Tools and Processes for Participatory Modelling of Wellbeing Implications Ecosystem Service Tradeoffs:

Description and reflection on methods developed and used in the ESPA P-Mowtick project

December 2012

About this document

Participatory Modelling of Wellbeing Trade-Offs in Coastal Kenya (P-mowtick) was funded by UK Research Council ESPA (Ecosystem Services for Poverty Alleviation) in 2011 and 2012 to develop a framework and tools for explicitly identifying trade-offs between the wellbeing of different stakeholders resulting from changes in ecosystem services. The framework combined wellbeing research with primary stakeholders, marine ecosystem modelling, social-ecological systems modelling, scenarios, and participatory processes to understand, document, and explore trade-offs between Ecosystem Service benefits to the wellbeing of different user groups under different governance arrangements. More information on the project can be found at http://www.espa.ac.uk/projects/ne-i00324x-1.

This report documents the participatory tools used and communicates reflections on these methods for the use of other researchers or practitioners who may want to draw from the experiences of this project. Each section describes the activities undertaken. This document is based on the team's own observations, reflections, the notes of independent observers and interviews with participants.

Reflections are shown in boxes like this:

> **Example- Reflections 1**
> Reflections are presented beside the activities' descriptions

Acknowledgements

Contents

Project overview

P-mowtick comprised of a series of linked research and participatory exercises which are described in this document. Each is briefly described below. The participatory process was organised around three different levels: primary stakeholders, secondary stakeholders, policy makers. The emphasis in the document is on the participatory workshops held with secondary stakeholders. The tools were developed and tested for a coral reef fishery in Mombasa on the Kenyan coast. P-mowtick was designed to develop and test a framework and associated tools to explicitly identify trade-offs a) between different ecosystem services and b) between the wellbeing of different stakeholders resulting from policy and development scenarios and changes in ecosystem services.

Conceptual Framework:
Workshop 1 collected a diverse range of experts to help design the project.

Ecological Modelling Activities- Two main ecological models were developed. The first is a mass balanced model focused on fisheries dynamics implemented in Ecopath with Ecosim. The second model is a STELLA based model originally designed to model coral reef ecological dynamics including interactions between corals, algae and disturbances such as coral bleaching.

Integrative Social-Ecological Modelling- The toy model allowed stakeholders to run trials with key parameters and see the modelled effects on wellbeing of different stakeholders. This gaming process enabled teams to capture 'social feedbacks' into the modelled systems through discussion.

Scenario Development- Scenario development is a way to explore possibilities for the future that cannot be predicted by extrapolation of past and current trends. The team created four scenarios of plausible futures for the next 15 years of Mombasa region, to encourage stakeholders to consider the positive and negative implications different development trajectories may have on their future wellbeing.

Secondary Stakeholder Activities:
Workshop 2 aimed to elicit secondary stakeholders' understanding and perception of the relationships between wellbeing and coastal ecosystem services of the Mombasa region and generate a collective 'mental model'.

Workshop 3 brought secondary stakeholders together to analyse scenarios that have been produced from a combination of data from the Focus Groups; analysing trade-offs, discussing implications and suggesting modifications.

Post Workshop Interviews for WS2 and WS3 were conducted to ask the participants to reflect on their experience and learning from the process.

Final Workshop- Policy Makers Meeting disseminated learnings to more senior policy makers and stimulated them to think about wellbeing and trade-offs associated with the governance of the fisheries.

Primary Stakeholder Activities:
Focus Group 1 explored how different groups of people perceive wellbeing, how it relates to access to fish, and how achievability of wellbeing is changing for them and also others in wider society.

Focus Group 2 sought to create conceptual maps to show linkages and mediating factors which affect how ecosystem services affect wellbeing.

Focus Group 3 intended to understand the wellbeing implications of different scenarios for the primary stakeholders, and to discuss their likely and possible responses.

Focus Group 4 aimed to bring stakeholders' perspectives together and provide an opportunity to interact with the toy model.

Primary Stakeholder Open Meeting invited primary stakeholders at the study site to learn about the project and to engage together in a discussion about trade-offs in their wellbeing that might exist in alternative futures.

Landing site	WB FG (FG1)	Scenarios FG (FG2)	Toy-model 2	Principles voting	Policy rec.	Open meeting
NGO, agencies	Systems mapping (WS2)	Toy-model 1	Scenarios		Policy rec.	
Policy makers					Toy-model 3	Policy brief
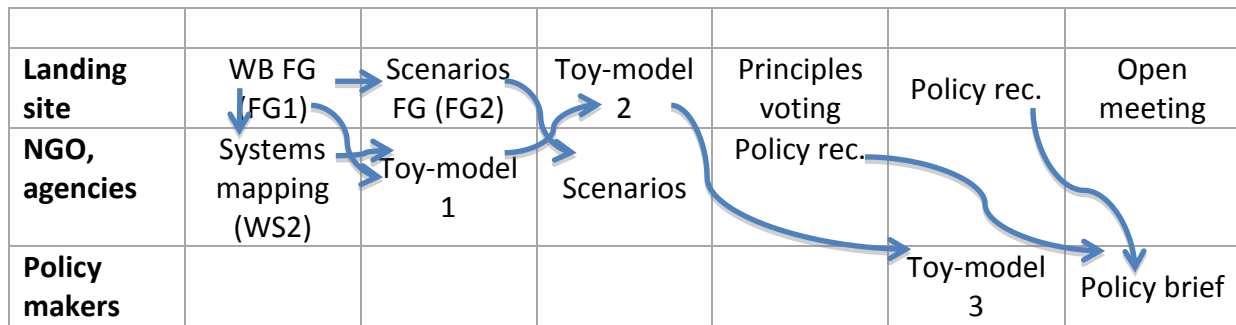
Figure A- *A summary of the process with details of how tools build on each other*

The research has three components with mixed tools in each:

Tool	Description	Understanding Trade- Offs
Wellbeing focus group (FG1)	We selected a small group of primary stakeholders of each group – average four – and conducted a focus group following methodologies derived from the 3D wellbeing framework (Gough and McGregor 2007) Primary stakeholders described the different aspects of their multi-dimensional wellbeing and how large scale changes might affect their wellbeing.	Multiple components of individual wellbeing; Major changes in the last 10 years; Values of ecosystem services in relation to different dimensions of wellbeing;
Ecological modeling	Modeling focused on provisioning service - fisheries – and coastal protection – beach nourishment	Emergence of trade-offs depending on how the ecosystem is managed
Systems mapping (WS2)	Secondary stakeholders description of how the SES works; drivers of change; effect of shocks	A broad perspective on all ecosystem services occurring at the coast. Major drivers of change; What defines fishing effort;
Toy-model	A stylized fuzzy-logic model in excel reflecting the general dynamics of the systems.	Consolidates information from WB, ecological modeling and systems mapping. Allows exploration of T.O. dynamics
Scenarios	A set of four storylines built based on major drivers of change and links to WB	Allows for exploration of agency of primary stakeholders to different drivers of change; Elicits constrains and spaces available for change by management organizations
Interviews	Workshops were monitored by pre and post surveys; Major workshops with secondary stakeholders were followed up with interviews	Participants reflecting on the process improves learning Which tools are most important? What should be adapted? What should be discarded?
Principles voting	Participants voted in which principle should be used in addressing T.O.s	What do I values most? What do others value most?

Table A- *All tools employed within the P-mowtick project and why they are useful to study trade-offs in SES*

Activities were inspired by the following key texts:

Brown, K., Tompkins, E., and Adger, W.N. (2001). Trade-off Analysis for Participatory Coastal Zone Decision-Making (Norwich: Overseas Development Group, University of East Anglia).

Cheung, W.W.L., and Sumaila, U.R. (2008). Trade-offs between conservation and socio-economic objectives in managing a tropical marine ecosystem. *Ecological Economics* 66, 193–210.

Etienne, Michel (2011). Companion Modelling: A Participatory Approach to Support Sustainable Development (Versailles Cedex: Editions Quae).

Gough, I., and McGregor, J.A. (2007). *Wellbeing in developing countries: from theory to research* (Cambridge Univ Pr).

Peterson, G.D., Cumming, G.S., and Carpenter, S.R. (2003). Scenario Planning: a Tool for Conservation in an Uncertain World. *The Journal of the Society for Conservation Biology* 17, 358–366.

Tompkins, E.L., Few, R., and Brown, K. (2008). Scenario-based stakeholder engagement: incorporating stakeholders preferences into coastal planning for climate change. *J. Environ. Manage.* 88, 1580–1592.

P-mowtick Timeline of Activities

ID	Component	Tasks	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
						2011											2012								
	Phase 1																								
	WS1 (Conceptual workshop)		█																						
1	Ecological Modeling																								
1.1	CAFFEE model						█	█	█	█	█	█	█	█	█										
1.2	Ecopath					█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
		EcoPath Training						█	█																	
2	Participatory Activities with Primary Stakeholders																								
2.1	Wellbeing Focus Groups																								
2.1.1		Training workshop					█																		
2.1.2		FG1 (Wellbeing)								█	█														
2.2	FG2 (Linkages between components of WB)																								
2.3	FG3 (Scenarios)														█	█									
2.4	Stakeholder survey																								
2.5	FG4 (Toy Model)																					█		
2.6	Primary Stakeholder Open Meeting																█							
3	Integration																								
3.1	Creation of formalized social-ecological models														█	█								
3.2	Develop Scenarios																								
3.4	Develop Toy model														█	█	█							
4	Participatory Activities with Secondary Stakeholders																								
4.1	WS2 (System Mapping)										█														
4.1.1		Follow up Interviews WS2													█										
4.2	WS3 (Trade-offs/Scenarios)																								
4.2.1		Follow up Interviews WS3																█	█						
5	Dissemination																								
5.1	Final Workshop-	Policy Makers Meeting																						█	

Figure B- Timeline of events involved in the P-mowtick project

Workshop 1- Conceptual Workshop

Purpose

The aim of the workshop was to collect together a diverse range of experts to help design the project.

Participants

Fifteen experts were assembled from a range of relevant disciplines to share knowledge and experience of different approaches for studying ecosystem services and trade-offs, and to outline a framework for participatory modelling of ecosystem services and wellbeing trade-offs to be applied in Kenya. These included people with particular methodological (e.g. companion modelling, fuzzy logic, ecological economics) expertise and/or familiarity with the Kenyan case studies.

Activities

This workshop spanned over 3 days, with an entire day focusing on modelling. Discussions were diverse and ranged from clarification of terminology within the project, (such as Ecosystem Services, Stakeholders, Trade-offs, poverty and well-being) to exploring the relationships between wellbeing, Ecosystem Services, access, and the trade-offs between these facets. A contextual discussion was held regarding Kenyan coastal systems and the selection of suitable sites for this project. Later on in the workshop discussions also focussed on the technical aspects of modelling; exploring different approaches and ascertaining the best technique for our needs.

Presentations and discussion topics during Workshop 1

- Kenyan stakeholders and sites- Arthur Tuda (Kenyan Wildlife Service)
- Modelling Kenyan coral reefs with Stella - Carlos Ruiz (Wildlife Conservation Society)
- Why are we using wellbeing to analyse trade-offs in fisheries? Sarah Coulthard (Uni of Ulster)
- Social wellbeing framework for fisheries - Allister McGregor (Institute of Development Studies)
- Ecosystem Services in the Eastern Arc Mountains Marije Schaafsma (Valuing the Arc Project)
- Including subsidies in an Ecopath model of the North Sea - Sheila Heymans (Scottish Association for Marine Science)
- Fuzzy Logic and Expert Systems - Steve Mackinson (Centre for Environment, Fisheries and Aquaculture Science)
- Participatory modelling of Social-ecological systems: The companion modelling approach and some lessons regarding stakeholder participation Companion modelling (ComMod) - Cecile Barnaud- Agricultural Research for Development (CIRAD)
- The Trade Off Analysis Process - Kate Brown (UEA)
-
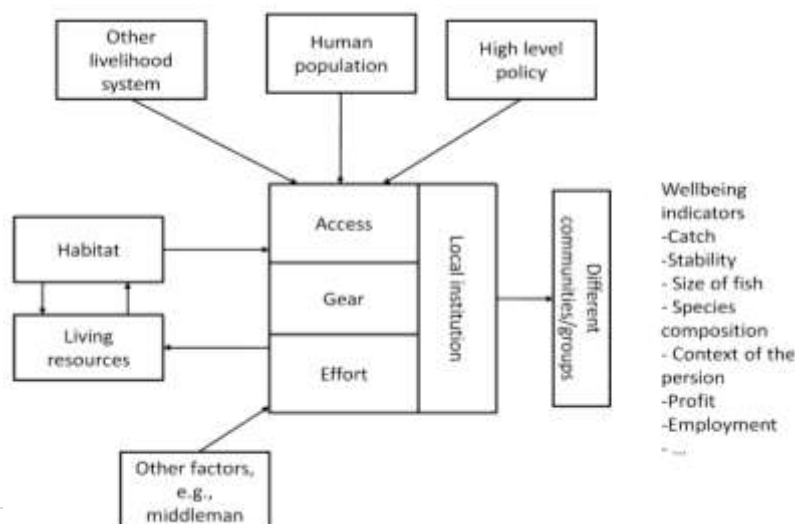
Figure 1.1- *A conceptual diagram of the Social-Ecological System model developed from the workshop*

Secondary Stakeholder Activities

Workshop 2- System Mapping

This workshop took place on 2 consecutive days. A group of local experts from the Mombasa region were brought together for Workshop 2, to integrate local expertise with ecological modelling and in-depth poverty research conducted by the team. Stakeholders were selected from a stakeholder analysis with a focus on stakeholders with high 'influence' (following Evans, 2009). 12 stakeholders attended the meeting.

The invitation letter gave a broad overview of the objectives of the workshop:

Workshop on modelling poverty, human wellbeing and coastal ecosystem services

I would like to invite you to a two-day workshop organised by the University of East Anglia (UK) and the WCS Coral Reef Conservation Project (CRCP) as part of the project 'Participatory modelling of wellbeing trade-offs on the Kenyan Coast (P-Mowtick)'. This is funded by the UK government Ecosystem Services for Poverty Alleviation (ESPA) programme.

The workshop will use a novel approach to develop a model of poverty and coastal ecosystems in the Mombasa area, to characterise trends, and to develop future scenarios.

The project team will work with a small group of local experts to integrate local expertise with ecological modelling and in-depth poverty research conducted in the past 6 months by researchers from CRCP, Kenya Fisheries Department, and the universities of Ulster and East Anglia (UK), Stockholm (Sweden) and British Columbia (Canada).

We are especially keen to have your involvement in this meeting due to your familiarity and knowledge of the local situation. The workshop will be an opportunity to consider, comment on and define the boundaries of the modelling conducted by the project, as well as interacting with a range of stakeholders and researchers.

The aim of Workshop 2 was to use a modification of the ARDI (Etienne, 2011) method to collectively build a mental model of the system with a focus on ecosystem services and wellbeing of the poor, by generating a rich picture of people's understanding and perceptions of the relationships between wellbeing and the coastal ecosystem services of the Mombasa region. The employment of a series of 'exercises', each discussed in turn, investigating different perspectives allowed participants to collectively generate an understanding of the key features associated with the social-ecological system.

