>Capital grants</td>
<td>US$1 million</td>
</tr>
<tr>
<td>Social discount rate</td>
<td>3.5 per cent (real)</td>
<td>Fisher compensation</td>
<td>0 per cent</td>
</tr>
</tbody>
</table>

Source: Vivid Economics

The best estimates of the bio-economic model suggest a real rate of return of 9 per cent on equity investment when catches are reduced by 25 per cent in the transition phase compared with their 2014 levels. In order to achieve a return at this level, equity investment requires enhancement from capital grants. A total of US$6.8 million of investment is required, made up of US$2.4 million in equity, US$3.4 million in debt and US$1 million of grants. Seventy-six per cent of funding is required for management operating costs during the fishery recovery phase; 15 per cent for capital costs; 4 per cent is capitalised interest from debt; and 4 per cent is provisions and working capital. A capital grant can be targeted at making the project more appealing to investors, and is required as a cushion against risk involved in rebuilding the biomass. Given the social gains accruing from the project, the government and/or an international development organisation may choose to subsidise the reform project.

The total return on the investment is expected to be real 6 per cent, with debt earning 5 per cent and equity earning 9 per cent. The revenues come from a 40 per cent share of total fishing revenues, which are estimated to be US$6.2 million per annum when catches are at their MSY level, compared with US$3 million in 2012 and US$2.3 million if the fishery were to be stabilised but not rebuilt. The timing of the biomass rebuilding is important since no revenues are generated during the transition phase. Cash flows available to equity investors are revenues net of management operating costs, interest and debt repayment, and 25 per cent corporation tax, and are expected to be approximately US$350,000 per annum for a period of 23 years from 2018. These cash flows have a present value of US$2.5 million, assuming a real 7 per cent discount rate. The present value of all equity outlays is US$2.1 million, giving an NPV of US$0.43 million. Debt interest plus principal repayments start in 2018 at a level of US$380,000 per annum. The lowest debt service cover ratio over the life of the project is estimated to be 2.1.
4.1.4 Fishers’ income

The impact of the management reform on fishers may be compared with a scenario in which the fishery is stabilised at the current biomass level. In the reform scenario the total fishing effort is reduced during the transition period and then increases. The central scenario assumes a reduction of 25 per cent in catches, with the number of fishermen required to harvest the available catch decreasing from 1,500 in 2012 to 360 in 2015. The lowest number of fishers required to harvest the available catch is estimated at approximately 410 in 2016, when catches are still low and fishers’ productivity improves due to stock rebuilding. When the fishery starts operating at MSY, the number of fishers required to harvest available catch increases to 990. In the stabilised fishery scenario, the number of fishers is 1,180 from 2015, with relatively low catch per unit effort.

Fishers’ total income, which includes per fisher income and profits, has an NPV of US$46 million in the reform scenario, assuming a 3.5 per cent social discount rate, compared with an NPV of US$29 million under a stable current biomass. This represents an increase in the present value of fishers’ income of US$18 million. Fishers’ total annual income falls from US$2.3 million in 2012 to US$ 0.7 million in 2015, when catches are cut. Similarly, income per fisher decreases by 38 per cent, from US$ 1,570 in 2010 to US$ 970 in 2015. When the biomass is rebuilt, fishers’ total income rises to US$ 3.2 million per annum, representing an 8 per cent increase relative to 2010, and would be 180 per cent higher than income under the stabilising scenario. Per fisher income rises substantially in the reformed fishery, when it is operating at MSY, as fishers’ overall productivity increases by 270 per cent relative to 2012. Per fisher income is expected to be US$3,200 per annum when the fishery is operating at MSY. In the stabilised fishery scenario, annual income per fisher would be much lower, at US$1,400. During the transition phase the fishing fleet is assumed to operate at full capacity and surplus boats are either retired or mothballed. The impact of the fishery reform on the number of fishers and on per fisher income can be softened by a compensation package during the rebuilding period. However, this increases the cost of the reform and requires a higher revenue sharing rate in the latter stages of the project to sustain the rate of return to prospective investors.

4.2 Model uncertainty and option value

4.2.1 Parameter uncertainty

The uncertain biomass rebuilding rate is the main risk factor for prospective investors. The state of the current biomass and its intrinsic growth rate give a wide range for the predicted duration of the transition phase. Two important parameters in determining the rate and scale of rebuilding are the carrying capacity, which is the maximum biomass the fishery can sustain, and the intrinsic growth rate, which measures the recruitment of biomass. The central model scenario is populated with the best estimates of the intrinsic growth rate ($r$) and the size of the initial biomass as a proportion of the carrying capacity ($K$). These estimates are:

- intrinsic growth rate of 1.2 for the BSC;
- size of the initial biomass as a proportion of the carrying capacity of 40 per cent for BSC;
- resulting carrying capacity estimates of 5,700 t.

As well as best estimates (B), low (L) and high (H) values for intrinsic growth rate and the initial biomass of the carrying capacity are also considered, making nine different combinations of model estimates \{LL, LB, LH, BL, BB, BH, HL, HB, HH\}. 

vivideconomics

MRAG
The central scenario (BB model) shows an attractive equity return with a positive NPV at a revenue sharing rate of 40 per cent. Equity returns are insensitive to the level of TAC reduction. The rebuilding time of the biomass is short and decreases by at most one year when the reduction in catches changes from 25 per cent to 50 per cent. In the central scenario, return on investment barely changes, while equity return increases from real 9 per cent to 10 per cent if catches are reduced by 50 per cent. Fishers’ income NPV is not sensitive to the level of TAC reduction. Given the high revenue sharing rate required to generate an adequate return, the most important risk factor for investors could be the small net operating margin, which is determined by crab prices and management operating costs.

A low intrinsic growth rate has a critical impact on investment returns. Models with low $r$ cannot generate positive equity NPV, even at high profit sharing rates. Figure 14 presents a heat map of equity present values, discounted at real 7 per cent, for a collection of model assumptions. No management option produces positive equity NPV at all revenue sharing rates and discount rates when the intrinsic growth rate is low. Medium estimates of $r$ generate positive NPV at a 40 per cent profit sharing rate and high discount rates. However, with a high intrinsic growth rate, equity investment can be attractive even at a 35 per cent profit sharing rate. The increase in fisher income is robust to a range of bio-economic model and revenue sharing rate assumptions.

The option of partial management reform followed by full management enhancement may be attractive. The full investment decision can be delayed until more data on the intrinsic growth rate is obtained. With a high intrinsic rate, the equity return can be attractive even at low revenue sharing rates. The model with the best estimates of $K$ and high estimates of $r$ (BH) shows an equity return of real 17 per cent compared with the central model (BB) real return of 9 per cent, and the −1 per cent of model (BL). By putting a partial control system in place while data is collected, more precise estimates of $K$ and $r$ might be obtained. Full reform could be implemented if favourable bio-economic parameters were obtained.

Figure 14 depicts equity NPV under a range of parameter values and management scenarios. For each model, equity NPV varies with the level of reduction in catches, the level of the capital grant, and the equity discount rate. Positive values are shown by green bars and negative values are shown by red bars. The chart shows:

- how NPV changes with values of $K$ and $r$ across management scenarios;
- how, within each model, equity NPV varies with levels of TAC reduction and the capital grant;
- a range of real discount rates, given investor perception of the riskiness of the project and the required rate of return that might be sought by the market.