Objectives

- Elicit mental models of the stakeholders regarding the system of coastal ES and the wellbeing of the coastal poor in a way that can be modelled through a fuzzy logic expert system and that provides linkage to the ecological modelling.
- Consider current and future change to identify key drivers, now and in the future
- Present structure and principles of ecological modelling and receive feedback from the stakeholders
- Present wellbeing focus group research and receive feedback
- Assist stakeholders to develop a complex systems understanding of the factors and dynamics influencing ES and poverty at the coast.
- Monitor the process to provide indications of the impact of the process on participants

Pre-Workshop Activities

Welcoming
The night before Workshop 2, participants were invited to come to the hotel and join the team for dinner. This was to encourage prompt attendance for the start of the workshop as well as give the stakeholders a chance to interact in a social setting and get to know one another as early as possible.

Questionnaires
As the participants arrived they were asked to complete a pre-workshop questionnaire before the start of the workshop. The questionnaire for Workshop 2 (see Appendix 2) included a statement of 'the workshop question': ***How can the coastal ecosystems of Mombasa, and the benefits they provide support the well-being of the poor, now and in the future?*** Four other questions were included in the questionnaire to stimulate prior thinking and record individual perspectives on joining the workshop.

Room Layout and Group Environment
The room was set up with people sitting around tables in a 'café' layout around a whiteboard and large wall space at the front of the room. As people came in the team aimed to manipulate the seating so that some stakeholders and 1 or 2 team members sat at each of 4 tables. During the second day participants were shuffled amongst the tables to create different subgroup dynamics and more interaction among participants.

To encourage people to make new connections, during the course of exercises the participation mode was alternated between plenary and subgroup discussions.

Figure 2.1- *The Room Layout*

Day One

Introduction
Tim Daw introduced the project as a novel combination of modelling and participatory methods. He briefly showed a conceptual map from a discussion with UEA masters students on what affects students' wellbeing as an illustration of a conceptual/mental model.

He welcomed and thanked the participants and emphasised the diverse knowledge of the stakeholders, the interest in the knowledge of the participants and the need to listen respectfully to one another's views. He also requested permission to record the proceedings to help with note-taking.

Reflections 1- The Facilitator's Role

In a participatory process the facilitator plays an important role in balancing the discussion and making sure participants have the appropriate space to share their own perspective. In this process we learned:

- The facilitator's attitude characterized by instilling energy and dynamism when needed, listening to the participants and respecting their views, and showing no (apparent) stress, contributed a lot to the open and smooth discussions that occurred in these two days.
- It is important to highlight at the very start that the workshop about "your perception, your knowledge", "diversity of perceptions", "respect".
- The facilitators often (if not always) said things like "good point", "thank you for this remark" which, contributed to make the participants express themselves openly
- The rephrasing process (systematically rephrasing the participant's suggestion) had several positive and negative impacts. On the positive side, it ensured the facilitating team had well understood the participant's point and going deeper in the explanations if needed (efficient to make their reasoning explicit, learning process between the researchers and the participants, increased mutual understanding), emphasizing the participant's point and leveling the playing field (even if they have various communication skills, or if they speak more or less loud, their remark is raised in plenary in the same way), stimulating answers of other participants, especially through the question "does every one agree with that?". However, the reverse effect was that sometimes, the facilitator rephrased it in a way fitting better to his/her own mental model (it is not always easy to say no to questions such as "is that right?", "is that ok to merge these two groups?"). So the facilitators' mental model is inevitably reflected. The implication is that mental models produces in such process are not an objective outcome and will vary depending on the process and particularly on the personal style of the facilitator.

Exercise 2.1- Identifying Primary Stakeholder Groups

The workshop question projected along with a simple definition of wellbeing as *enjoying a satisfactory quality of life. Related to concepts of happiness as well as material wealth.*

Participants were then asked:

- ***Whose wellbeing is affected by the status and management of marine and coastal ecosystems, near Mombasa?***

Participants were asked to individually write answers down on separate post-it notes and stick them on the wall of the meeting room.

Figure 2.2- *Individual post-it notes to identify stakeholders*

Tim then led a process of grouping the post-it notes and agreeing in plenary to the list of primary stakeholders who would be considered. This was a led plenary discussion, where groups were either included; merged with other groups; or disaggregated. This was accompanied by the following questions projected:

- *Is the wellbeing of all these groups affected by the changes in the same way? What sub-groupings do we need?*

- *Who are the primary stakeholders i.e. whose wellbeing is directly affected by coastal ecosystems?*

During these discussions, the definition of primary stakeholders was clarified as ***those whose wellbeing is directly and significantly affected by changes in ecosystems*** and participants were asked to check that the stakeholders in the list were all considered primary stakeholders. The boundary of the system was also clarified during this discussion.

This led to a list of primary stakeholder groups being identified, and being written on separate post it notes. They were displayed down the left hand side of a large area of flipchart paper, marked out as a matrix. Secondary stakeholders were added to a separate flipchart paper as seen in Figure 2.3.

Figure 2.3- *Final list of primary and secondary stakeholders*

Reflections 2- Exercise 2.1 Clarifying the system and definitions

High quality discussions depend on unambiguous definitions and framings. Although the team had aimed to define terms and scope of the study, the initial discussion threw up confusion about both the geographical scope as well as the definition of primary stakeholders. Realizing this, the team had to think on their feet to propose more explicit definitions. These were recorded on flip chart paper and posted on the wall for reference.

Exercise 2.2- Mental Model 1: Primary Stakeholder Wellbeing Matrix

Participants were asked to discuss in groups what factors affected the wellbeing of the previously identified stakeholders and write them on post-it notes; prompted by the following question projected on the screen.

What are the 'things' (factors, items, actors, resources) that directly determine or affect the wellbeing of one or more of these primary stakeholders? (These may or may not be related to ecosystems or their governance)?

After 5 minutes of discussion amongst tables, each participant in turn, was invited to contribute a factor. Participants were asked to make explicit cause-effect statements for each factor to differentiate between direct and indirect factors. New post-it notes were written when new factors emerged from discussions. Direct factors were arranged along the top of the matrix with indirect factors placed on the wall above (see Figure 2.4).

Figure 2.4- *Adding direct and indirect factors affecting wellbeing*

The matrix was then completed to identify the impact on each stakeholder's wellbeing from each direct factor based on the following questions:

- ***Which of the primary stakeholders' wellbeing is significantly affected by this factor?***

- ***How does this factor affect the wellbeing of each of these stakeholders?***

Where possible, we captured whether the factor had a positive or negative impact on each affected stakeholder. The matrix was used to summarise whether each of the proximate factors have a positive (+) or negative (-) **e**ffects on the wellbeing of each stakeholder. We marked the type of relationship in the matrix and recorded how, in further detail, in notes.

Figure 2.5- *Completing the stakeholder/factor matrix*

Reflections 3- Exercise 2.2 The Wellbeing Matrix

The matrix exercise was seen as important to emphasize the trade-offs that might exist between the stakeholders. However it soon became clear that the size of the matrix (11x13 cells) meant that either the exercise would have to be rushed, with no discussion on individual cell, or it would take up a large portion of time and exhaust the participants.

Rather than leave it incomplete the team opted to rapidly complete it by asking participants to vote by holding up with either of two colours of post-it notes to indicate positive or negative. In the event, this was felt to be unsatisfactory as several participants lost interest.

The exercise still took a considerable amount of valuable time, and the outputs were deemed unreliable. In fact this exercise may have been more efficient and reliable if it was facilitated to highlight the most important cells, rather and ask the group about each 141 cells. This could be done by going through each of the factors and simply asking, 'which of these stakeholders has their wellbeing directly and significantly affected by this factor?'

Exercise 2.3- System Model

While the participants were engaged in the matrix exercise, other team members arranged the direct factors in a circle on a whiteboard with lines of influence between them and to indirect factors drawn according to the points made during the previous discussion. The matrix was left intact, and the direct factors were duplicated on new post-it notes and added to a large whiteboard, show in Figure 2.6.
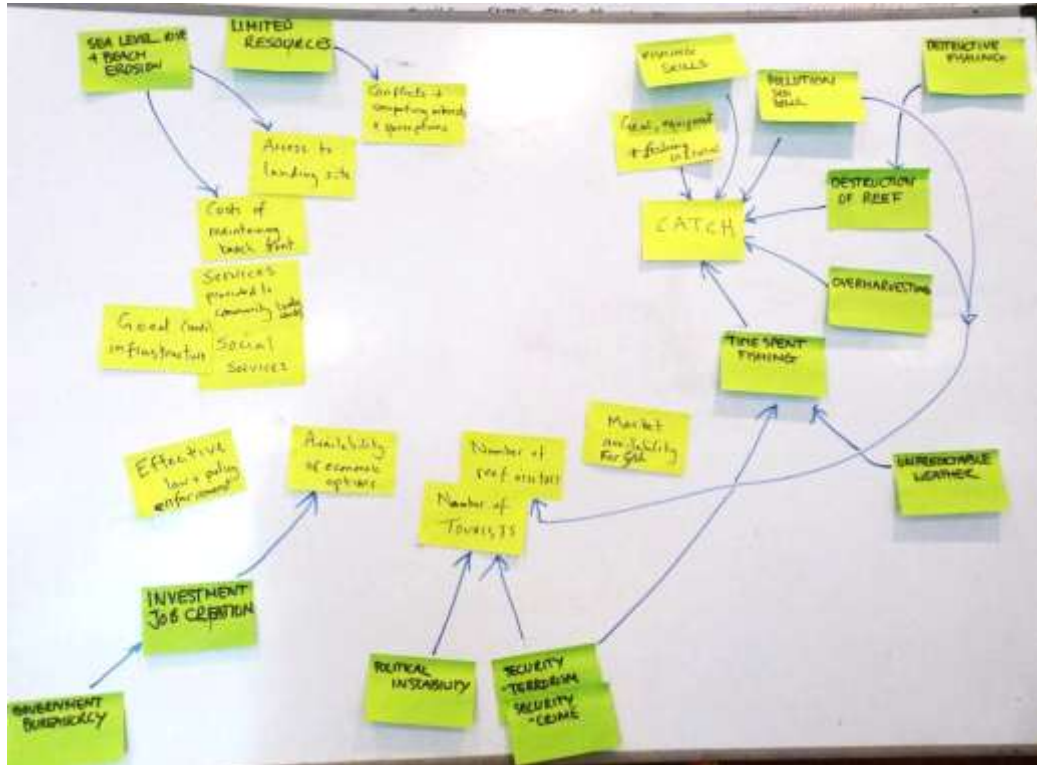
Figure 2.6- *'Prototype Model' presented to participants to start system modelling*

Then the following proposition was made: ***Here are the factors that we have identified as directly influencing wellbeing, now we will try to map out how these are connected, and what affects them.***

- ***How does each of these affect each other?***

- ***What other factors affect each of these?***

Each participant, in turn, was invited to add new relationships or factors to the prototype model. As relationships were proposed participants were invited to accompany the link with a verb explaining the link or influence between concepts. Participants were also asked to comment on whether proposed relationships are 'strong' or 'weak' influences.

Reflections 4- Diverse Methods

The very high diversity of tools and communication configurations used in WS2 increased the chance of every participant being heard. In particular, the sub-group discussions which were followed by the expression of more individual opinions-voting, writing post-it notes, speaking in plenary- were very efficient to stimulate the participant's reflection and to make them more confident about it. It also stimulated participants to engage in the discussion from their individual as well as institutional perspectives.

Figure 2.7- *Conceptual Model of interrelationships between factors*

The emphasis at this stage was to represent the internal dynamics of the system (i.e. feedbacks and actors within the system). The idea was to 'park' *external factors* in a separate list of *drivers* but in practise this was not done and 'drivers' were included in the model (e.g. recession).

Exercise 2.4- Mental Model 2: Bringing in the Ecosystems

This exercise was not facilitated due to time constraints and the fact that ecosystem conditions (e.g. fish stock) were already included in the model. The planned exercise outline is included before for reference.

> The previous exercise should have been open to all influences on wellbeing and may not have included much on the ecosystems. Having asked this open question, we now focus more on ecosystem services by adding concepts or relationships which represent or involve ecosystem services.
>
> If the results of Exercise 2.2 are strongly ecological this exercise could be skipped.
>
> - *How does the condition, and management of coastal ecosystems affect parts of this [refer to result of Exercise 2] model?*
>
> - *What concepts representing the ecosystems are relevant to include in this model of wellbeing primary stakeholders?*
>
> If missing, new concepts and new linkages are added to the model to capture the role of ecosystem services.

Exercise 2.5- Presenting the Model and reviewing Importance and Uncertainty of Linkages

A computer drawn version of the mental model produced using CMap tools (http://cmap.ihmc.us/) during and based on the previous discussion was projected as large as possible onto the wall for the participants to review.
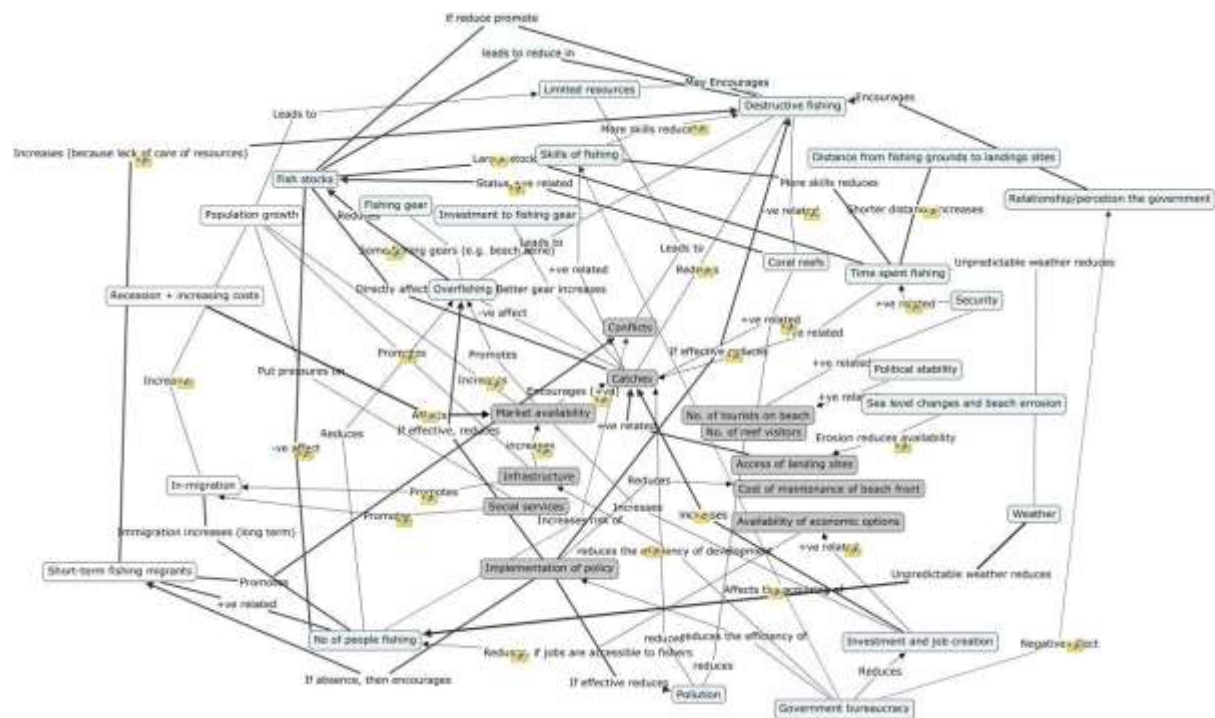
Figure 2.8- *CMap tools image of the first day's mental model*

Participants were then invited to discuss, in four sub-groups, which links in the model were most uncertain and which were most important. Team members joined in each group to help the discussion and make notes.

- *Looking at this model of the system, which linkages are the most important to affect the wellbeing of the primary stakeholders?*

- *Which of the linkages in this model are most uncertain? I.e. Where are the gaps in knowledge/evidence?*

Each participant was given five red and five blue dot stickers, and after discussion invited to vote on the most important and the most uncertain linkages in the model by sticking their dot onto the relevant arrows of the projected image. The four corners of the projected image were marked with stickers to allow it to be repositioned in the event of the projector being moved. The distribution of red and blue dots were counted up and recorded.
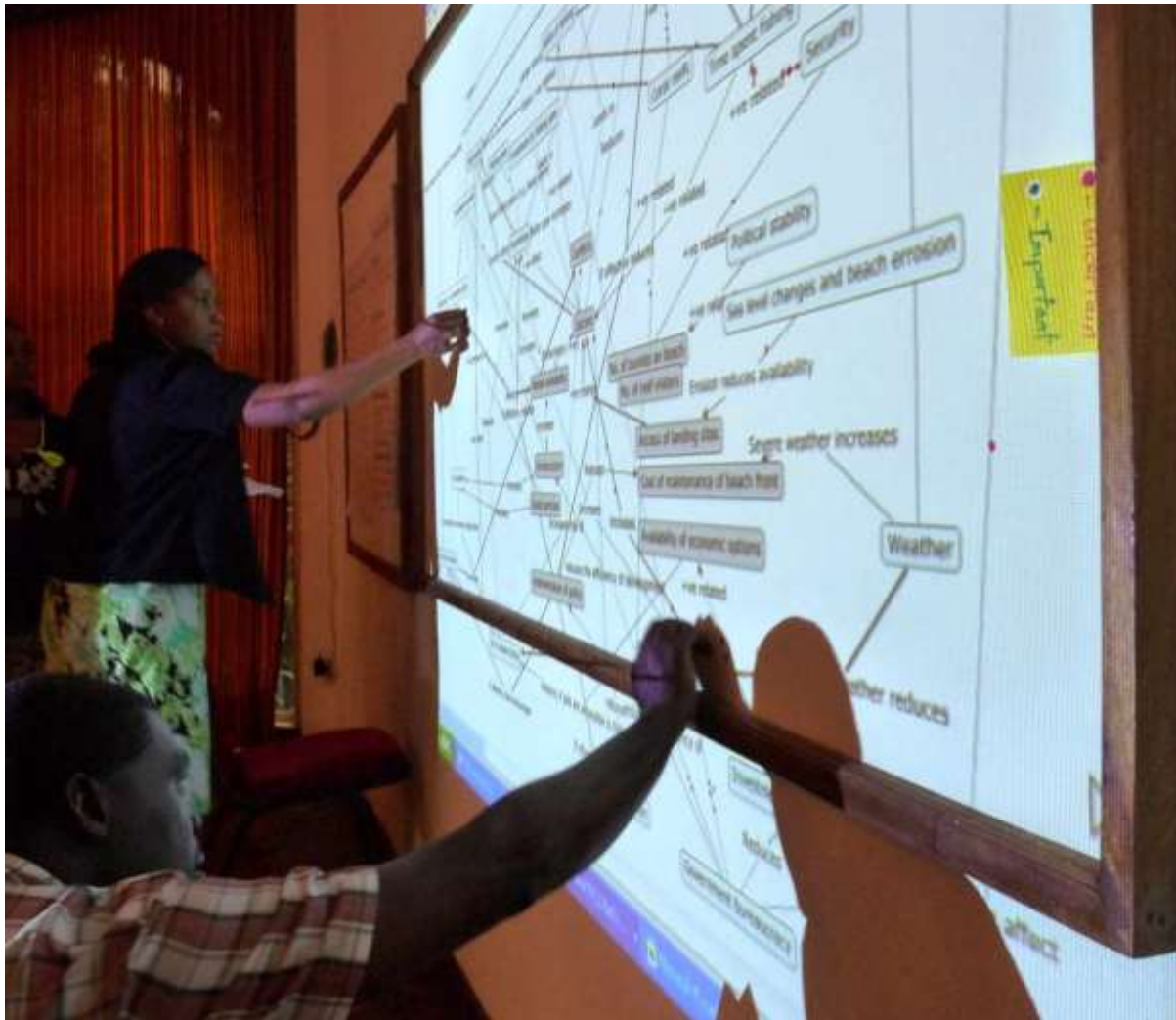
Figure 2.9- *Participants adding stickers to the projected image to vote on uncertain and important links*

> **Reflections 5- Exercise 2.5 Voting on the conceptual map**
> The projection of a computer version of the complex map had a strong visual impact and gave a feeling of an impressive and collectively created output from the first day of the workshop.
>
> Asking participants to vote on arrows rather than factors emphasized the systems perspective and the interaction between factors rather than the factors themselves. Thus, for example, participants would not vote that 'Destructive Fishing' is important, but that the impact of destructive fishing on catches is important.

Day Two

Participants were mixed up between the tables to create new groupings. The CMap tools figure from the previous day was printed on A3 paper and distributed during the brief introduction for the day.

Exercise 2.6- Drivers Analysis

This exercise progressed from mapping out the internal dynamics of the system to focus on processes and drivers of change. Kate led an introduction recapping the previous day and explaining the concept of drivers as the outside influences that are affecting and will affect the system.

We have a conceptual model of the dynamics of the coastal ecological system as it affects the wellbeing of the primary stakeholders. What are the key drivers (outside influences) that are and will affect this system in the next 10 years?

Participants discussed in their table groups and one member recorded the drivers on post-it notes. Then, in plenary, each group in turn was invited to give an important drive and to explain the linkages. Kate asked whether the drivers were expected to increase or decrease in the future. The post-it note was added to a large board of 'Drivers' flipchart sheet (see Figure 2.10). Kate asked about the effects of the drivers and Kate and Tim later recorded the linkages/effects of the drivers.

Figure 2.10- *Drivers board at the end of the drivers plenary discussion*

The drivers were then ranked, similar to the previous exercise, as important or uncertain. Votes were placed on the driver themselves rather than on the links. The votes were counted and totalled up during the next exercise.

Reflections 6- Exercise 2.6 Driver Analysis
In this exercise there was some ambiguity about the meaning of 'uncertainty' votes. Did they mean that people were uncertain about whether it really was a driver, or that the future patterns of change in the particular driver are uncertain.

Figure 2.11- *Showing the sticker process*

Exercise 2.7- Shocks Analysis

The aim was to provoke the participants to reflect on surprises and shocks. Kate introduced the idea of surprises or shocks.

Will the dynamics of this system be the same in 10 years from now?
- *Which of the processes or linkages might be different?*
- *Which of the concepts might be less relevant?*
- *Which new concepts are likely to become important?*

What shocks or sudden changes may occur which might lead to a different system of interactions? When you think about the future, what are the unknowns?

Sub-groups discussed what shocks could radically change the system, they recorded their ideas on post-it notes and then they were discussed. In plenary, each group was asked in turn to present a 'shock' which was explained and added to a 'Shocks' flipchart paper (see Figure 2.12).

Figure 2.12- *Results of the Shocks groups and plenary discussion exercise*

Reflections 7- Exercise 2.7 Shock Analysis

The term shock tended to be understood as a negative influence so it is important to emphasize the possibility of positive shocks. A less normative term like 'surprise' may be less susceptible to this bias.

Only one group discussed a positive shock: that the new Kenyan constitution would shock the system into a more desirable trajectory.

Exercise 2.8- Qualitative Scenarios

Based on the drivers and shocks analysis, the team selected scenarios for the participants to imagine. A two-axis diagram was drawn to consider possible future combinations of two drivers to create support and interest in discussion and seemed interesting to explore. The selected scenarios were based on a combination of good or poor implementation of Kenya's constitution and on high and low population growth, portrayed in Figure 2.13.

Each table of participants was tasked with discussing and developing a storyline for developments over the next 10 years, given the identified drivers and prompted by the following questions:

- *Who would be winning and who would be losing?*
- *What would the policy response do?*
- *How would the stakeholders respond?*
- *What would the coastal resources look like?*
- *Come up with a name for your scenario...*

Rapporteurs were allocated to each group to record the resultant scenarios and feed them back to the plenary. These were summarised and added to the two-axis diagram.

> **Reflections 8- Exercise 2.8 Scenarios**
> It is important to limit the scenarios to unrelated drivers, rather than outcomes. Otherwise there is a risk that internally inconsistent drivers are presented to the stakeholders. The scenarios could have been more carefully constructed. The implementation of the constitution may have an effect on population growth.
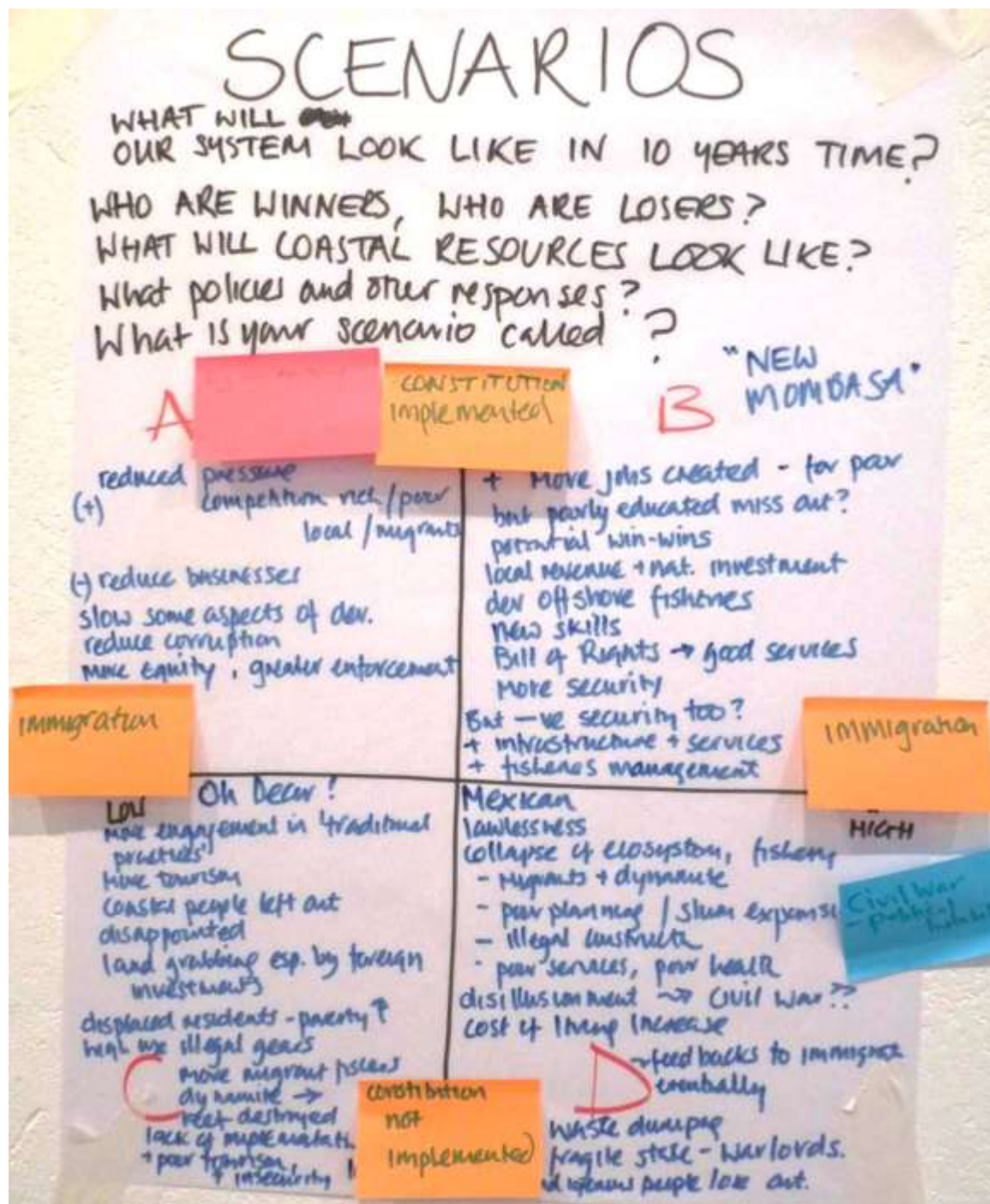
Figure 2.13- *Key points of the four qualitative scenarios*

Exercise 2.9- Explaining the Project

This exercise was left until late in the workshop to avoid leading the participants by our previous work.

Tim introduced the project including presenting the overall framework, emphasising that all models were wrong but some are useful. Sarah explained the wellbeing focus group research and presented some preliminary findings. William introduced ecosystem modelling, food chains the input and the outputs of these models and how they could be used to explore scenarios.

The final two exercises were then run in parallel with half of the participants joining each then switching over.