The middle panel, which presents the equity NPV generated under the best estimates for both $K$ and $r$ (model BB), shows positive values at all discount rates only when the revenue sharing rate is set at 40 per cent, when a shallow cut to catches is applied. At a 30 per cent sharing rate, equity NPV is expected to be negative. The picture is the same when a deep cut option is pursued. The chart also shows the pattern of positive NPV for a range of model parameter values. The lower panels show model outputs when the intrinsic growth rate is high. The frequency of positive NPV is higher especially for those models with the best and the low estimates of $K$, models (LH) and (BH). Finally, the upper set of panels indicates the risk of a low intrinsic growth rate. In such circumstances, it could be a challenge to generate any income for prospective investors.
Figure 14. Equity NPV heat map shows negative NPV when intrinsic growth rate is low

<table>
<thead>
<tr>
<th>Path</th>
<th>Revenue sharing rate</th>
<th>Model average</th>
<th>4%</th>
<th>5%</th>
<th>6%</th>
<th>7%</th>
<th>8%</th>
<th>9%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model average</td>
<td>25% cut average</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Path 25% cut average</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Path 50% cut average</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Path 50% cut average</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>Model average</td>
<td>25% cut average</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Path 25% cut average</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>Model average</td>
<td>50% cut average</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Path 50% cut average</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Equity NPV for various model parameters and assumptions. Central scenario is obtained by assuming best estimates for intrinsic growth rate and proportion of initial biomass of the carrying capacity (Model BB). It also assumes that catches are cut by 50 per cent, a levy rate of 25 per cent and a discount rate of 7 per cent.

Source: Vivid Economics
4.2.2 Illegal, unreported and unregulated fishing

The level of IUU fishing plays an important role in investment returns. IUU fishing is important for fishery management for two reasons; first, it affects the bio-economic model estimates of the sustainable biomass and catches; and second, the future level of IUU affects biomass rebuilding time and the level of the cut that is needed for rebuilding. Three levels of IUU are assumed for the purpose of bio-economic model estimates: 5, 10 and 20 per cent. There are three possible management outcomes, depending on the strength of the control regime and the source of the IUU fishing. In the first instance, IUU fishing remains constant at the 2014 level. If this is the case, it may take longer for stock to be rebuilt since this lowers the effectiveness of TAC control; therefore, for the biomass to be rebuilt successfully, a deeper cut in legal catches may be needed. In the second outcome, IUU fishing is reduced at the same rate as catches but not removed completely. This also makes the transition period longer, since the MSY of biomass is expected to be larger, hence it takes a longer time period to rebuild stocks. This can be mitigated by applying deeper cuts. Finally, IUU fishing is assumed to be removed completely under a strong control regime. This does not hasten biomass rebuilding compared with the central scenario; however, because IUU fishing becomes part of legal catches, it improves legal fishing revenues, the return on investment and fishers’ income.

If IUU fishing is removed, the equity return increases from real 9 per cent to 14 per cent in the central BB model when the level of IUU fishing is assumed to be 10 per cent of catches. The return on investment increases from real 6 per cent to 8 per cent, and fishers’ income NPV increases by US$2 million in the reform scenario. In each panel of Figure 15, equity NPV is shown for a combination of the level of IUU fishing and management outcome for a range of inputs on the level of TAC reductions, the revenue sharing rate and finally the discount rates. Model parameters are taken from the central model estimates. Given the nature of fishing in South Sulawesi, the level of IUU fishing is likely to be high. Effective management of IUU may be essential in improving the performance of the reform programme and it may reduce the burden on legal fishers of the reduction in catches.
Figure 15. Heat map for equity NPV, for central scenario at different IUU levels and management options

<table>
<thead>
<tr>
<th>Revenue sharing rate</th>
<th>Discount rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4%</td>
</tr>
<tr>
<td>Average</td>
<td>Model average</td>
</tr>
<tr>
<td>25% cut</td>
<td>5% IUU op 0</td>
</tr>
<tr>
<td>50% cut</td>
<td>5% IUU op 0</td>
</tr>
<tr>
<td>50% cut</td>
<td>5% IUU op 0</td>
</tr>
</tbody>
</table>

Note: Equity NPV under various IUU assumptions and IUU management options under central scenario assumptions.
Source: Vivid Economics
4.3 Other risk factors and sensitivity analysis

The equity rate of return is sensitive to the level of management costs. Some level of fisher compensation may be required to make the project politically viable. Figure 16 shows the equity rate of return from the central model scenario (BB), as it varies with assumptions on management costs, fisher compensation and capital grants. The maximum equity rate of return is 47 per cent. There is limited scope for producing an investable entity, as the return on equity is very sensitive to model parameters and assumptions.

If management operating costs were higher at US$2.1 million per year, return on equity could decline to real –5 per cent, in the central scenario, while the management firm operating margin would fall to US$0.2 million. The lowest debt service coverage ratio would be 1.1, while equity investors would earn US$50,000 per annum, on average, over the course of the project, compared with US$380,000 under medium estimates of management operating costs. The return on the entire investment falls to real 1 per cent. Fishers’ income is not affected since all costs are borne by the management entity. A 25 per cent increase in management operating costs relative to medium estimates makes the project unviable as it fails to generate positive returns to equity holders at any revenue sharing rate less than 40 per cent and a capital grant of US$3 million of more.

The level of fisher compensation has a moderate impact on equity return, given the short time it takes the biomass to recover. Figure 16 suggests that compensation introduced at a rate of 80 per cent of fishers’ income, based on pre-reform margins, would decrease the equity return in the central scenario from real 9 per cent to 6 per cent. Assuming a rate of 60 per cent compensation, the equity rate of return would decline to 7 per cent and fisher compensation would average US$ 0.3 million per annum during the transition phase, adding US$0.5 million to the present value of fishers’ income.

The variables used in Figure 16 are compensation rate, debt interest rate, revenue sharing rate and capital grant. Compensation rate is the proportion of fisher’s income, based on pre-reform margins, that is offered to the fisher to soften the impact of the reform on their incomes. Debt interest rate is defined as the interest rate on debt capital. Revenue sharing rate shows how the returns are shared with the equity holders. A capital grant is typically provided by a philanthropic foundation, a local government or a foreign donor government. It enhances the returns to other finance components and shifts up the returns or reduce the risk of default to each.
Figure 16. Opportunities to create an equity investment with adequate returns are limited

<table>
<thead>
<tr>
<th>Debt interest rate</th>
<th>6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue sharing rate</td>
<td>Capital grant</td>
</tr>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>20%</td>
<td>-11%</td>
</tr>
<tr>
<td></td>
<td>-11%</td>
</tr>
<tr>
<td></td>
<td>-9%</td>
</tr>
<tr>
<td></td>
<td>-1%</td>
</tr>
<tr>
<td>25%</td>
<td>-4%</td>
</tr>
<tr>
<td></td>
<td>-2%</td>
</tr>
<tr>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>30%</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>35%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td>35%</td>
</tr>
<tr>
<td>40%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>34%</td>
</tr>
</tbody>
</table>

Note: Equity rate of return under various model assumptions. A rate of −100 per cent indicates a non-investable project, where there is no income paid to equity investors. Blanked out cells indicate that equity investment is not needed under the current capital structure assumption. Central biological parameters.

Source: Vivid Economics
Figure 17 highlights the range of equity returns under the upper and lower ranges of the financial model’s inputs. The highest level of uncertainty is the level of management operating costs, with a high annual estimate of US$2.1 million, and a low estimate of US$1.3 million. Prices have a degree level of uncertainty and can lead to equity returns falling by 4 per cent if prices are 10 per cent lower than in the central scenario. Equity returns are less sensitive to levels of the capital grant and the rate of fisher compensation. This enforces the conclusion that management operating costs are the most risky component of the project. The risks attached to the level of the capital grant and fisher compensation are not as important, since these can be gauged before the investment takes place. However, there is a certain amount of sovereign and political risk attached to them.