Exercise 2.10- Systems Affecting the Fishery

Following William's introduction to the fisheries model, he asked the participants to help produce a conceptual model that captured the determinants of the inputs for the ecological model including fishing effort, gear and target species. Participants volunteered suggestions and William captured these in a post-it note and whiteboard model. A team member took detailed notes on the linkages described.
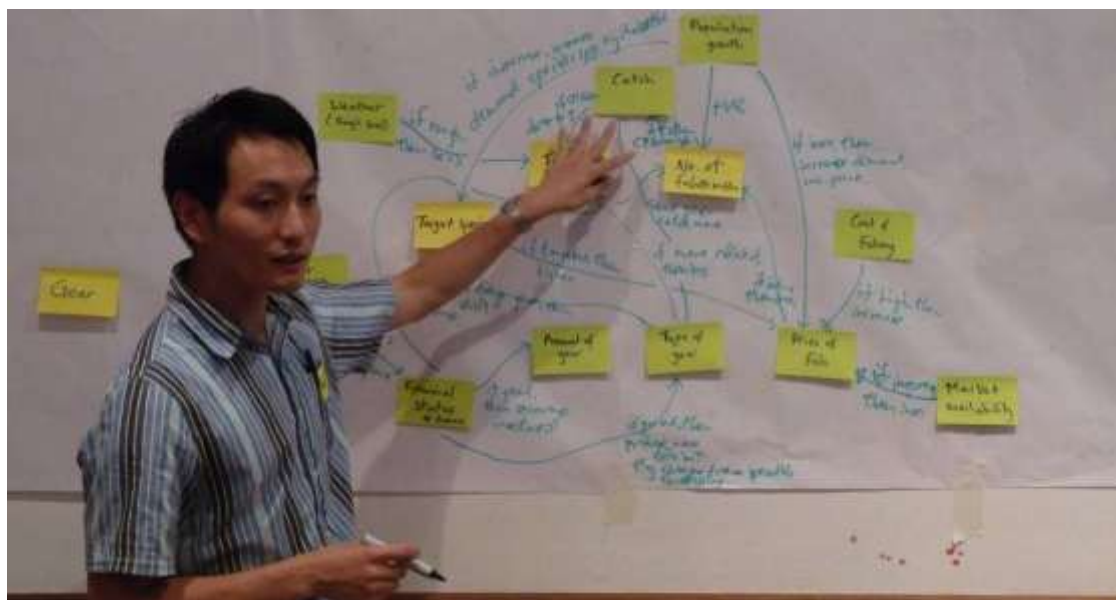
Figure 2.14- *William facilitating the mental modelling of fisheries inputs*
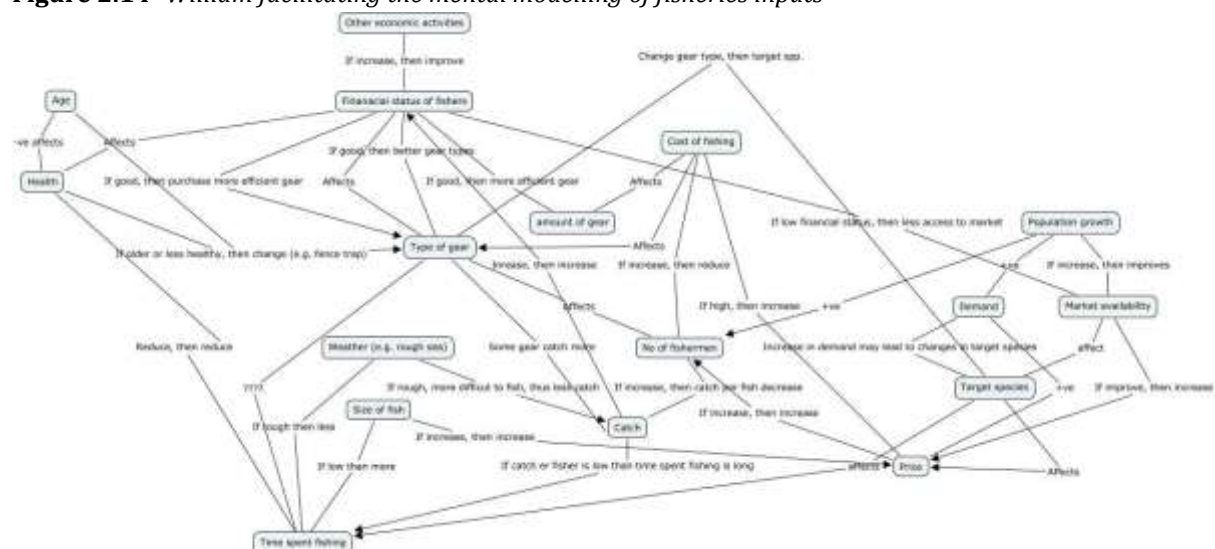
Figure 2.15- *Final mental model of how factors determine fisheries inputs*

Exercise 2.11- Detailed linkage between Ecological Outputs and Wellbeing

Tim led a discussion with the other half of the participants to elucidate the relationships between ecosystem model outputs (type of fish, volume of fish and amount of catch) and the wellbeing of primary stakeholders. The discussion was noted by Caroline, and illustrated by Tim on a whiteboard (see Figure 2.16).
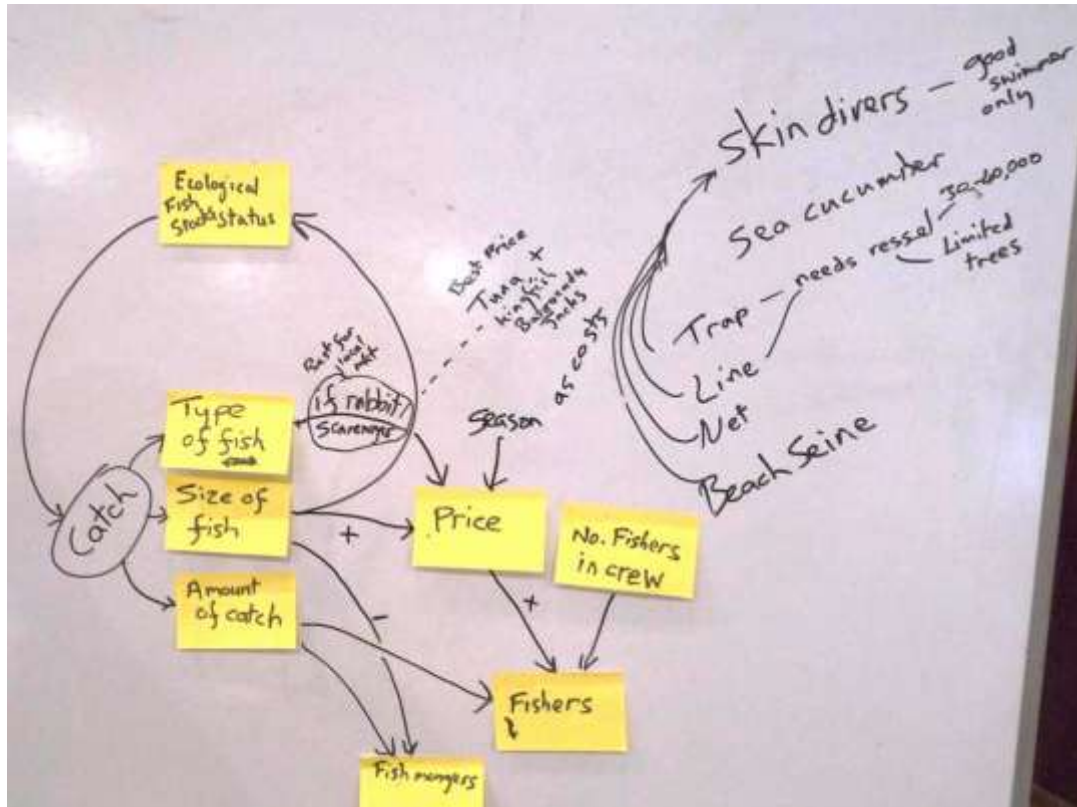
Figure 2.16- *Illustrating the detailed linkages generated by Exercise 2.11*

Reflections 9- Exercise 2.11 Linkage mapping between ecological outputs and wellbeing

This was the most difficult of the exercises, perhaps because it came at the end of the day, and that it was introduced late to the participants, who may have expected the exercises to be finished. Probably it was also due to the nature of the exercise which asked a strange question that most participants had limited knowledge of (except for the fishers' representative who thus dominated the exercise). This kind of information is likely to be more available from discussing contrasting scenarios with primary stakeholders.

Exit Questionnaire

After the final exercises the participants were thanked, invited to take coffee and refreshments before leaving and asked to fill out an exit questionnaire (Appendix 3). The questionnaire sought feedback on the workshop, the collectively created model and their final reflections on important factors affecting stakeholders.

Post Workshop 2, Pre-Workshop 3 Activities

Ecological Modelling

Two main ecological models were created for the project, Ecopath with Ecosim: a mass-balanced model designed to focus on fisheries impacts and dynamics; and a STELLA based model called CAFFEE, which was originally designed to model coral reef ecological dynamics including interactions between corals, algae and disturbances such as coral bleaching.

Initially both models were parameterised to the study area and the following initial scenarios were run for comparison and as an initial indication of their behaviour.
1- Status quo of fishing effort
2- Doubling of fishing effort
3- Halving of fishing effort
4- Removal of all beach seine effort (without allocation to other gears)

Ecopath

Omukoto and William developed an Ecopath model for the Kenyan reef system based on data from the WCS monitoring programmes. This data included abundance and biomass estimates within and outside of the marine protected area collected from underwater visual census, landings data, and economic data of the fisheries e.g., fishing price and cost. Based on this data, a preliminary model was developed that included 54 functional groups. The model represented the coastal ecosystems located north of Mombasa

in the early 2000s period. The model explicitly represented three different habitat types: coral reef, seagrass, and other habitats. In the model, the system was exploited by five fisheries: beach seine, fence trap, handline, net, spear fishing and cage trap.

The property of the model was examined to generate quantitative scenarios of changes in marine ecosystems and fisheries under different changes in fishing mortality between fisheries. This included checking the validity of the estimated parameter values such as mortality rates, and responses to changes in fishing mortality in Ecosim. Omukoto also prepared time-series biomass estimates (2001 to 2010) of some major functional groups to conduct time-series fitting in Ecosim. The model was also run with different scenarios of changes in fishing mortality rates, and the policy-optimisation routine to determine the ecosystem structure and fisheries outputs under different objectives of fisheries development e.g., maximizing food production vs. conservation vs economic efficiency of the fishery

STELLA model of reef dynamics (CAFFEE)

CAFFEE (Coral-Algae-Fish-Fisheries Ecosystem Energetics), is a system-dynamic model of a coral reef ecosystem based on the transfer of energy implicit in interactions between functional groups. CAFFEE was developed in the modelling programme STELLA prior to the P-Mowtick project to represent a conceptualized reef food-web, including 6 primary producers, 8 primary consumers, 2 secondary consumers and 1 tertiary consumer (Fig. 1). It was parameterised for the study site and used in parallel with the Ecopath modelling approach. The models offered different strengths – e.g. CAFFEE models benthos and calcification in more detail, Ecopath captures population dynamics of fished species, and explicitly models catchability of species by different gears.

Use and comparison of two different model implementations provided greater confidence in ecological simulations and allowed different outputs (e.g. policy optimisation from Ecopath and carbonate production from CAFFEE).

The Development of the Social-Ecological Toy Model

The objective of the 'toy model' was to provide a simplified simulation of key interactions within the system so that stakeholders could run trials with key parameters and see the modelled effects on wellbeing of different stakeholders. This activity is followed by a discussion of the dynamics of the model and aspects which are more or less realistic. This gaming process can allow teams to capture 'social feedbacks' into the modelled systems (see Exercise 3.2- 3.4). The process of moving from the mental model in Workshop 2 to the Social-Ecological Toy Model in Workshop 3 is described here.

During Workshop 2, stakeholders developed a collective mental model of how the Social-Ecological System in focus works (see exercises 2.3-2.5). The map (Figure C) reveals the complexity associated to the dynamics within this system. Linkages were associated to a degree of uncertainty in terms of how uncertain the link itself is or how uncertain the nature of the outcome is. Linkages were also attributed a degree of importance in terms of how key a particular link is in defining the overall behaviour.

Figure C- *WS2 collective model*

The challenge was to reduce this complex set of interactions to its key dynamics and link the simplified model to the Ecopath ecological model and finally to the wellbeing of different stakeholders. Below is a description of methods used to arrive at the simplified representation of how major drivers impact ecological processes and the wellbeing of different people.

The first step in the process of model simplification was to represent and think about the collective model in terms of networks. By translating the model into a network we used standard tools used in network analysis to aid the process of simplification.

Figure D shows the collective model represented as a network. Each node represents a variable. In Figure D, the thickness of each link represents the degree of importance that stakeholders associated to that particular linkage. Most important linkages are those between the number of people fishing and fish

stocks, also between coral reef and destructive fishing. Figure E is the same network model but thickness represents the uncertainty of each link.
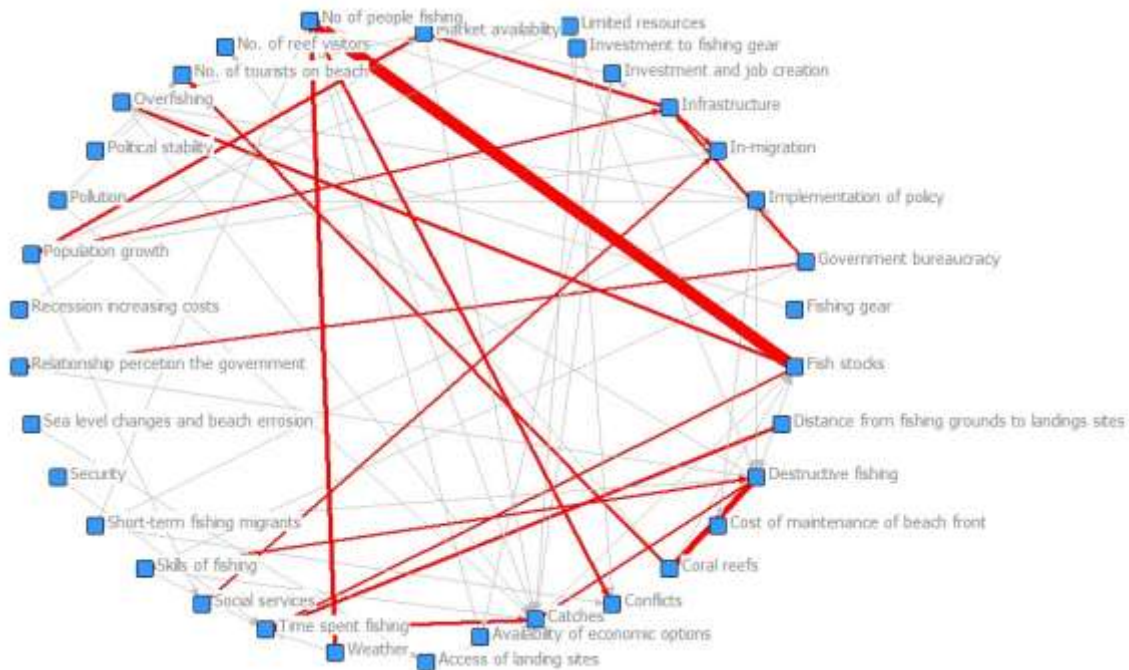
Figure D- *Collective model in a network representation. The thickness of links represents the degree of importance as identified by stakeholders*
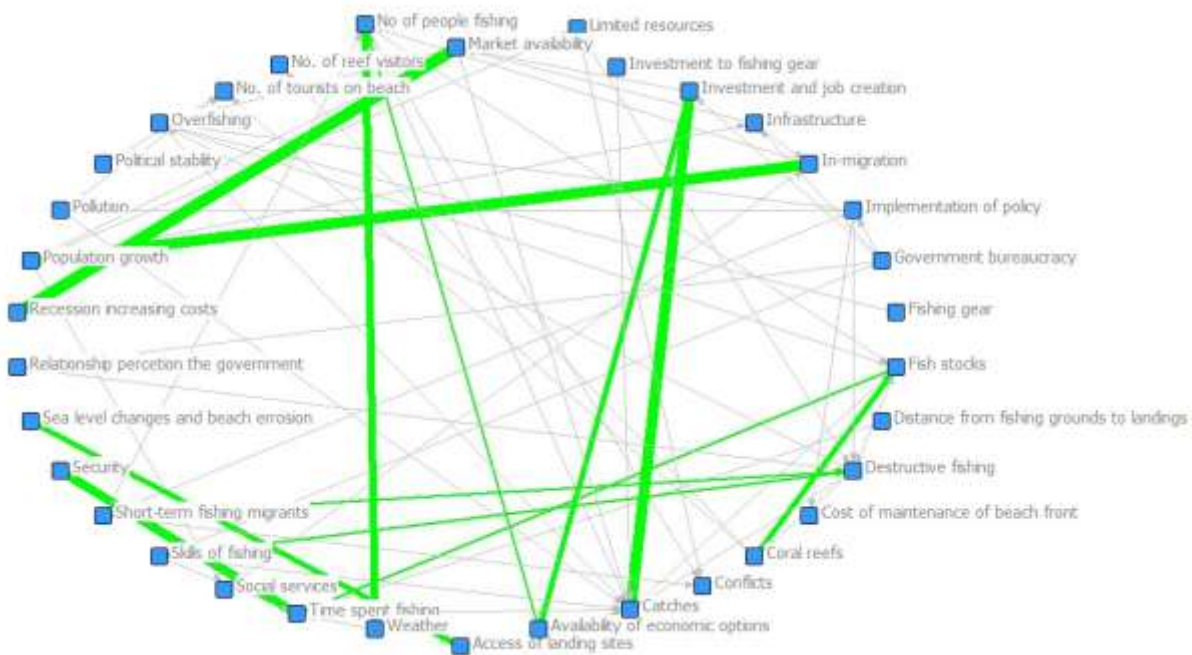
Figure E- *Collective model in a network representation. The thickness of links represents the degree of uncertainty as identified by stakeholders*

By looking at the collective map through the network analysis lens we can think of linkages as directional. This means that if a statement says weather affects number of people fishing, we can imagine a directed link going from weather to number of people fishing. In other words, weather is a source and number of

people fishing a receiver. With this kind of representation we can then identify which nodes (components) are more frequently sources and which are more often receivers. In Table B, concepts/variables are aligned first in descendent order according to the number of outgoing links (driver side), then in descendent order according to in-going links (receiver side).