Source: Vivid Economics
5 Conclusions and recommendations

A fast growing fishery and valuable building opportunity necessitating the creation of a new management system

The paucity of current management capability in place in Indonesia has overseen a rapid expansion and then decline of the catching sector, putting the blue swimming crab population in South Sulawesi under pressure. The fish stock is well below its optimal level and the value of the fishery could be doubled with judicious management and a willingness to reduce catches for around three or four years. For every US$1 of wise investment in this fishery, US$2 of benefit is created. Once the stock is rebuilt and maintained, fishing incomes will be much higher and there will be an enduring surplus for those working in the supply chain and for the government.

The rebuilding of a fishery involves investment in the natural capital, the stock, and complementary necessary investment in management systems to sustain the stock. It may also involve complementary desirable, discretionary investments along the supply chain.

The stock investment can only be made by reducing fishing mortality substantially below the recruitment rate. In Indonesia, this can be achieved through a cut in the total allowed catch. There is no regret, in economic terms, from making a deeper cut in catch, because it brings forward in time the achievement of maximum sustainable yield. However, the people who pay for this investment are the fishers, and to some extent others along the supply chain, or, if fishers are paid compensation, the government. If the fishers are allowed to trade their fishing rights, which they currently are not, then much of the compensation may take place between fishers, but otherwise they might appeal for compensation from government or may resist deep cuts in the catch. Thus, the question of compensation is of political importance.

Management systems are the key to the building of a highly productive, sustainable fishery. They involve significant expenditure both to establish and to maintain and the value of the fishery is dependent on both the effectiveness of the controls and the efficiency with which they are operated. The better the knowledge of the biological parameters of the fishery and the more effective the control of illegal, unreported and unregulated (IUU) fishing, the better characterised and higher the returns on the management investment. In South Sulawesi, enforcement of legal controls will be an necessary part of the new management arrangements if the fishery is to become fully productive.

Information on the biological parameters of fisheries and the costs of management is valuable. Its publication to high statistical standards would make it easier to assess the costs and benefits from fisheries management improvement globally. Additional information on catching costs, the supply chain structure and fish prices would add further richness to the data.

This investment could be financed with the help of a range of financial parties but it is not yet clear, because the management cost estimates are quite uncertain, whether the returns on offer would be sufficient to finance some of the structure on commercial terms. Some grant or concessionary finance would be necessary to fund initial steps to stabilise the fishery and to demonstrate effective management and revenue recovery.
mechanisms. Once these steps have been completed, a new financial assessment could be made to test the feasibility of financing the remaining steps on a more commercial basis.

The circumstances of the fishery suggest a number of candidate options for funding the investment, ranging from: local fisher participation, aggregated through cooperatives; government sponsorship, through a management authority and perhaps a shift to rights based management; and international finance from donors and international financial institutions, accompanied by technical assistance. Other combinations of these funding parties might also be possible. The current institutional arrangements appear to be fragmented and immature, and there is further work needed to explore how current institutions might take on management roles and might work alongside a financial entity or might provide a conduit for finance.

The case study also shows what it takes to make an investible fisheries improvement project. The pieces are:

- a track record of scientific and management data;
- proven management success using respected management approaches;
- an integrated bio-economic-financial model used for assessing and characterising risks, informing a risk mitigation plan; and
- an appropriate financial entity, structure and group of financial participants.

Considered as part of a wider and longer-term programme of fisheries investment and financing, the Indonesia case presents an opportunity to advance standardisation in aspects of data collection, financial risk assessment and management, contracts and statistical publication which could be of significant value to other fisheries projects in other parts of the world and might justify technical assistance and targeted funding. If reform were delivered successfully in South Sulawesi, it would provide many lessons in establishing and funding fisheries management from an incomplete system and a small capital base.
References


USAID, & Indonesia Marine and Climate Support. (2014). *WORKSHOP HAND-OUT ON HARVEST CONTROL RULES IN THE FISHERY OF BLUE SWIMMING CRAB BASED ON DATA COLLECTED*.


Appendix 1: Fisheries institutions

The Ministry of Marine Affairs and Fisheries (MMAF) oversees fisheries in Indonesia. The Directorate General of Capture Fisheries within the MMAF has the mandate to develop and issue policies for capture fisheries (Forestry and Agriculture Organisation of the United Nations, 2004).

Other official agencies and institutions play research and enforcement roles. A number of official agencies provide research assistance to the Ministry, including:

- the Indonesian Institute of Science and Technology (LIPI); and
- the Central Fisheries Research Institute (CRIFI).

Further, other formal institutions with overlapping mandates include:

- Ministry of Local and Interior Government - for management authority devolution to both the provinces (0-12 nm) and districts (0-4 nm);
- Ministry of Forestry – taking management authority for all marine parks;
- Ministry of Environment for maritime environment-related issues;
- Navy, Maritime Police for maritime enforcement roles.
Appendix 2: Bio-economic modelling

A bio-economic model was constructed with which to project the South Sulawesi blue swimming crab (BSC) stock status and catches resulting from the implementation of different control paths. The control paths are outlined in section 3 and relate to biological reference points ($B_{msy}$) or concepts, such as stabilisation of stocks.

The fishery data available for the BSC is summarised in section 2 and comprises catch and effort data. The biological component of the bio-economic model was constructed using biomass dynamic models, otherwise known as surplus production models. The biomass dynamic models were tuned to nominal catch per unit effort (CPUE) data using maximum likelihood estimation. Errors were assumed to be log-normally distributed.

Initially, the performance of different assumptions of stock growth functions was explored, including the use of Schaefer, Fox and Pella-Tomlinson production functions. A comparison of maximum likelihoods and Akaike information criterion values indicated that the Schaefer production function provided the best fit to the observed nominal CPUE data, and this was implemented in the bio-economic model.

The Schaefer production function has two parameters: $r$, the intrinsic rate of growth; and $K$, the carrying capacity. The rate of growth in biomass, $B(t)$, is expressed as:

$$\frac{dB(t)}{dt} = rB(t) \left(1 - \frac{B(t)}{K}\right)$$

The biomass in a given year, $B_{t+1}$, is then given by:

$$B_{t+1} = B_t + rB_t \left(1 - \frac{B_t}{K}\right) - C$$

where $B_t$ and $C$ are biomass and total catch weight in the preceding year respectively. The catchability coefficient, $q$, defines the fraction of the population fished by an effort unit, that is:

$$C = qEB$$

where $C$ is catch and $E$ is effort. The catchability coefficient is required due to the use of CPUE as a relative abundance index. The stock status at the beginning of the time series is also required, which can conveniently be expressed as a proportion of $K$, $B_{initial}$.

In summary, the model has four parameters: $r$, $K$, $q$ and $B_{initial}$. The catch and CPUE data for the BSC fishery was not sufficiently informative to allow for robust estimation of $r$, $K$ and $q$ simultaneously. Instead, available estimates of $r$ for BSC stocks were used to identify a plausible range of values. A similar approach was taken for $B_{initial}$, in that a review of available literature informed a plausible range of values for $B_{initial}$. Parameters $K$ and $q$ were then estimated for different combinations of $r$ and $B_{initial}$, by fitting the model to the observed CPUE data.

Available estimates of intrinsic growth rate for BSC from other stocks were relatively sparse in the literature. Intrinsic growth for the South Australia BSC stock is estimated to be 2.58 (Cheshire & Svane, 2005). Available estimates for other swimming crab species were lower, such as 0.6 for the Texan blue crab (Callinectes sapidus) fishery (Sutton & Wagner, 2007). BSC is known to be a fast-growing species, reaching maturity by the age of one year. It is clear that the intrinsic growth rate of BSC is likely to be substantially higher than those for queen conch and lobster, as examined in the Belize case study. In light of the available
Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

information, the range of plausible estimates of $r$ for BSC was set at 0.8 to 1.8, with an intermediate value of 1.2.

Estimates for $B_{\text{initial}}$ for the BSC stock were based on plausible estimates given available information on the catch history of the fishery. It appears likely that the fishery was fully exploited by 2001. At the same time, it is likely that the stock was at a level where recruitment was not significantly impaired, given the stability in catches in subsequent years. Consequently, the range for $B_{\text{initial}}$ was set at 0.3 to 0.5, with an intermediate of 0.4. It is important to note that it is difficult to robustly estimate $B_{\text{initial}}$. An alternative approach would be to either reconstruct a full time series of catches or to extrapolate known catches back to a particular start year for the fishery (Medley, Cheung, Fulton, & Minte-Vera, 2009). Given the data available for the fisheries, the approach of setting $B_{\text{initial}}$ was considered more pragmatic.

The resulting model fits for the different parameter combinations provided the starting points for the model projections. The process of fitting the biomass dynamic model was not an attempt to conduct stock assessments for the BSC stock. Rather, the intention was to estimate plausible ranges for parameter values and to use these to undertake projections from appropriate starting conditions.

Table 5 below provides the estimates for $K$ and $q$ for the different combinations of $r$ and $B_{\text{initial}}$.

Table 5. Parameter estimates of $K$ and $q$ for BSC

<table>
<thead>
<tr>
<th>$B_{\text{initial}}$</th>
<th>Low $r$ (0.8)</th>
<th>Medium $r$ (1.2)</th>
<th>High $r$ (1.8)</th>
</tr>
</thead>
</table>
| Low $B_{\text{initial}}$ (0.3) | $K = 9,700$  
$q = 0.028$ | $K = 6,700$  
$q = 0.040$ | $K = 4,500$  
$q = 0.058$ |
| Medium $B_{\text{initial}}$ (0.4) | $K = 8,200$  
$q = 0.026$ | $K = 5,700$  
$q = 0.038$ | $K = 3,900$  
$q = 0.054$ |
| High $B_{\text{initial}}$ (0.5) | $K = 7,400$  
$q = 0.025$ | $K = 5,200$  
$q = 0.035$ | $K = 3,600$  
$q = 0.051$ |

Source: MRAG

The fit of the model to CPUE is provided below for the medium $r$ and $B_{\text{initial}}$ parameter sets (see Figure 18).

The model generally fitted well to the observed CPUE. CPUE, and therefore biomass, was estimated to have decreased by more than 50 per cent from 2001 to 2012. This scenario appears consistent with anecdotal information suggesting that 50 per cent of fishers exited the fishery between 2012 and 2014 due to its condition. Fitting $r$ along with $q$ and $K$, with fixed $B_{\text{initial}}$ ranging from 0.3 to 0.5, resulted in estimates of $r$ ranging from 1.2 to 1.8, indicating that the range for $r$ assumed in the modelling (0.8 to 1.8) is generally supported by the data available from the fishery.

Effort data for 2001 to 2012 was denominated in units of trap equivalents. As discussed above, anecdotal evidence suggests that 50 per cent of fishers left the fishery between 2012 and 2014. This was taken into account in model projections by assuming a linear 50 per cent reduction in effort over the same time frame. The resulting observed effort for 2001 to 2012, and estimated effort for 2013 and 2014, is presented in Figure 19.
Figure 18. The fit of the model to observed CPUE data for BSC

Source: MRAG

Figure 19. Effort from 2001 to 2014, in fisher days fished

Source: MRAG
The sensitivity of model results to levels of IUU fishing was explored. IUU fishing was assumed to have persisted from 1996 to 2014, accounting for a fixed percentage of legal catches. Three levels of IUU fishing over this time were used in the sensitivity analysis: 5, 10 and 20 per cent. In addition, three scenarios of IUU fishing were used in projections: IUU fishing continuing from 2015 at the same fixed percentage of legal catches; IUU fishing instantly removed in 2015 and stock instead caught by the legal fishery; and IUU fishing continuing from 2015 at 2014 levels.
Appendix 3: Financial modelling

Management regime and investment revenue

The financial model analyses how investment returns are derived from increased fishery revenues or surpluses. Figure 20 shows the link between an illustrative management regime and investment revenues. In this illustration, the cooperative obtains revenue by selling the harvest at international prices. The revenues and profits to the cooperatives are shared between the investors, the crew and vessel owners. The cost structure of vessels depends on their number, utilisation, catch per unit effort and technological trend. Under the management regime, rent can be extracted from the cooperative in the form of a levy or royalty and from the vessel owners in the form of licence fees or leases. This rent constitutes the investment revenue.

The investment revenue is used to purchase fishing rights or quotas, to cover management and enforcement costs of the regime and to cover the costs of setting up. The performance of the investment is judged by metrics such as return on investment or return on equity and return to the vessel owners and fishermen.

The financial income generated by the investment revenue is used for paying interest, debt and dividends. A gearing ratio and debt service coverage ratio is specified for the financial structure, determining how much equity is required.

Figure 20. The flow chart shows the link between management regime and investment revenues
**Spreadsheet layout**

Figure 21 shows the layout of the financial model. The model uses the outputs of the bio-economic model on harvest trajectories, associated effort and fish stock as inputs. User defined variables include sensitivity parameters and choice of scenarios. External input data in to the model is on effort, costs and prices.

Using the control variables and the data, the model produces cash flow statements for the fishery under a business-as-usual scenario and a management scenario. An overall statement for the management project is calculated where parameters such as revenues, capital expenditure, operational expenditure and financing details are reported.

The outputs are categorised under fishery performance and project performance. Fishery performance outputs comprise the incremental NPV, incomes of fishermen and vessel owners and fish stock. Project performance outputs are free cash flows, net present value, incremental rate of return, return on equity, leverage ratio and risk measures.

**Figure 21. Spreadsheet layout of cash flow statements**

- **Data**
  - Harvest and production: —harvest trajectory; —quality of catch.
  - Effort and costs: —number of fishermen; —number of boats; —capacity utilisation; —technical and compositional efficiency; —licencing fees, dues and other levies.
  - Prices

- **Cash Flow Statements**
  - Fishery BAU
    - Revenues
    - Costs
    - Consolidated CFS
  - Fishery Managed
    - Revenues
    - Costs
    - Consolidated CFS
  - Management project
    - Development
    - Financing
    - Revenues
    - Costs
    - Consolidated CFS

- **Outputs**
  - Fishery performance:
    - incremental NPV;
    - fishermen/vessel owner income;
    - fish stock.
  - Project performance:
    - Free cash flows;
    - NPV, IRR;
    - ROI/ROE;
    - leverage ratio/ debt coverage ratio;
    - risk measures.

**Source:** Vivid Economics
Appendix 4: The role of finance

Introduction

This discussion paper explores the participation of investors in the transition of fisheries to sustainable, high productivity, discussing the financial structures, project vehicles, associated policies and risk management strategies that might be employed.

The purpose of this paper is to show investors, government and other participants the potential role of finance in fisheries transition. It asks why, how and who would be involved when investment takes place. It describes the nature of the investment and associated revenue streams, shows how the financial arrangements might be structured and introduces the types of investor who might be involved. It also considers how the financing of fisheries might evolve over time and how a programmatic approach to the development of this financial market might accelerate its maturity and expedite investment.

A well-managed fishery is an asset. A productive fishery has a productive stock and supportive ecosystem, making up its natural capital. It has an effective management system, regulating fishing pressure. Its fishers are knowledgeable, their vessels are well equipped and fully utilised and they have efficient means of getting their product to market. This natural, management, catching and supply chain capital adds value by increasing prices, reducing costs and raising quantities of production. They lead to higher prices as a result of better quality product reaching consumers and a fairer distribution of surpluses. They cut the cost of fishing, processing and distribution and they increase the volume of fishery output. All these forms of capital are obtained through investment: investment in the natural asset, recovering it to a more productive state; investment in management systems, giving stable long-term control; investment in equipment, supply chain logistics and processing to add value; and, by creating incentives to cooperate.