'Governance bureaucracy' and 'Implementation of policy' are the two components with higher number of links reaching out. This is an indicator that these two particular concepts are important drivers in the network since they affect many other variables (5 each). In the receiver side, the top ranking variables are related to fisheries. This reflects the fact that the whole exercise that fisheries at the core, therefore it is natural that those variables receive influencing links from other concepts.

Based on this explorative analysis we created four broad categories (purple columns in Table B) that function as an umbrella for several other variables. The categories are governance, population, economy and tourism (Figure F). Variables related to ecosystem functioning were categorized as Ecopath since their dynamics were incorporated in the detailed Ecopath model.

DRIVER concepts/variables	Out-degree	In-degree	Category	RECEIVER concepts/variables	Out-degree	In-degree	Category
Governmental bureaucracy	5	1	Governance	**Catches**	1	10	Ecopath
Implementation of policy	5	0	Governance	**Destructive fishing**	4	6	Ecopath
Population Growth	4	6	Population	**Fish stocks**	2	5	Ecopath
Destructive fishing	4	0	Ecopath	**Time spent fishing**	1	5	Ecopath
Coral Reefs	3	4	Ecopath	**No of people fishing**	3	4	Population
Investment and job creation	3	1	Economy	**Market availability**	2	4	Economy
Short-term fishing migrants	3	1	Population	**Overfishing**	2	4	Ecopath
Skills of fishing	3	1	Ecopath /Gov	**Conflicts**	0	3	Population
No of people fishing	3	1	Population	**No. of tourists on beach**	0	3	Tourism
Weather	2	5	Ecopath	**Infrastructure**	2	2	Governance
Limited resources	2	4	Ecopath	**In-migration**	1	2	Population

Table B- *Degree analysis of the WS2 collective model*

Figure F- *Yellow: Population, Orange: Governance, Purple: Economy, Blue: Tourism, Green: Ecology*

These categories were then utilised as the drivers for change within the Social-Ecological Toy Model. The Toy Model was produced in Excel to allow the participants to manipulate the drivers to witness and interpret the sequential outcomes (see Exercise 3.2- 3.4). The causality in the model was implemented with fuzzy logic rules between the variables, for example IF Governance is HIGH then Enforcement is HIGH. Ecopath dynamics were summarised by running scenarios for high and low fishing effort (0,0.5,0.75,1,1.25,1.5 x current levels) by the different gear groups. The resultant quantified input/output tables were linked by fuzzy logic to the outcomes of the driver modelling.

The Development of Scenarios

One of the aims of P-Mowtick was to explore possible futures for the Mombasa region. In a context of change and uncertainty scenario development is a way to explore possibilities for the future that cannot be predicted by extrapolation of past and current trends.

Based on input from stakeholders during Workshop 2, in Mombasa in October 2011, the team created four scenarios of plausible futures for the next 15 years of Mombasa region. Our purpose in developing these stories was to encourage stakeholders to consider some of the positive and negative implications that the different development trajectories have in the wellbeing of different stakeholders groups. Notice how each story was a mixture of strengths and weaknesses. In that sense no scenario was meant to clearly be the 'best'. These scenarios were not based on a 2x2 matrix of drivers as in Workshop 2, but were constructed so that all of the key issues were represented somewhere across the 4 scenarios. This approach drew on the scenario approach of the Millennium Ecosystem Assessment (Peterson *et al.,* 2003).

The scenarios were represented in three ways: visually by a professional artist who was familiar with East African coastal communities; narratively by a written description; and by a causal systems diagram illustrating the logic of causality in each. The draft images were reviewed by the field team for local relevance and appropriate symbolism and edited accordingly.

Scenario	Policy Emphasis	Intermediate Variables	Initial Outcomes
A	Conservation, Aquaculture	Prices, Access	Loss of fish, exclusion of Beach Seiners
B	Welfare-based, Populist	Productivity	More fishers
C	Development, Tourism	Prices, Catch, Beach Seine Effort	Enforcement of beach-seine ban, less fishing livelihoods
D	Offshore fisheries	Decreased fish prices, decreased effort, coral bleaching	Decreased number of fishers, decreased wellbeing for inshore fishers

Table C- *Summary of the Scenarios*

Reflections 11- Scenario Images
The scenario images proved to be a really strong tool that not only helped engagement with the primary stakeholders but also secondary stakeholders and other researchers. The investment of time and resources to have professional images created and to have several drafts with input from the team was well worth it. The pictures are a very flexible tool and were used all the way from our 100+ people dissemination meeting at one of the landing sites to our meeting with policy makers.

Scenario A

azote.se

Global slowdown means limited investments in tourism in Mombasa. A top down government implements strict regulations on beach seining. Fishers usually catch high quality fish but have limited market because of competition with aquaculture industry that has been developed elsewhere in the country.

The story:

A global recession has impacted the number of international tourists in Mombasa region and the economic growth of Kenya overall. This reduces immigration rates from other parts of Kenya. Local tourist businesses focus on low-volume, eco-tourism rather than mass tourism and there is limited additional investment of tourism infrastructure. The new government has less emphasis on individual rights and policies are pushed top-down with little engagement with local communities. Environmental policies are strictly enforced with the influence of remaining ecotourism operators. The ban on beach seines is strictly enforced displacing fisher folk from this livelihood. Inland and coastal aquaculture begins to develop providing low-income livelihoods and cheap fish (in competition with coastal fisheries) which persuades more fishers to diversify their livelihood. As a result of the removal of beach seining and reduction in fishing effort, the condition of corals, seagrass and nearshore fish stocks improve. Those fishers who do remain enjoy high catch rates of high quality (large) fish, but make limited money due to limited demand and competition from aquaculture that has been implemented around Malindi.

azote.se
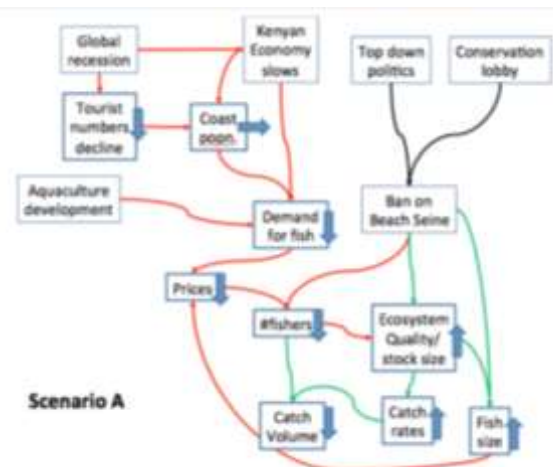
A populist government enhances community participation. People are moving to Mombasa but job availability is low. The number of fishers increases. Young people move into beach seine as their source of income. Fish selling and trading grows due to the availability of small and cheap fish.

The story:

The government with strong ideas of inclusion and popular policies has enforced individual rights and community participation. Fisheries are managed by county governments and power is devolved to communities and supported by better healthcare and educational programs. There is a reluctance to enforce environmental regulations which displace livelihoods and a sceptical approach to large development proposals with limited benefits to local people. Meanwhile several years of drought combined with ethical and political tensions in other regions of Kenya have driven people to the coast. Mombasa is a safe haven against problems in other parts of Kenya and because of its newly implemented social policies. However few occupation options are available given the low economic growth. Mombasa's tourist industry struggles and low occupancy rates lead to redundancies in the tourism sector. Lacking of other job options many young men enter fisheries, especially as labourers in the beach seine fishery, which is legalized in response to popular demands for jobs and sources of cheap fish. Immigrants also seek work in fish trading and frying. The demand for cheap fish products from the growing local population is high and marine resources are strongly exploited. Fish traders gather around the arriving boats at the
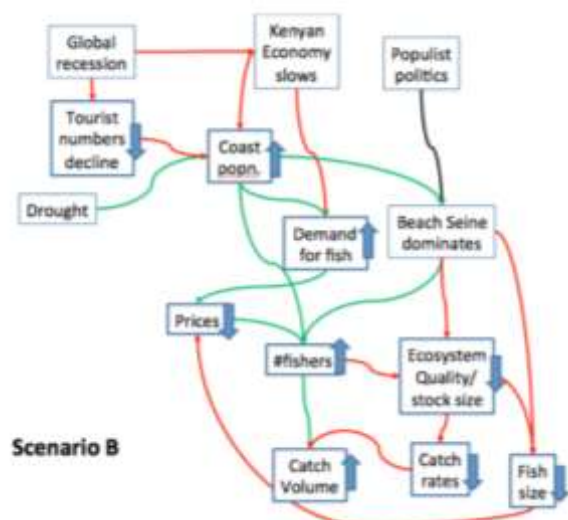
beach to find only small and cheap fish in fisherman's net.

Scenario C

azote.se

International and local driven development helps Mombasa expand its touristic aspects. Many fisher folk leave fisheries to take up other job opportunities. Conflicts and political tension rises due to inequalities and unconstrained beach development erodes the beach line.

The story:

Kenya is enjoying a prosperous phase. A pro-business government and low taxation attracts foreign investments. Mombasa is a reflection of the booming economy with its newly expanded port and influxes of local and international investments which fund infrastructure, hotel investments that promote a growing mass beach tourism market. Port development raises land prices and standard of living. Some fisher folk are attracted out of fisheries into opportunities in construction, tourism and services or as a result of displacement from their landing sites by other economic interests. Those fishers who persist benefit from lowered competition at sea, high demand and high fish prices. Their catch rates are good and include larger species. In time, the unconstrained beach development results in beach erosion, which has an impact on tourism and fish landing sites. Conflict between beach seiners and other types of fishers rise. Political tensions are also stoked by increasing levels of inequality as some entrepreneurs get rich and establish exclusive residences along the coast.

Scenario D

azote.se
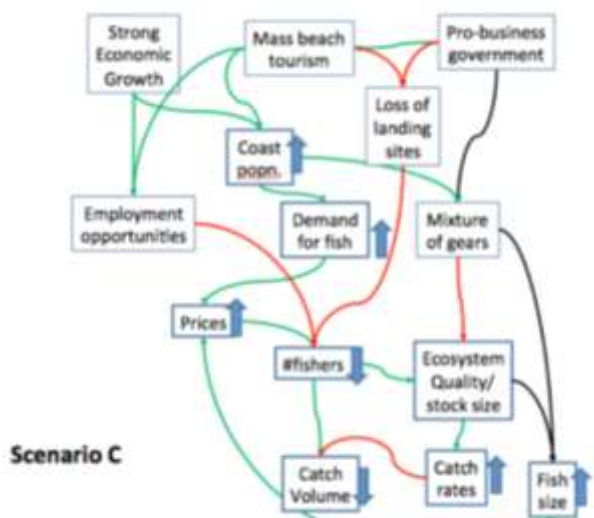
A donor funding project leads to off-shore fisheries development while coral bleaching affects in-shore stocks. What started as a promising alternative turned out to be more complex than expected since fish catches are not reliable which ends up driving many out of fisheries. In 10 years offshore fishery is mostly owned by a few larger business people recruiting crew from the outside.

The story:

Implementation of a project on external donor funding – e.g. Kenya Costal Development Project – leads to provision of vessels, training, and fisheries marketing infrastructure along the coast by Mombasa. This supports development of an offshore fishery targeting semi-pelagic deep water fish with modern ring nets and aided by fish finding technology. Initial trials are variable but generally successful and within 5 years 10 large vessels operate from the coast immediately north of Mombasa. These are collaboratively owned by members of fisher organisations and BMUs and crewed by locals as well as migrant Tanzanians as hired labourers and captains. The catches from these vessels are significantly larger than those from small-scale nearshore gears and beach seines, leading to a reduction in the price per kilo of fish landed from the reef and seagrass fishery. The number of fishers using spear, small nets, handline and beach seine reduces due to some fishers receiving training and joining the new larger vessels, and some opting to leave fisheries in the light of market competition with the new fishery. This leads to a slow recovery of fish in the nearshore habitats, but coral bleaching over repeated years reduces diversity and cover of corals. High catches from the offshore fishery attract investment from local business interests, but fluctuations in catches make it difficult to repay loans on investment, and several local and community owners have to sell their vessels and operations after poor seasons, or due to lack of financial capital and management. Thus within 10 years the offshore fishery becomes consolidated to be owned by a few larger business people who hire crew from outside the area. Some fishers lose access to this fishery as a result and reluctantly return to inshore fishing.
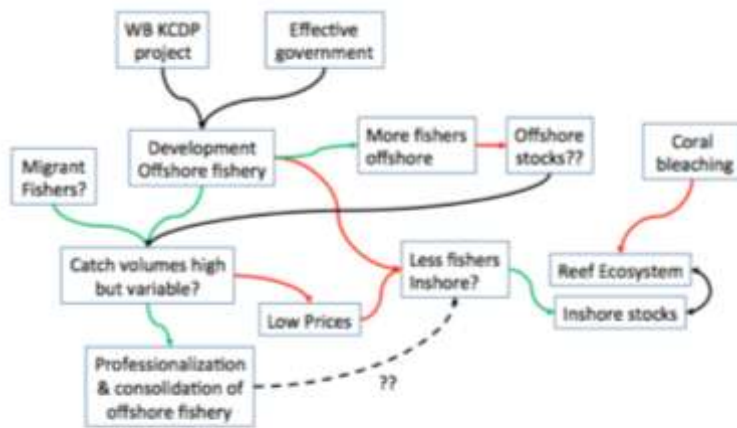
Scenario D

Workshop 3- Trade-Offs and Scenarios

Workshop 3 took place on 2 consecutive days. The team sought to bring together the same secondary stakeholders that attended Workshop 2. However, due to availability there were a few different stakeholders present. 14 stakeholders attended the workshop and stayed throughout the two days.

Workshop 3 intended to promote reflection and understanding of system dynamics occurring in the Mombasa coastal zone, particularly the trade-offs, and get feedback on the development of the social-ecological system- the Mombasa fishery. Utilising the series of 'exercises', each described in this report, enabled participants to explicitly consider the trade-offs between wellbeing of user-groups directly affected by the Mombasa coastal ecosystem.

Day One

Introduction

Participants were introduced to the project and to each other, stating their expectations for the coming workshop. Tim Daw gave a short run-down of the progress of the team and project so far, as well as a definition and simple typology of trade-offs. He also requested permission to record the proceedings to help with note-taking.

Exercise 3.1- Carousel to Report on Project Findings

The participants were divided into 3 groups; each group went to one of three stations where different aspects of the project were being presented. In one corner, William Cheung and Johnstone Omukoto gave an explanation of the ECOpath and CAFFEE models, and presented some potential trade-offs between different types of output (e.g. big fish vs. small fish). The second group of participants received a presentation by Sarah Coulthard on the wellbeing data collected during the focus groups, in which different fisheries stakeholders had been asked the extent to which aspects of wellbeing were important to them and how easy or difficult they found it to improve these aspects. Respondents questioned the extent to which stakeholders in the fishers' community could be separated because of the links between the wellbeing of different individuals. Finally, Diego Galafassi gave participants a short introduction to the toy model, including how it has been constructed from previous participatory workshops and ecological data.

Figure 3.1- *Team members presenting the different research component*

Reflections 12- Exercise 3.1 Carousel

The carousel exercise was utilised to introduce the various components associated with the project. However, it might have had too much going on with three people talking at the same time and may have been distracting to begin with.

William and Johnstone's Station- Ecological Model: Due to the technicality of ecosystem modelling, it meant that the presentation was longer than the other 2; leading to less time for participants to offer any suggestions and/or feedback.

Sarah's Station- Wellbeing: There were many opportunities for discussions; all for 4 participants engaged with the feedback on wellbeing and deliberating on various points and/ or made suggestions.

Diego's Station- Toy Model: The presentation gave an overview of how the toy-model was created and how it works. The interface was shown and participants started to develop a feeling for the interactivity with the model that would be follow in the subsequent activity. This activity provided an opportunity to ask questions and being in a small group (4-5 at the time) was easier to ensure that all participants had understood the model.

Exercise 3.2- Introduction to the Toy Model

In plenary, Diego gave a quick explanation of the workings of the model, including how to manipulate the drivers and how to interpret changes in the model outputs. The group was then divided into pairs, each of which was given the opportunity to play with the toy model.
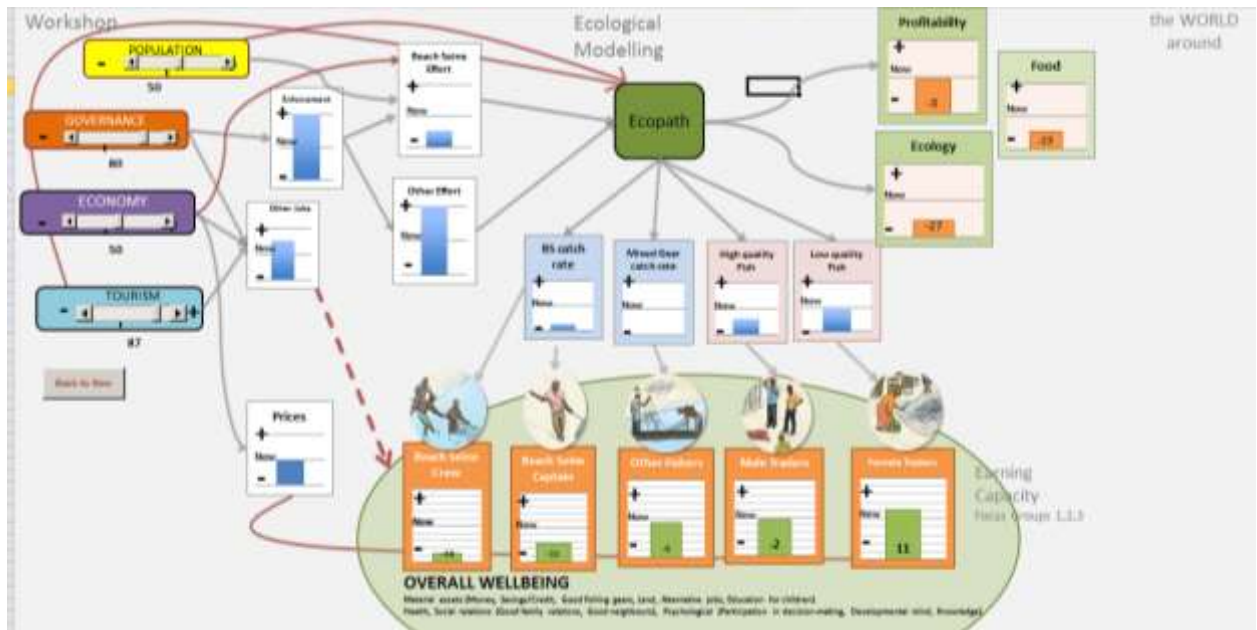
Figure 3.2- *Toy Model Interface. The model is controlled by the four drivers on the left which can be changed using the slider controls. The results are shown in bar graphs for the other intermediate and final variables.*

Participants were asked to predict the outcome of changing drivers regarding the wellbeing of different groups. They then tested their expectations by running the model. Several surprises were thrown up, and there was plenty of discussion during the resulting plenary, and in some cases, disagreement about the results.

Figure 3.3- *Participants engaging with the toy with some help from Diego when required*

Reflections 13- Exercise 3.2 Toy Model

There was good coordination between facilitators; reminding each other of important points of discussions. The sufficient amount of helpers for all computers utilised meant that all participants were fully-engaged and able to play with the models. During the exercise intriguing questions were raised.

During the exercise, it emerged that several groups had an outdated version of the toy model. Although this called into question participants' trust in the model outputs, it was used to show how models are merely representations of reality and should not be seen as a true picture, i.e. multiple versions of the model existed. Indeed, several participants asked about the validity of using the model for policy recommendations if it produced questionable results. Rather than commenting on the accuracy of the model outputs, and hence their use as policy implementations tools, the team were keen to use these opportunities to show that the model was more useful as a heuristic tool for learning about systems dynamics and surprise trade-offs, not for prescribing policy.

Exercise 3.3- Model Feedback

Tim gave a quick presentation explaining that they now would have the opportunity to give feedback on the design of the model and comment on the structure of the system.

Dividing into 3 groups; William, Diego and Tim turned back to drawing the model on paper, going through the steps in turn, so that each link could be understood and critiqued. The result was a list of suggested additions or changes to the model from the stakeholders. In order to assess the importance of each of these suggestions, the facilitators asked each group to choose the top 3 from their list, highlighted in Figure 3.4. 6 changes were selected from the 9 produced, considering overlaps and feasibility. The resulting changes are shown in Table 3.1.

Figure 3.4- *Photos showing the results of two groups' feedback on a model*

Input	Change	Output	Comments Explaining the Changes
Population	Add negative link	Ecosystem	Population increases in Mombasa have a direct effect on ecosystem through habitat degradation and pollution.
Tourism	Add negative link	Ecosystem	Tourism has direct effect on ecosystem through pollution (e.g. effluents from swimming pools)
Prices	Add positive link	Male Trader Wellbeing	Price of fish positively affects male traders because for each fish sold, there is more profit.
Prices	Add negative link	Female Trader Wellbeing	Above a certain price for fish, female traders cannot gain access to the market.
Economy	Add negative link	Beach Seine Effort	Economic growth increases livelihood alternatives for beach seiners (e.g. construction jobs)
Other Jobs	Add positive link	Other Fishers Wellbeing, Male Trader Wellbeing, Female Trader Wellbeing	Availability of alternative livelihoods particularly benefits other fishers and traders because these groups tend to work in other jobs available to them whilst maintaining fishing as a source of income.
Other Jobs	Change existing link (reduce weight)	Beach Seiner Crew	The strength of the link between other jobs and beach seiner crew was weakened to show that beach seine crew often have little training, education, or capital to take advantage of new opportunities.

Table 3.1 – *Changes made to the model as a result of participant's feedback*

Reflections 14- Exercise 3.3 Model Feedback

Obtaining feedback on the model structure and adjusting it accordingly during the workshop helped to emphasise that any model is a single, imperfect representation. It also avoided a 'black box' approach and the idea that models of such complex systems should be trusted for decision making.

Drawing out the model structure and causal links from scratch was a more pedagogic way of explaining the workings of the model than presenting an image of the complete model.
As you can see, each participant had the multiple opportunities to look at the model in different ways – first in the carousel, then the plenary interaction, and finally through this detailed look at its variables and relations. This multiple views was necessary to make sure the model was not seen as black-box, but really to get the participants in the spirit of "iterative modelling".
This activity highlighted the main sources of incongruences in the assumptions we had built into the model. Overnight we made adjustments and brought the model back to the plenary as you will see in Exercise 3.5

Exercise 3.4- Scenarios

Participants were split into 4 groups, and were introduced to each of the four scenarios. Once the relevant details of each scenario had been described by the team, participants were given a chance to feedback on the likelihood of each scenario, especially whether different components of the scenarios could co-exist. After that, in line with developing the trade-off lens, participants were asked to document the winners and losers in each scenario. They were also presented with some of the responses given to these questions from Focus Group 3.

Figure 3.5- *Amini describing Scenario B to a sub group for their comments and responses. The post it notes describe the winners and losers as described from FG3 with primary stakeholders.*

Reflections 15- Exercise 3.4 Scenarios

Scenarios

Dividing the participants into 4 groups and rotating around the scenarios, after 30 minutes, provided great feedback on the scenarios and how realistic they are.

Winners and Losers

The discussion of secondary stakeholders' perceptions on how primary stakeholders would win or lose from the scenario was useful for facilitating a discussion. It became apparent that some of the scenarios, or at least parts of them were familiar to the participants in that they had already happened in different parts of the country. For example, Scenario A with its aspects of slow economic growth was labelled as 'Lamu' after the traditional northern Kenyan fishing village.

Day Two

Tim gave a brief introduction to the day, including where we finished the day before and an outline of the day to come.

Exercise 3.5- Plenary Experimentation with the Adjusted Model

William presented some of the changes made to the model overnight as a result of the model feedback session (Exercise 3.3) the previous day. William explained each of the changes made to the model (see Figure 3.5), and then Diego led an exercise, in plenary, in which participants were asked to predict how the outputs of the model would respond to changing a single driver. The model interface was projected

and each of the intermediate variables affected by the driver were marked with a sticker showing the estimated direction of change, shown in Figure 3.6. Participants were then able to see how well their predictions related to the changes given by the model.

Figure 3.6- *Diego putting stickers on the participants' estimated direction of change*

Model Discussion

A debate ensued between members of the team and participants who felt like the model displayed a number of behaviours that contradicted their mental models of the system (for example a participants' perspective on what would happen to the system following overfishing was different to what the model portrays).

Several participants felt that the presence of an illegal gear would necessarily lead to environmental destruction and decline in fish catches. In contrasts, the model, based on Ecopath modelling showed that high fishing effort with beach seine can result in high yields (of smaller fish) while the ecosystem indicator (based on the projections of larger fish in the ecosystem) was also sensitive to the legal 'other gears'. Thus the dynamics of the model challenged the simplistic view of the impacts of illegal gears on catch and whether an 'unsustainable' fishery always inevitably declines.

The same participant stated that: *'I think that the root cause of the problem is not that the model is wrong but that the data used to prepare the model is wrong because we are not getting what is representative of the system'.* The team then had to balance between explaining why the system might behave like that and emphasising the use of the model as a heuristic tool for provoking discussion about trade-offs rather than a tool for accurately modelling optimal outcomes for policy changes.

Reflections 16- Exercise 3.5 Plenary Experimentation

Diego's activity where participants were asked to estimated direction of change of outcomes, was a much better way of going through the model via plenary discussion and getting participants to predict what will happen; especially useful for those who did not fully understand in the previous day and for new comers.

Exercise 3.6- Optimisations- Single Stakeholder Wellbeing Maximisation

Participants were split into groups of 2-3, each with a laptop with the toy model, and asked to find the optimal wellbeing value for a particular stakeholder group or management priority given by changing the set of 4 drivers to the system. After each group had found the optimum for their specified group, they added the driver and output values to a table that allowed comparisons between the model settings that benefitted each of the different stakeholders (see Figure 3.7). This allowed all to see the quantitative differences in earning capacity between different stakeholder groups, as predicted by the model.

Figure 3.7- *Constructed by participants to show the values of each variable achieved when the model is optimised for particular groups (shown in red circles)*

Reflections 17- Exercise 3.6 Single Stakeholder Wellbeing Maximisation

Participants became very engaged in the task and set about optimising the system to engineer their stakeholders' maximum possible wellbeing.

Some individuals continued to argue that the model was unrealistic. There was an increased appreciation of the fact that models should not be taken as the perfect guide.

Participants found different ways of finding the optimal set of values of the drivers, for example, by fixing first the optimal value found in the first driver, then moving down to the second and so on. In this way, participants found the optimal value by 'adding' the wellbeing contribution from changes to each successive driver. This was made possible because the model itself is additive in the way that parameters affect the variables and the drivers themselves do not interact. Therefore, the parameter values themselves have no bearing on the contribution of the next parameter to the intermediate variable (there is no multiplier effect for example).

Exercise 3.7- Optimisations- Paired Stakeholder Wellbeing Maximisation

In the second optimisation task, participants remained in the same groups. They were given two different stakeholder groups or management priorities and asked to find the maximum joint wellbeing value taking into account the wellbeing of two objectives.

These pairs had been specifically chosen by the team to illustrate the nature of trade-offs, particularly how different types of trade-offs, or even synergies exist between groups. Once all groups were finished finding this compromise of values, Tim led a plenary in which he prompted participants to describe the nature of the trade-offs they had found. For example he asked groups whether increasing the wellbeing of one stakeholder group led to an increase or decrease in the wellbeing of the other group, and whether that decrease was steep or a shallow decline the wellbeing. These two alternative types of trade-offs were named 'strong' and 'weak' trade-offs.

Reflections 18- Exercise 3.7 Paired Stakeholder Wellbeing Maximisation

This exercise exposed participants to the dynamics of what is termed in economics as the *Pareto frontier* – once Pareto efficiency has been achieved, no further improvement can be made for either group without impacting negatively on the wellbeing of the other group.

Difficult decisions were illustrated in this process. For example, by merely totalling the values of the wellbeing contribution of each group, it is possible to find a range of values in which the total wellbeing value is the same, but the wellbeing of each of the stakeholders is markedly different. This raised the issue of normative decisions about equity and discussion about whether the wellbeing of all stakeholder groups should be equally prioritised.

Exercise 3.8- Prioritising outcomes

Tim introduced the idea of management optimisation after the discussion about different trade-offs. To illustrate how trade-offs required managers to make decisions regarding what they would prioritise (and thus what they wouldn't prioritise) participants were handed 5 stickers, and asked to consider which of the 5 stakeholder groups and 3 management priorities they would prioritise. They marked each of these 8 choices with the stickers, and were able to strongly prioritise certain options by allocating up to 5 stickers in a single box (see Figure 3.8).