Investment begets investment. One of the advantages of making a leading investment in restoring the natural capital and management systems, among other elements of a fishery, is that the commitment and long term reliability which it signals will encourage other parties to make investments, in vessels, ports, processing, market development and so on. None of these occurs without secure natural capital to underpin them. A second advantage is the crowding in of investment, which can happen where the presence of knowledgeable, capable investors with a reputation for competence, achieves investment success and attracts the participation of other less specialist investors, who join the opportunity identified by the former. By these two routes, initial participation of suitable investors in natural capital can lever substantial additional capital flows and value creation.

Unfortunately, many fisheries have experienced dis-investment, that is, the depletion of natural capital. Economic history shows how damaging to welfare disinvestment in natural capital can be. It is common to find that natural assets in fisheries have been consumed or degraded and ineffective institutions have been unable to channel investment to sustain and restore them. Recent periods of under-investment in quality management and in fish stocks have created attractive opportunities for investment now, to the potential benefit of all of society: consumers of fish, fishers, the rest of the sector supply chain and taxpayers.
One can be optimistic that improvements in the understanding of what makes effective fisheries management, including the use secure tenure and other policies, mean that alongside access to capital, the science of how institutions can be made more effective is well developed. The politics will always be a potential source of challenge because the costs and benefits of reform may not be evenly distributed.

The question of how to distribute the costs and benefits of optimally managed natural capital is at the heart of the political challenge. In fisheries, since the underlying capital is a natural, renewable resource, the underlying foundation of investment is the building up of the stock in the fishery to the level of maximum economic yield or maximum sustainable yield. This is achieved by reducing fishing mortality to below the level of recruitment. Short term reductions in harvests are offset by growth in the stock, which will become more productive in the long-term. Unlike traditional investments, this investment does not involve expenditure directly on the stock itself, but it does involve the same forgone consumption or saving and it involves expenditure on the management systems to control fishing mortality, to set science-based limits and to monitor recruitment. Thus there are two elements of investment that can be made in the stock, one in the form of management expenditure and the other in the form of foregone income. One might be made by a management authority of some description and the other by the fishers and the whole of the supply chain. At a later date, the payoff from investment is a larger and more profitable catch of fish, to the benefit of future fishers and the whole of the supply chain. In financing this transition from a low to an optimal stock there is a political question to address, which is how the costs and benefits of the transition will be divided between people today and people in the future and, in particular, between fishers and others. Financing allows the cost of transition to be transferred to a later date, but there is a political economy question as to whether and to what degree to compensate fishers today for the sacrifice of reduced harvests during the period of transition: the transition may need to achieve broad support from participants if the policy is to stick.

The choices of detailed institutional arrangements are much easier to make once political decisions have been taken. Political choices over the objectives of transition and the distribution of costs and benefits from transition will be made before the design of the institutions to deliver them. In particular, the form of tenure or rights to fishers, commitments and accountability follows the function assigned to them. Options such as ‘leasing’ of fishing rights, the purchase of rights or the suspension of fishing rights, which have fundamentally different distributional effects, will be discussed later in this section.

The finance market is segmented to allow specialisation. This needs to be understood in order to make the best use of finance in funding the transition. Just as in other markets, specialisation leads to greater productivity and this is also the case in finance. This specialisation appears in the products or forms of finance available, such as debt, equity and guarantees which transfer risk between parties to different extents, and in the financial institutions, whose resources are most effective in taking on particular roles or being active in specific sectors. Since the general financial market is large and developed, but financing of fisheries transition is nascent, it must be structured wherever possible to take advantage of the general products and institutions to secure the least cost distribution of risk and the most effective intangible benefits of governance and policy commitment.
Smoothing the costs of transition

There are a number of expenditures to fund: the initial set-up and transition, the ongoing management, the individual fisher and vessel monitoring and the wider environmental programme, as well as the opportunity cost of the temporarily lower catch. As explained above, the transition to a fully productive fishery involves (amongst other things) additional expenditure on management and potential compensation for lost income at a time of reduced revenue. Finance can be used to shift the burden of these costs and transfers to a later time, when revenues have recovered, incomes are higher and there are surpluses sufficient to repay these expenditures. The pattern is shown in Figure 22.

Figure 22. An illustrative control path for fishery transition

Note: Harvest and income are both shown as higher after transition. It is likely that income will be higher. Harvest might be lower.
Source: Vivid Economics

The cost of management controls may be difficult to meet from income during the transition period. An effective management system is based on scientific research to monitor and model the status of the stocks. The scientific information is valuable but involves some cost to collect and process. The design of the management regime and the establishment of the institutions to run it is a larger expense, nevertheless it is smaller than the ongoing costs of operating and enforcing the management controls. The ongoing expenses include administration of licensing, setting of allowed catches, self-reporting and remote monitoring, inspection of vessels and enforcement of compliance. During the period of transition, when fisher revenues are already reduced because of low allowed catches, it may not be feasible to share these revenues sufficient to fund management expenditure, but when the fishery is operating at full productivity, there may be more
than sufficient revenues available. In this case, finance offers the means of implement the needed changes in
the short-term, while delaying payment for the expenditure until the stock has recovered and surplus
revenues are available. In the long run, many fisheries will be self-funding. There have to be compelling
social reasons for continue to operate fisheries which are not self-funding.

**Ecosystem management may be integrated into the fisheries management regime.** Being part of an
ecosystem, the management of the fishery might not be separable from the management of the ecosystem or
wider marine environment. If they are managed on an integrated basis, non-fisher activities such as habitat
protection might be funded under a common arrangement, using the income from the natural capital asset to
pay for the sustainable management and maintenance of the whole of that asset.

**Investing in natural capital in many cases involves the temporary or permanent reduction in fishing
effort.** Since there are, in virtually all circumstances, many fishers, a management system is needed to
coordinate action and to ensure reduction in effort. The management controls may encompass both fishing
mortality and collateral ecosystem damage. The primary control over mortality is usually the catch, achieved
directly through allowed landing weight or sometimes indirectly via allowed fishing effort or licensing of
vessels. This is usually supplemented by restrictions on minimum landing size, prohibited areas, landing of
berried (gravid) females and allowed gear types.

The reduction in fishing mortality requires fishers to contribute to transition by temporarily reducing
their incomes. A reduced catch can usually be made by reducing catch of all participants in a fishery, by
reducing the number of participants, perhaps temporarily, or through a combination of both, until the stock
increases. Some forms of fishery management, such as transferable catch rights, establish a market
mechanism to transfer catch opportunities between fishers, allowing for adjustments of catch and possibly
compensated exit from the fishery. Other forms of management do not establish markets for adjusting catch
between participants, and exit is often uncompensated, occurring when incomes from alternative
employment becomes larger than that from fishing. In the former case, transferable rights, the remaining
fishers compensate the fishers who exit the sector. They may find capital to purchase catch entitlements from
fishers who exit, and it may help them to have access to finance. In the latter case, an absence of rights, or a
prohibition on the transfer of rights, weakens this market mechanism for exit. Consequently, a share of the
return might become part of a package of reform, offering an inducement to accept the reform, or there may
be payments made to fishers who exit the sector. Thus there are two ways in which a share of the return
might be facilitated through finance, one directly by the funding incentives to fishers under a scheme in
which rights have not been established, and the other indirectly, in which rights are established and are sold
or otherwise transferred from some fishers to other fishers.

**There are at least three ways that fishers could capture a share of the return from investment.** The
first, leasing, takes established fishing rights and transfers the option to use them to a third party for a defined
time, perhaps with the option to extend the length of lease or to break it early. The price of the lease reflects
the opportunity cost to the lessor: a proportion of their wages and profits from fishing. If the lessor can find
alternative income from employment while they are not fishing, he or she will be willing to accept a lower
price. Then, when the lease expires at the end of transition, the lease will return to the fisher who can resume
his or her fishing activities. The feasibility of this option partly depends on the ability of fishers to re-enter

---

*The image contains a watermark indicated as 'vivideconomics'.*
the catching sector after a period of inactivity. The second, a management buyout, involves a fisheries association, such as a cooperative, buying out the rights of all the fishers. A buyout would be most easily achieved if, when the rights are established, a decision by some majority of fishers to sell their rights to the association can force or ‘drag along’ all the other fishers and that no fishers are willingly left out of the process, being given the right to ‘tag along’. This association would need to have a strong constitution and management and either a memorandum or policies on how access to fishing would later be allocated between fishers, presumably on the basis of their original rights, any limitations as to whom and when they could later transfer those rights to others and any restrictions on how those transfers would be priced. The third option is a rights swap, in which the fisher swaps their current rights for the option to take up future rights. They are paid to relinquish their current rights, providing the compensation during transition, and will have to pay some amount to exercise the option in the future when transition is complete; additionally they might be offered a loan or commercial mortgage to help pay to purchase the option later. A question with all these arrangements is how to anticipate the future allowable catch and efficient fleet size once transition is complete, so that an orderly exit of capacity is achieved, if it is needed. This is because the maximum sustainable yield may be lower than catch levels before transition begins and the efficient fleet size at maximum sustainable yield may be lower. Some purchase and retiring of rights, conversion of rights from absolute rights to shares, or buy-back of rights may be appropriate.

Capturing returns on investment

One or more mechanisms could be introduced to capture and share revenues in order to pay for the transition costs and to fund the ongoing fishery expenditures. There are several principles which might guide the introduction of payment mechanisms, helping to ensure they operate fairly. Key features guiding their design would be that the mechanisms recover revenues according to a stated purpose of recovering costs, repaying finance or sharing surpluses, with clear accountability and transparent reporting of figures against these objectives.

Four mechanisms are suggested here. The greatest transparency, and perhaps political acceptability, is achieved by establishing mechanisms specific to each investment. There are a number of investments to fund in management and the opportunity cost of the temporarily lower catch, meanwhile there may be complementary investments in ports, logistics and other supply chain infrastructure. For each of these, there is a revenue recovery mechanism. For example, a levy can be used to fund public goods such as environmental improvement, while a fee is more appropriate for covering the costs of licensing, monitoring and the scientific programme. The term ‘levy’ is generally used where the goods and services purchased with the funds raised do not benefit only the people who paid the levy. The term ‘fee’ means a payment which gives the purchaser rights to goods and services, here the opportunity to catch fish, where the payment is not used to fund the direct costs of producing those goods and services, here because they are partly the product of natural capital. The recovery of the initial investment in the stock and for access to other assets such as port infrastructure and auction facilities might be best achieved through a charge on landings. This charge would vary over time, reducing as the finance is paid off and falling to a level where it is sufficient to cover ongoing maintenance and operation of facilities. If, after this point, a mechanism is introduced to share the revenue, as the fishery is considered a public good, then it might be labelled a royalty. These capturing and sharing mechanisms are summarised in Table 6.
Table 6.  **Menu of revenue sharing mechanisms**

<table>
<thead>
<tr>
<th>Type</th>
<th>Base</th>
<th>Association</th>
<th>Timing</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levy</td>
<td>Sales or catch</td>
<td>Public environmental goods</td>
<td>After finance paid off</td>
<td>Pays for protected areas, research and development. Benefits felt widely</td>
</tr>
<tr>
<td>Fee</td>
<td>Vessel or fisher</td>
<td>Licensing, monitoring, science</td>
<td>Partial from start of transition</td>
<td>Pays for the fixed costs of management systems. Benefits participants, like a club membership</td>
</tr>
<tr>
<td>Charge</td>
<td>Sales or catch</td>
<td>Infrastructure, transition finance</td>
<td>Once stock rebuilt</td>
<td>Pays for supply chain infrastructure and transition finance. Benefits users in proportion to their activity</td>
</tr>
<tr>
<td>Royalty</td>
<td>Sales or catch</td>
<td>Surplus</td>
<td>After finance paid off</td>
<td>Shares the rent between participants and society</td>
</tr>
</tbody>
</table>

*Note:* We do not consider here the merits and demerits of basing some mechanisms on sales or catch.

*Source:* Vivid Economics

**The structure of finance**

The objectives in choosing a financial structure are to transfer risk at least cost, to force commitments to capture a share of the return and to benefit from the resources of participating institutions. The structure of the finance, that is, the elements in the capital stack and the contractual terms under which they are offered, have the effect of partitioning the risk between financing parties, of limiting the actions of those parties and of restricting the discretion of managers. The purpose of these arrangements is to reduce cost by incentivising good management of risks, by allocating risks to parties who can best control or most cheaply absorb them, and by obtaining the involvement of parties whose expertise and skill can improve the performance of the fishery.

**Risk structuring can reduce the tax liability for the investment vehicle.** The differential tax treatment of debt and equity can distort the choice of financial structure and can be highly material to the returns to investors, but taxation is specific to local tax rules and there is nothing to be gained in a general treatment such as this from exploring the range of tax planning arrangements that might be adopted.

**The capital may be composed of a variety of products.** Capital grants enhance returns to the other finance components and shift up the returns or reduce the risk of default to each. Capital grants would typically be provided by a philanthropic foundation, a local government or a foreign donor government. Further enhancement can be achieved by guarantees which syphon off specific risks. Guarantees relating to policy commitment or institutional performance might be written by a local government while sovereign risk guarantees might be written by an international financial institution, such as a development bank. Equity, which absorbs much of the project risk and participates fully in upside performance, might be provided by local or international private investors or by local participants such as fishers, processors or exporters.
International equity investors may feel more protected against the risk of some degree of expropriation if there is local equity participation and small investors may feel similarly protected by the presence of large institutional investors capable of making a robust legal challenge to interference or reneging on contracts. Sitting underneath equity in the capital stack, there could be a tranche of subordinated debt in place for the purpose of enhancing the credit risk of the ordinary debt. This structuring of the debt into tranches might allow part of the debt to attain a higher credit grade and to tap a larger and more liquid pool of capital. Access to larger pools of capital can make the financial structure easier to complete and can improve the terms of contract. However, the subordinated debt is a more complex product and might have to be provided by a specialist group within, for example, a development bank. A development bank might also be able to lead the syndication of ordinary debt and, by taking a lead, could reduce transaction costs. The ordinary debt completes the financial structure.

The capitalisation needed for individual fisheries may be small. In the two case studies presented here, calculations suggest that the scale of investment needed is less than USD 20 million. This amount is likely to be too small to justify the cost of a more complex capital structure, but it is possible that the portfolios of investments can be built up to form a fund and that a fund could provide all or some parts, such as the debt and risk mitigation products, of the capital stack in the small amounts needed by some fisheries. This would leave open the possibility of local participation in the equity and would not rule out local participation in the debt portion.