Figure 3.8- *Photos showing the results of two groups' feedback on a model*

Reflections 19- Exercise 3.8 Potential explanations for the spread of stickers

There was clearly a greater emphasis given to the wellbeing of certain groups and management objectives. Other fishers gained 17 stickers, whilst Beach Seine Crew received none. Perhaps this was done as a question of legitimacy. Beach Seines are seen as illegal and very destructive of the ecosystem whilst other fishers are seen as a legitimate and sustainable method. Perhaps it was also because of the nature of the activity. Participants were able to see the choices made by others, and might not have wished to be seen choosing a group whose gear is illegal. Female vendors were prioritised more than male vendors, perhaps because they were seen as a more vulnerable group. Finally, ecology was prioritised as a management objective more than food and profitability (17, 12, and 10 respectively). One explanation for this could be the representation of organisations and personalities in the room. Perhaps NGOs supporting conservation were more represented than NGOs with other priorities.

One final note – Is it important to bear in mind the timing of this activity in the workshop. Whilst not overestimating the impact of the workshop on participant's mental models, it might cautiously be suggested that previous discussions between participants had led to an emerging discourse on 'female vendors' vulnerability that contributed to them scoring higher than the male vendors.

Exercise 3.9- 'Trade-off' Lens

Sarah introduced the idea of a 'trade-off' lens, to look at environmental dilemmas suggesting that rather than trying to optimise system for particular management objectives, management should focus explicitly on trade-offs and how to mitigate the costs to particular groups given particular decisions. This was presented in a wellbeing context whereby all trade-offs decisions taken are done with a consideration that there is a minimum level of wellbeing, below which harm is done to the individual, and therefore no decision should ever put individuals in danger of crossing this threshold. Sarah then asked participants to

allocate themselves to whichever of the 4 alternative scenarios introduced the previous day they found most interesting. She asked them to consider possible responses to that particular scenario; choose the preferred management solution; evaluate the winners and losers of that strategy; and then finally suggest how harm done to those 'losers' could be mitigated.

Once the groups had dispersed to their scenarios, they were presented by the facilitators with the responses/reactions given by the primary stakeholders issued with the same set of scenarios in Focus Group 3. This provided a range of possible starting points for their own discussions. Participants were given 45 minutes to assess different possible reactions and strategies.

Figure 3.9- *Participants presenting to the rest of the group*

Finally, participants came together in plenary and 1 member from each sub-group presented their ideas. Sarah facilitated the discussion and prompted participants to comment on the viability of the ideas on offer. Therefore, whilst artificially fixing prices was proposed as a strategy to guarantee wellbeing for the female vendors, it was suggested that this might be difficult to enforce. Therefore, an alternative suggestion that fishermen be credited in other ways for maintaining profitable links with female vendors was greeted with more enthusiasm.

Reflections 20- Exercise 3.9 Trade- Off Lens

One issue to bear in mind was whether participants would keep within the system as represented by the toy model - 'optimising' to reduce the severity of the trade-offs - or whether they would suggest ways to engineer the system in a new way to overcome these trade-offs and create new synergies.

All four groups produced different ideas to manage the issues presented to them in the scenarios. However, many groups alluded to the local co-management organisations (Beach Management Units) as the vehicle through which positive change might be accomplished and through which harm might be mitigated. Each of the four groups chose innovative strategies and evaluating the wellbeing trade-offs that could result.

Conclusion

Tim gave a presentation that summarised the activities of the two days, and a quick account of the considerable progress made by the participants in developing the trade-off lens and using the model to challenge their own mental models. He then went onto thank the participants for their invaluable

contributions to the project and gave a rundown of the next steps including a workshop report and policy brief.

Exit Questionnaire

The team asked the participants the most important trade-offs when they arrived on Day 1 and when they left on Day 2, as well as their experience and assessment of the exercises (see Appendix 4).

Post-Workshop Telephone Interviews

Purpose of the Interviews

Retrospective telephone interviews were employed to assess and understand the impact of the workshop participatory processes on their thinking, and how, if in any way, their actions are likely to be impacted. Moreover, the interviews sought to find out what kind of emotions the participants had during various activities as well as assess the level which the workshop was able to connect/network the participants with people they previously did not know or had not worked with. Participants were also given an opportunity to suggest ways in which the process could be improved in the future. Full reports on each of these sets of interviews are available on the webpage (http://www.espa.ac.uk/projects/ne-i00324x-1).

The advantage of telephone interviews was flexibility for when interviews were conducted, and saving on travel costs. It also encouraged the respondents to keep their answers brief and relevant to the questions.

Post- Workshop 2 Telephone Interviews

Data Collection

All of the twelve workshop participants indicated willingness to be interviewed and were contacted via emails to establish interview appointments. Their pre- and post-workshop questionnaires and the workshop report were also sent to them in advance to assist them in recalling their views and discussions from the workshop. Nine responded and we successfully interviewed seven. Interviews were conducted using a speaker telephone and the conversations recorded interviewees' responses were transcribed into the relevant sections of the interview guide. On average the sessions lasted 40 minutes.

The researcher asked seven questions (17 including sub-questions) in four categories:

  i)   Participants' experience of WS2;
  ii)   Changes in systems thinking and wellbeing outlook;
  iii) Changes in subsequent actions; and
  iv)   Expectations from WS3.

Data Analysis

Of the seven participants who were interviewed, all expressed an appreciation of the participatory nature of the workshop as they were able to contribute towards creation of the socio-ecological model. Moreover, through the modelling exercise all felt that they increased their awareness of the vast interconnections between different ecosystem services and wellbeing. For most, ecosystem modelling was a novel idea and they were pleasantly surprised at the wealth of information that was generated in such a short period of time. Terrorism and political instability were ranked highest as the most surprising drivers / shocks in the socio-ecological system of the Kenyan Coast. Overall, participants said that they would be willing to participate in a similar participatory exercise, but also stated that the process might be better informed if there was a wider representation of both primary and secondary stakeholders.

In addition to the workshop's success in broadening the participants' perspective of the factors that influence the socio-ecological system in the Kenyan coast, it also had an impact to a certain extent on how they approach their work. Majority said that whilst planning projects, they now consider and consult with other departments related to their field which they previously had failed to do. The participatory exercise has also enabled some to consult and deal with project beneficiaries in a more understanding and conducive manner, and for one, it has driven them to take up new actions. After learning of the possible

existence of dynamite fishing, this led him to conduct a rapid assessment and is hoping to publish a paper on it. Moreover, the workshop has been successful in fostering the participants' desire to disseminate information from the exercise, as to a large extent respondents have shared their experience and knowledge gained with their colleagues, beneficiaries or donors.

The creation of scenarios was a novel approach for most, though a few felt that some scenarios were too bizarre. Either way, all were looking forward to the next workshop in hope of deepening their understanding of the previous workshop's discussions, findings and the use of participatory techniques. Furthermore, many hope to come up with ways which they can work together in order to mitigate the negative changes that are expected in the Kenyan coast in the near future.

Key Thoughts

Stakeholders
- Concerns over the representation of stakeholders in terms of variety and numbers present- more primary and secondary stakeholders should be present to enrich discussions. Suggested other avenues for stakeholders such as women traders, beach boys, National Museums, land owners and hotel industry.

Modelling Approach
- According to the majority of the participants, the conceptual modelling approach was the most surprising thing they learnt from the workshop as the conceptual model itself demonstrates the links between the economic, ecological and social aspects.
- The modelling exercise broadened their understanding of the array of linkages

"We were shown the model towards the end of the workshop and I hadn't realised that all the information we had been discussing would be put together to form a complex model; it was quite surprising how all our ideas could be put together and were all interrelated"

Subsequent Actions
- Increased an awareness of the need to adopt a holistic or broader perspective when planning for their work or projects to have better results. Participants spoke about checking with various departments in their organisations when preparing proposals as they now appreciate the need to integrate
- Participants had also learnt and employed the techniques used in the workshop. The most popular techniques were the use of sticky notes and consultation of more stakeholders during the planning phase of their work
- Participants had built new contacts with stakeholders and agencies that were not previously in their network- mainly those present in the workshop

Reflections 21- Post-telephone interview WS2
The interviews took place 5 months after Workshop 2. The advantage of conducting them a few months later was that it provided concrete information on the kind of impact that the workshop has had on participants' work and actions. Moreover, it refreshed the participants' memory in preparation for workshop 3 which started a couple of months later. The disadvantage was that reflections may be a little vague due to the time lapse.

It was felt that this kind of qualitative self-reporting was a more appropriate way to assess impact of activities than a formal statistical before-after test for two reasons.
- The low number of participants meaning that any change would not be statistically detectable
- That the impact of these activities will depend on the prior thinking of the participants, some may already be thinking in a holistic way with existing awareness of these trade-offs. Others may be so far from that thinking that they will find it hard to engage with the activities. Others may be at a stage of developing their thinking such that the activities really accelerate their learning. Quantitative approaches would not pick up this variation between participants.

Post-Workshop 3 Telephone Interviews

Data Collection

Majority of the participants (14/16) indicated their willingness to be interviewed on their post workshop questionnaire where they also provided their contact details and appropriate times to be called. The following week, all 14 interviewees were available and these were recorded and transcribed in the same way as the previous interviews. On average the sessions lasted 40 minutes.

The researcher asked 5 questions (13 including sub-questions) in five categories:

   i) Information on expectations and perceptions coming into the process;
   ii) Surface learning – e.g. learning new facts or about processes or topics not previously familiar;
   iii) Stimulation of higher-order thinking skills;
   iv) Practical application of knowledge or learning to their existing work; and
   v) How can the project have impact

Data Analysis

Majority of the attendants said that they had attended the workshop in order to increase their understanding of issues related to management of the Kenyan coastal marine eco-system. Evidently the workshop was successful at this, given that almost all of them reported to have left with a better understanding of the concept of trade-offs and an acknowledgement that this was beneficial in assisting managers to make the best decision for both the primary users and the ecosystem. They also expressed an appreciation of the opportunity to interact and exchange ideas with other stakeholders. Even for the few who said that they had not learnt of any new trade-offs which exist in the system, all in one way or another said that the workshop had enhanced the significance of various linkages in their minds which they may have previously given less priority to or overlooked. A majority also reported that the solutions discussed were relevant to their work.

In response to 'which activity was most useful in explaining the concept of trade-offs', a significant majority said that the optimisation activity using the toy model had been the most effective. Throughout the workshop the interviewees underwent a mix of both positive and negative emotions with the positive feelings being mainly attributed to their ability to contribute towards the discussions and the participatory nature of the workshop. Many said that they were pleased with the project team for having incorporated their comments on the toy model so quickly. The negative feelings on the other hand were mainly attributed to the state of confusion some felt whilst playing with toy model especially when they did not see their expected results. Another factor which led to negative feelings was the high level of information which was delivered in such a short amount of time. Nonetheless, all but one participant said that they had positive expectations for the coast in the near future.

In terms of the workshop's ability to impact on the participant's work, almost all of them (11/14) felt that their experience of the workshop will affect some of the decisions or activities in their work. The key reason provided for this was that the model was a powerful tool which could be used to convince policy makers to consider various trade-off points before making key decisions. Another key factor was that they appreciated the importance of participatory management decision making following the participatory nature of the workshop and they said that they would attempt to increase their work engagements with other stakeholders; this point was made despite the fact they most of them already knew each other or have previously worked together.

The respondents also offered some ideas on how the process can be improved and what the next steps of the project should be. A key number of them expressed a desire for the findings and discussions to be

disseminated to higher level decision makers and most of them said that they are in a position to assist in disseminating the information. As for the suggestions on how to improve the process, the most outstanding ones were that the data used in the 'toy-model' and in the scenarios should be improved; more primary and secondary stakeholders should be involved in the process; and that more time should be allocated to the workshop activities in order to avoid an information overload and to increase the effectiveness of the discussions.

Key Thoughts

Trade-Offs
- Understanding of the concept that trade-offs exist in the management of marine ecosystems, which is beneficial in assisting managers to make the best decision.
- Increased awareness of the interconnectivity that exists. However, one participant noted that being aware of trade-offs is different to understanding the interconnectivity of components and the interdependencies that exist.

Toy Model
- The toy model influenced their learning as it enabled them to predict interactions between various stakeholders with the purpose of searching for a balance.
- The optimising exercise, whilst playing with the toy model, was the most effective in explaining the concept of trade-offs. Participants say that it helped them appreciate the different links within the system and therefore they will remember cater for all stakeholders when making decisions.
- An understanding from the participants that they too have a role to play in influencing the expectations of the coast in the near future; because i) they were enlightened on the socio-ecological state of the Kenyan coast; ii) they realised the need for more stakeholder collaborations when making interventions and; iii) they can draw on modelling as a tool to make predictions which can be used to convince politicians towards certain actions.

'What really drove the idea of trade-offs home was the optimizing exercise because it enabled me to see the interconnectivity between factors and I could visualise how when one increased the other decreased.'

Scenarios
- Other participants suggested that the scenarios were the best at explaining the concept of trade-offs

Suggested Improvements in the process future
- Lots of information within a short space of time, participants suggested the amount of time spent on the workshop should be increased.
- Dissemination of the discussions, either in the form of a policy brief or by conducting a similar workshop with higher level key decision makers.
- The project should aim towards directly impacting the primary stakeholders through creation of a poverty reduction project

Reflections 22- Post-telephone interview WS3
It is important to note that the interviews were conducted only a week after the workshop unlike the previous telephone interviews which were carried out 5 months after the workshop. The advantage of conducting them immediately is that it acts as a reinforcing process of what they learnt or discussed in the interview as they are forced to reflect upon it quite early on. In addition, this is likely to increase the likelihood of the workshop impacting on their subsequent activities. The disadvantage however is that it cannot give concrete information on what kind of impact the workshop would have on the participant's work since it is done before they can implement any changes.

Post-Workshop 3: Team Members Interviews

Data Collection

All team members present at the third workshop, totalling 10 people were interviewed after workshop 3 had been concluded. They were asked to reflect upon their personal experience in the project and to say what they had learnt from it. A range of information was captured from these interviews as the respondents had not prepared for the questions, and they had the freedom to speak out their thoughts and ideas related to the main question. Interviews were recorded and all responses were summarised into seven themes:

i) Definition of the project and the value of using participatory techniques
ii) The initial uncertainty and things finally coming together
iii) Learning experience for team members
iv) Impact of project
v) Importance of team work
vi) Communication proved difficult at times
vii) Other shortcomings in the project/suggestions on future steps

Key Thoughts

Participatory Methods
- The methods forced the secondary stakeholders to think about the trade-offs that occur, e.g. thinking about women traders much more explicitly
- The value of the participatory models was that given the limited amount of quantitative data it was possible to open up the process and introduce new variables into it by asking experts who know the model well (qualitative) to combine the qualitative and quantitative data.
- The toy model enabled participants to appreciate the concept of trade-offs and offer management suggestions through the trade-off lens.
- Participatory methods have the power of bringing two disciplines together and informing coastal resource management.

Stakeholders
- It is important that stakeholders must be equally represented, and that discussions remained free from bias so that the group capture the heterogeneity in the system.
- Even the team members considered the realisation that these processes can have an effect on the stakeholders where discussions revealed that the participants received new information and different perspectives as a highlight.