Figure 23. A mixed stack makes for a more efficient financial structure

Source: Vivid Economics
**Types of investor**

**Most investors will require market returns.** Although there are some ‘impact’ investors such as family trusts, philanthropic funds and donor governments that target environmental or social impact as much as they target returns, these make up a small proportion of global capital available and there are many calls on their resources. In order to secure the scale of funds which can transform fisheries globally, the returns available will need to achieve market rates in at least part of the capital stack. Investors who have a direct interest in the health of the fishery, such as fishers, processors, exporters and government, may accept sub-market returns from the investment on the expectation that they will benefit from a capital gain in the value of their direct business or policy interests and so it may be possible to reduce the cost of finance by encouraging participation from these individuals. Even with these investors, the competition from other investment opportunities will discourage investors’ participation unless the financial components are priced close to market levels. The benefits to fishers will be increased catches when the total allowed catch is raised and reduced cost per unit catch as the stock builds during the transition. There may also be greater efficiencies in management, in fleet utilisation and in the supply chain. The processors and exporters will benefit from increased volumes and improved quality and prices.

**On the debt side, investors differ in the opportunities which they pursue.** Some, such as institutional investors, that is the pension and insurance funds, are very large scale and invest mainly in large scale, standardised and low risk projects. They also look for intermediated opportunities by placing their investments with banks, infrastructure funds and other managed financial institutions which go on to make individual, smaller-scale, managed investments of a whole variety of types. It is not likely that they would invest directly in fisheries themselves. Investment banks, however, may intermediate debt investments in fisheries and could aggregate this debt and sell it on, perhaps as blue bonds, if there is market demand for paper of this type, for example from institutional investors. For the faster growing fisheries with the best existing institutions, the debt could be dated five to ten years, but for slower growing stocks and weaker institutions, the investment period might be 10 to 20 years, and this is likely to push beyond the boundaries of most debt markets. This is where the international financial institutions such as the development banks could play a role. They are able to take quite long term positions on investments and there are two reasons why they can do this. First, they have objectives other than making commercial returns and expanding their business, which is to achieve development goals. Second, they can manage political and technical risks through the medium of their influence with local governments and the provision of technical assistance. This technical assistance may be provided at subsidised rates or free and may be a condition of the loan. The international financial institutions can also provide a useful role in maturity transformation. That is, they can convert a portfolio of longer-term debts into parcels of shorter-term debt which they can sell onto the investment banks or structure into funds which larger institutional investors can buy into. In establishing these products, they may also introduce some forms of credit wrapping insurance to further reduce the risk to the investor.

**On the equity side, risk management capability is valuable.** Equity investors have more influence over management policy than debt investors and they absorb more risk. Investors with fisheries management experience will have a strong advantage over other investors in fulfilling the equity finance role. The role lends itself well to individual local fishers, via subscription or through an aggregator such as a Cooperative,
fish processing and trading companies, and private investment vehicles specialising in fisheries investment. The smaller investors, such as fishers, are too small to take a lead and exercise the supervision which is an essential part of the equity participants’ role. All these participants bring knowledge of the risks involved in fisheries transition to the investment and are able to exercise more effective control over the management as a consequence. The greater their stake, associated long-term interests, local knowledge of the local fishery and knowledge of fisheries transition in general, the more effective they will be as shareholders, but they will need management resources, and that means the controlling equity participants should have scale.

Table 7. A classification of investors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Traditional</th>
<th>Responsible</th>
<th>Thematic</th>
<th>Impact first</th>
<th>Impact only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical investment</td>
<td>Those that generate financial returns</td>
<td>Those that protect or enhance competitive financial returns through ESG analysis</td>
<td>Those that can generate a competitive financial return</td>
<td>Those that generate a below-market financial return</td>
<td>Those that require grant funding with no capital repayment</td>
</tr>
<tr>
<td>Typical investor</td>
<td>Institutional Investors, Private Equity, Retail Investors, Commercial banks</td>
<td>SRI investors (Socially Responsible Investors)</td>
<td>Social/impact Investors, Development banks</td>
<td>Foundations, Governments, Social/impact investors</td>
<td>NGOs, Foundations, Governments</td>
</tr>
</tbody>
</table>

Source: (Bridges Ventures, 2012)

There are fewer investors willing to participate in ‘First of a Kind’ deals. The transaction costs of ‘First of a Kind’ deals are high and risk management is less effective so most investors eschew these opportunities in favour of commoditised and standardised deals. However, the ‘First of a Kind’ and ‘Early or Next of a Kind’ deals are valuable in establishing and testing financial models and building experience of the management of the project, in this case, fishery transition. The early deals are likely to attract only small, specialist investors and they will require high financial returns in compensation unless they are impact investors, so it seems likely that impact investors have a crucial role to play at the early stages. At this early stage, government institutions and multilateral development banks have an important role to play as pilot programmes will need heavy public involvement to defray the costs of setting them up. Other investors may then follow, if they can see a pipeline of sufficient deal volume and quality emerging. It will require some effort on the part of some participants, perhaps development banks, other international financial institutions, NGOs or impact investors, to develop this pipeline. It seems unlikely that private investors would bear much of the costs of this market development activity.

A credible party is needed to coordinate the participation of investors. With all these possible investors and a variety of structures to choose from, there may be a role for a co-ordinator or facilitator to invite all the investors to the table, to encourage the participation of some and to discourage others, and to propose the
fundamental structure of the vehicle. This person does not need to be the leading equity participant, but they could be, and they should certainly be experienced in this role and highly knowledgeable about fisheries, finance and familiar or willing to become deeply familiar with local politics. Personnel with an investment banking or private equity background might be suitable in the role, so long as they are sensible to the policy objectives and public interest purpose of the investment.

Figure 24. Innovation path in fisheries finance

<table>
<thead>
<tr>
<th>early phase</th>
<th>Commoditisation, standardisation and improvement in risk management</th>
<th>mature phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact investors</td>
<td>Institutional investors, private equity</td>
<td></td>
</tr>
</tbody>
</table>

Source: Vivid Economics

Role of public capital

The purpose of public capital participation is to obtain returns to society which commercial investors would not value. Like all forms of public intervention, public capital participation may be tied to social objectives: to deliver the public goods that private markets fail to deliver and to emphasise the long-term in contrast to the short-term focus of many private participants. Although some of these benefits may be secured through the considered drafting of the constitution of the investment vehicle, the strong participation of a public investor whose clear aims are to achieve these societal objectives will make a difference to the outcome.

The public investor may accept some returns in non-pecuniary form. While the public investor may value the public good outputs of the investment, private investors by and large will not. A public investor may choose to be satisfied by a blend of non-financial outputs and financial returns on its investment, while a private investor, other than the small but important class of impact investors, focuses almost exclusively on the latter. Hence a public investor may be willing to accept a lower return on their investment and subscribe their capital at a concessionary rate, in return for non-pecuniary conditions, such as environmental protection measures, the long-term constitution of the investment vehicle, the inclusion of long-term capital projects within the programme of investment, the publication and dissemination of information on the project and/or the participation of strategic co-investors who might re-use the lessons from the scheme in future investments.

A lower return may be structured in several ways. A public body might provide some equity in the form of a capital grant, enhancing returns for other investors, or it might pay directly for the project development, that is the phase of a project which a project developer would otherwise do and expect to be remunerated for, or might underwrite risks through a guarantee. These three options differ in the participation during the development phase. Under the capital grant, other participants would be involved and each may be required to contribute some capital, albeit maybe a small amount, in order to have some interest in the outcome.
Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

Under directly funded project development, no third party participation occurs and the public body has full control, much reducing the input from third parties who might later become co-investors. A public body might also provide equity in the form of a specific guarantee or insurance, absorbing certain risks in return for a concessory fee. These ought to be risks over which the public body has some control or expert knowledge. The obvious candidate for a guarantee is political commitment to the project through the setting of science-based TACs and the integrity of the fisheries management regime. If a form of words and means of triggering a guarantee can be found, then the public body might play a useful role in transferring these risks out of the investment vehicle. Finally, a public body might contribute concessionary subordinated debt. This debt has equity-like features in that it receives income only after the ordinary debt has been paid. It effectively reduces the gearing of the project, but by offering this cushion at a concessory rate, it achieves the same effect as more equity, which is to reduce the cost of debt, without the potential tax disadvantage and without the higher return that equity demands.

**Public investment agencies, public insurers or public investment banks may be available.** The roles suggested above might be fulfilled by existing local public institutions whose role is to make public co-investments in infrastructure, to write public guarantees and insurance, or to coordinate investor participation, to arbitrate between investors and to advise on project development. Sometimes these exist in the form of a national institution and sometimes they operate supra-nationally or regionally.

**Integrated support for transition**

Having touched on the role of finance, its structure and participation, now it is time to consider wider questions. First, in this subsection, the discussion turns to the broader system of fisheries improvement in place locally, within which finance plays its role. Second, in the next subsection, the debate moves to the geographically broad development of fisheries financing globally, in which individual cases have a role to play.

**The choice of management system may affect the long-term performance of the fishery.** Although the effective control of the catch may, on its own, achieve the desired effect of building the stock, the way in which it is implemented could affect the productivity of the catching sector. The greatest productivity over time will be achieved by a system that encourages fishers themselves to invest in the best catching technology, to disinvest old vessels and gear, and to support management activities that directly benefit their industry, such as stock assessments, monitoring and enforcement. Not infrequently there is a role for government, on behalf of all fishers, to experiment with new techniques and to find ways to introduce and disseminate best practice, in the design of gear and its use, in safety practices and in product handling. An effective management system encourages these wider developments.

**The natural capital base provides the opportunity, the supply chain adds value.** The value added by human endeavour through labour and capital includes port infrastructure, product handling and logistics, and product auctioning or sales. Further down the supply chain, value is added by product processing and distribution and consumer market development. The total value created by improving the productivity of the natural capital, the biomass, reflects the systematic enhancement of the whole supply chain, involving appropriate investment along its length. The private sector may bring forward much of this investment without much encouragement from government, but it is likely that coordination of investment plans along
Towards Investment in Sustainable Fisheries: Financing the Transition of Blue Swimming Crab in Indonesia

the supply chain will lead to a speedier response and investment decisions which are better informed by the intended actions of others. Furthermore, there are parts of the supply chain where stronger government intervention may be needed for one of several reasons. First, places where government owns or licenses the assets, such as port and road infrastructure and decisions related to investment come under its direct control or influence. Second, places where there is potential for bottlenecks in the supply chain, bottlenecks whose control might give some individuals the power to cream off rents from the sector, starving other parts of the supply chain of the income or margin they need to invest. The government can move to encourage competition or to regulate pricing to prevent this from happening. Third, government can step in and coordinate or lead action where several parties support action, and have an interest in the action taking place, but they have no means to fund the action collectively because they are competitors or because there are too many of them to make cooperative action easy. An example is the government promoting the product and brand to export markets, which rival exporters cannot do themselves and which the supply chain might not easily act collectively to achieve.

Fishers’ support for reforms is crucial and reforms may fail without it. The technical design of reforms, the management systems and the finance are not sufficient without the support of fishers and for this reason, action to consult, influence and garner support from fishers is an essential part of reform, and one which may be most effective if begun early, when the broad objectives of reform are determined. It is likely to take time and to involve grass roots discussion with individual fishers and society leaders. It deserves a well-developed plan within the overall transition strategy, and although it is not discussed in any detail here as we focus on other aspects, it would be included in the timetable and costings of the transition.

Cooperatives may play a pivotal role. Cooperatives have the capability to pool the resources of fishers or processors and could achieve the scale needed to undertake relatively large programmes or investments, indeed, they may be able to raise finance themselves. In order to take on this role, a cooperative will need a professional management and governance system and in some cases, it will take government and external advisory support to establish these internal resources within a cooperative. Some thought may have to be given to the formal relationship between government and the cooperatives and whether it is better for them to act completely independently or whether there is some degree of policy involvement, for example, setting a framework within which the cooperative acts, establishing its objectives and auditing its governance systems.

The investment commitments being made along the supply chain may be reflected by long term contracts from seafood companies. In a fishery that is becoming well managed, the catch available becomes more certain and the supply chain becomes more integrated. One of the features which might develop is the practice of writing long-term contracts between seafood companies (exporters) and fishers or processors. These contracts give more price certainty along the supply chain and the commitment they offer between parties might help to encourage investment up and down the chain, to the benefit of product quality and cost efficiency. Such contracts also allow direct specification of product size, quality, place of catch and gear used, which can, if done well, support, enhance and go beyond the requirements of the management regime.
Developing the market for fisheries finance

All of the elements described above together may have a positive impact on the planet’s fisheries if they can be developed and made widely available. The actions taken in an individual fishery and in particular the role of any external financiers should not be considered as isolated but rather part of a programme of developing the finance market in fisheries. A programmatic approach considers how many projects will be running and when they would take place, what resources are needed and what the ultimate scale would be. These are programme-level questions of concern to international financiers of all types. The answers might include programmatic solutions such as a Blue Investment Bank housed within the World Bank or a similar institution designed to play a particular financial and policy support role as outlined before. A pilot phase of several deals, led by multilateral development banks, could be established to test the approach and the financial products. The more projects that are developed, the greater the incentives by governments to reduce risk and create favourable enabling environments for investment in the sector.

There are a number of financial models of participation and products to be developed if the fisheries finance market is to achieve scale. These include models for intermediation between large scale investors and small fisheries projects and, flowing in the opposite direction, the aggregation of demand for finance to a scale which supports the efficient supply of finance. They encompass risk mitigation products such as guarantees and risk sharing or credit enhancement mechanisms such as subordinated debt and capital grants.

As the financial structure, product and commercial designs mature, standardisation may further drive down costs. Over time the new approaches will be refined and become better understood. It may be possible to establish new standards within fisheries finance, perhaps reflected in product trade, such as through a ‘sustainable finance letter of credit’ (which now exists in other sectors through the work of the Cambridge Banking Environment Initiative), with a line of account up and down the finance chain. These standards could operate at a global scale, given that fish products are heavily traded across borders, and could include global access to IT systems and potentially the establishment of not-for-profit stewardship and governance of the standards themselves.

The finance market would benefit greatly from experiences learned in individual cases as the portfolio builds up. One way to facilitate learning is to establish a repository of examples, recording their successes and failures and including copies of their documentation including laws, regulations, articles of association, contracts and policies. The legal documentation can act as templates for future cases, helping to reduce set-up costs. In addition, the publication of the costs of management would greatly assist budgeting for new management systems in fisheries as currently the management cost information is quite patchy. The opportunity for learning is created by the publication of information and transparent data, performance and administrative arrangements. Transparency is a prerequisite of learning, of standardisation and of the process of rolling out fisheries reforms globally, so there is scope for some thinking at programme-level about what information could be collected, how its collection might be standardised and through what platform it could be made available for sharing.

Financiers will want to know where the deals are. Financiers considering moving into fisheries finance will want to make a dispassionate assessment of the deal flow, that is, the number, size and quality of the financing deals that might appear and in which the financier might participate. There may be value in
preparing an analysis that tests and screens the prospects for fisheries transition and its finance globally and updates this assessment regularly so that financiers do not each have to bear the costs of this exercise themselves.
Company Profile

Vivid Economics is a leading strategic economics consultancy with global reach. We strive to create lasting value for our clients, both in government and the private sector, and for society at large.

We are a premier consultant in the policy-commerce interface and resource- and environment-intensive sectors, where we advise on the most critical and complex policy and commercial questions facing clients around the world. The success we bring to our clients reflects a strong partnership culture, solid foundation of skills and analytical assets, and close cooperation with a large network of contacts across key organisations.