Teamwork
- Several of the team members emphasised that working with the rest of the team played an important role in enhancing their participation in the project. Working in a team helped each other carry on with support and encouragement
- Continued communication is necessary to ensure that the project remained clear to all involved, especially when the team consisted of members located in different countries. There is value of getting the team together as often as possible to ensure that each member is on the *'on the same page'*, and ensure that it is a *'collective journey'*.

Future Suggestions
- Disseminate discussions back to primary stakeholders in order to increase the impact that the project can have.
- There is potential to take this form of participatory modelling to a higher political level

Final Workshop- Policy Makers Meeting

Purpose

The aim of this final workshop was to disseminate learnings to more senior policy makers and stimulate them to think about wellbeing trade-offs associated with governance of the fisheries.

Participants

The participants comprised of those who had been part of the P-mowtick process for the length of the project, but also policy makers and decision makers, such as the Managing Director of the World Bank KCDP Project, and the Assistant Director of Research at KMFRI. Workshop 5 was conducted over 1 day.

Introduction

The workshop was run in collaboration with another ESPA framework project WD-NACE. Each project team introduce the team, followed by a presentation on the project. For P-mowtick, the participatory processes, focus group study and ecological modelling were described followed by the findings.

Exercise 4.1- Model Introduction

A demonstration of how the agent based model of WD-NACE and the 'toy model' from P-Mowtick work was made by the respective project teams in plenary. Participants were subsequently divided into groups of 4 to run trials of the two models separately to assess their utility, compare outputs, explore if the models could be merged and evaluate their own management decisions; to provide a way forward for further incorporation of these tools into active management in Kenya.

Exercise 4.2- Model- Stakeholder Optimisation (based on Exercise 3.6)

Each group were given flip charts pre-drawn, and supplied with the following questions:

What to do:
1. *Optimize for one group of stakeholders or for one objective. Record the associated scores.*
2. *Try to balance optimization for two groups or objectives. Record the scores.*
3. *Is there a trade-off? What shape of trade-off?*

What to Report back:
1. *What are your key findings from the exercise?*
2. *What policy recommendation or emerging issues would you present from this exercise?*

They tested the outcomes that could emerge from different configurations of the four main drivers (population, governance, economy and tourism) against the wellbeing of different stakeholders, profitability of the fisheries, the ecological health of the system, and the provision of food by the system. After each group had found the optimum for their specified group, they plotted these in the flip chart table that allowed comparisons between different stakeholders. This allowed all to see the quantitative differences in earning capacity between different stakeholder groups, as predicted by the model. Once all groups were finished finding this compromise of values, each group chose leaders who presented their findings in the plenary discussion.

Responses from the groups after participation with the toy model.

The feedback from the groups focussed on additional details not included in the model, or reflections on the utility of the model for management.

- The need to factor north-east monsoon winds in the model
- The policy makers discussed the element of time. The participants wanted to know if it was possible to include time scale to show at what period does this start changing and get better or worse.
- The toy model was seen to be in an advanced stage; however, the definition of each driver (population, economy, enforcement and tourism) needs to be clearly proposed to the participants.
- The introduction of the two models seemed to be quite confusing for the policy makers. The team tried to describe the scenarios as a meeting point for the two models. However, it was also argued that the two are part of two different niches but there is a need to check the policy recommendations that come out of them.
- The strong notion that a the wellbeing of fishers is a priority

Reflections 23- Policy Makers Meeting

Despite the attempts to introduce the toy model as a heuristic tool, there was still a sense that participants expected a model to provide specific policy advice. This was reflected in discussions as to whether the model was 'finished' or 'ready to be used for decision making' as well as suggestions to make the model more complex by adding further complexity and resolution to it. It could be proposed that by stimulating these discussions and detailed thinking about the system the toy model had already met its objectives.

Given the far more limited time available for this meeting with higher level policy makers (two projects sharing a single day meeting) compared to workshop three (2 days for P-Mowtick) inevitably the degree of engagement with the model was less. While responses from the participants focussed on suggestions for adding to the model or evaluations of the model for policy making, individual participants may have learned about trade-offs and adjusted their mental model as a result of the exercise. It is difficult to assess the extent of this impact from the Policy maker meeting without the follow up interviews that were available for WS3.

Primary Stakeholder Activities

Focus Groups

Purpose

Focus groups (FG1, FG2, FG3, and FG4) were conducted with primary stakeholders in the Mombasa coastal ecosystem in order to gain an understanding of how wellbeing of these groups was affected by benefits derived from ecosystem services from the fishery.

Process

The team facilitated Focus Group 1 (Wellbeing); Focus Group 2 (Linkages between components of Wellbeing); Focus Group 3 (Scenarios); and Focus Group 4 (Toy Model). Five different primary stakeholder groups were identified and selected as being a) relatively dependent on the fishery system under study b) likely to have ecosystem-service-mediated trade-offs between each other. The five groups were: beach seine captains, beach seine fishers, male fish traders, female fish traders, and net/speargun fishers.

Focus groups aimed to ground the research in the actual subjective, lived experience of primary stakeholders, on whose wellbeing the project was ultimately focussed on. Specifically they were designed to:
- understand how wellbeing is understood within the community, and what is important for wellbeing (FG1)
- understand how people perceive their level of wellbeing in the present day, how their needs are being met
- to explore *how* wellbeing is affected by changes in access to fish, or changes in catch volume or type
- to explore other factors key to wellbeing and how they are interrelated
- to explore the impacts of specific scenarios on wellbeing of different groups of fishers (*whose* wellbeing is affected in which ways)

Focus Groups also aimed to disseminate our research directly to representatives of affected stakeholder groups. FG1, 2 and 3 were done discretely with each stakeholder group (i.e. repeated 5 times) and were recorded, translated and transcribed for analysis. FG4 was conducted with 10 participants, including 2 representatives of each group.

For further information on the methods used in these groups see focus group guides (**LINKS**) and the methods handbook (**Coulthard et al in prep.....)**

Focus Group 1- Wellbeing

Focus Group 1 explored how different groups of people perceived wellbeing (i.e. subjective wellbeing), how it related to access to fish (provisioning ecosystem service) and how achievability of wellbeing was changing for them and also others in wider society. The analysis of these linkages between wellbeing and fisheries was around three themes:

i) How wellbeing is perceived by people and how it relates to marine ES:

How wellbeing is thought about in their community and what is valued; important attributes for wellbeing; whether they feel they are achieving these components of wellbeing; and how people prioritise different elements. The different components of wellbeing were discussed in terms of the categories of security, basic material for good life, health, social wellbeing and freedom of choice.

ii) Key changes that are affecting the achievement of wellbeing on the Kenyan coast:

This theme documented key events, trends or changes that people feel are, or have affected their ability to meet their wellbeing criteria (either positively or negatively) using a 10 year time scale.

iii) Future aspirations for the coast/fishery:

This theme queried about future visions and expectations for the region and what was needed to bring about a favourable future.

Reflections 24- Focus Group 1

Question ii tended to elicit changes that had a negative influence on wellbeing, such as the establishment of the marine park, changes in the price of fish and other goods, and environmental degradation.

Focus Group 2- Linkages between components of Wellbeing

The analysis of FG2 identified key differences between these three primary stakeholders in terms of the contribution of fisheries to tangible and intangible aspects of wellbeing and the multiple linkages between them. For instance, although cash – or money – is a key benefit of fisheries, and one recognised by all stakeholders, money represents quite different things to different people. In fact, there are important linkages with other aspects of wellbeing, such as health, family and social relations, and trade-offs with security.

Focus Group 2 was completely transcribed and conceptual maps of the three different stakeholder groups were drawn. These conceptual maps showed linkages and mediating factors which affect how ecosystem services affect wellbeing.

Focus Group 3- Scenarios

Focus Group 3 reviewed and discussed the 4 scenarios. Scenarios were presented to stakeholders as 'stories about the possible future' and an explanation about the approach used to develop them. Each scenario is represented by a pictorial representation of the main qualitative aspects of the scenario (see '*The Development of the Scenario'* section). The aim was to understand the wellbeing implications of different scenarios for the primary stakeholders, and to discuss their likely and possible responses. This aimed to help the stakeholders reflect on their agency in the face of future change, and secondly to capture the feedbacks that occur between the impacts of the system on stakeholders and the impacts the stakeholders have on the system.

For each scenario the following questions were posed to the stakeholders:
- *1a) How would your life be affected?*
- *1b) Would you live well in this story?*
- *1c) Who would be the winners and losers in this story? Why?*
- *2)   How would a [group identity] respond?*
- *3)   Could this story happen in the future? How likely is it? Why?*

After all the scenarios had been presented and discussed, all the stakeholders in the focus group had to agree on the following question:
- *4a) What story would you most like to be told? Which would you least like to be told? Why?*

This question facilitated a group discussion. The stakeholders were given different coloured markers to stick on the favourite and least favourite scenario of the group.

The participants were finally asked to reflect on **what they think will actually happen in the next 15 years**.

Focus Group 4 – Project feedback and Toy Model

Focus Group 4 aimed to bring the different stakeholders' perspectives together, and provide them an opportunity to interact with the toy model as the secondary stakeholders had done. Two representatives from each of the groups were selected. The team selected individuals who were engaged and good at contributing their thoughts. The team also wanted to check their assumptions about how key parts of the system are affected by each other. The workshop was run in Swahili at a meeting room in a local hotel.

Exercise 5.4.1- Introduction and Scenarios

Caroline translated introductory remarks by Tim, then made a presentation on the focus group study and the four scenarios they had previously been introduced to. Most of the participants recognised the scenarios.

Exercise 5.4.2- Toy Model

In this session, participants were introduced to the toy model and shown how it worked. Images of a toy car and that of a real car were used to explain what the toy model is, in comparison with reality. In this explanation, the participants were asked to mention the differences and similarities between the two images. Johnstone Omukoto then took the participants briefly through how the toy model operates using a simple model platform of fish catch versus wellbeing and a combined fish catch versus fisher numbers and wellbeing.

A simplified version of the toy model was used in which the higher level drivers were removed and the operator changed the amount of fishing effort by each gear only. Simple 2 and 3 variable examples were used to explain how the model worked and build up to the full complexity (below left). The interface was adjusted to be more pictorial and intuitive (below right).
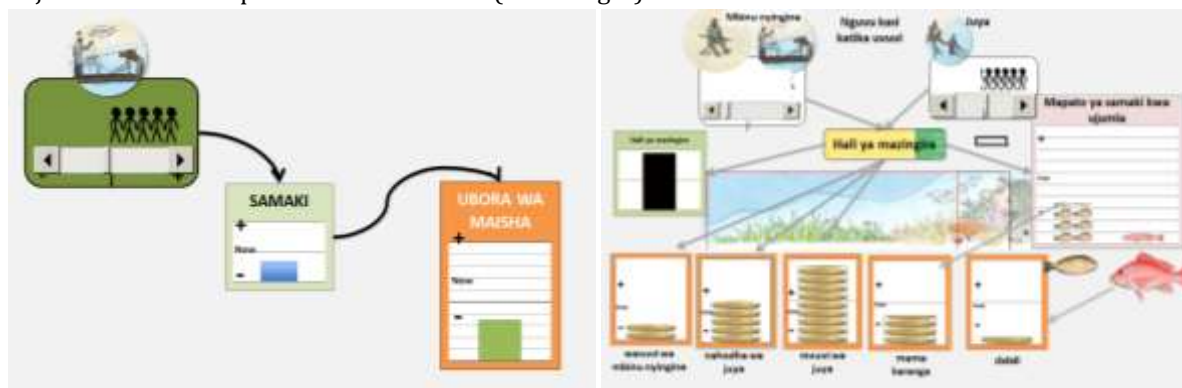
After the above two presentations the participants were split into two groups for an in detail interaction with the toy model.

Upon interacting with the model, participants were engaged to address the questions:
- *What causes an increase or reduction in number of beach seine fishers?*
- *What causes an increase or decrease in number of fishers using mixed (other) gears*?

Each group was also tasked to address the questions:
- *How does the amount of fish caught by a fisher (CPUE) affect the WB of others?*
- *How does the total amount of fish catch (total catch) affect the Wellbeing of others?*
- *How does fish size affect wellbeing?*

Responses

Various responses were appraised from the above 3 questions. One participant suggested that fishers are all happy when they all get more fish but that this is not usually the case. He further indicated that there is need for fishers to be helped to go further offshore with improved vessels and gears to get better catches. One mama karanga indicated that sometimes it is expensive to buy big fish and hence their reliance on small sized fish for their wellbeing. However she also stated that the more fish was caught the better it was for them because they will have more to take to the market. At the end of the session, it was realised from the group that there were several perceptions on what it means by increasing number of fishers versus what it means by increasing number of gears particularly for the beach seine. Most agreed that increasing fishers is preferred to increasing number of beach seines and when we ran this in the toy model, they observed that only beach seine captains and mama karangas become happy/better off with more fishing. This gave rise to a discussion on what this meant and it was explained that increasing fishers on one beach seine just increases efficiency of the gear thus more fish which benefits the captain and mama karangas, but lowers the earnings for each crew member.

Reflections 25- Toy Model Considerations

If you are in doubt whether stakeholders can use a computer/mouse, ask participants to "push the arrows" on the computer screen or on the projected image. Someone from the team can then implement the actions on the computer at the same time. The importance is that they focus on the dynamics of the model and not on the medium.

Model graphics should be intuitive/ simple. Aspects to watch for: size of characters, colours. Try to represent the actual elements of the model as close to stakeholders reality as possible, e.g. using an image of a fish in a bar chart that indicates the amount of fish

When projecting the model outdoors, colours will change and it is possible the model interface will suffer. If it can be arranged, consider projecting on to a whiteboard so that in case elements are not visible, they can be drawn on the board.

We were surprised at how well the toy model exercised seemed to work with stakeholders with no experience of computers.

Exercise 5.4.4- Voting

The voting exercise aimed to lead people to think about the principles that should be considered when negotiating trade-offs. Participants were introduced to six key principles one by one before being asked to vote what they consider high priority. Every participant had 5 stickers to allocate across the principles they wished. This forced the participants to choose at least to leave out one. The principles were:

- Total catch landed
- Catch/earnings per fisher
- Employment for many
- Total profitability
- Environmental conservation
- Justice, fairness and equity for all people

Figure 5.4.1- *Participants voting on their preferred principle*

Exercise 5.4.5- Interventions

Participants were briefed of the various emerging trade-offs in the toy model and scenarios. They were asked to critically look at these issues and provide amicable interventions that would help in streamlining the fisher operations and activities for equitable optimisation while ensuring effective maintenance of the ecological system that is considered as a cornerstone for a healthy fishery.

The objective of the exercise was to achieve an understanding from the stakeholders/fisher groups on what strategies to be put in place and adhered to in helping sustainable resource utilization and optimization of respective livelihood needs for all. We looked forward for the participants to be able to provide remedial interventions measures for all other stakeholders, including themselves as primary stakeholders, other community members, conservation NGO's and Government.

Exercise 5.4.6- Discussion in Rotating Pairs

After the voting, participants were asked to get into pairs and reflect on the sessions so far, and what needs to be done to improve the livelihoods and wellbeing of stakeholders in Nyali. The pairs were allowed to discuss for a few minutes, then they were asked to change pairs and continue the discussion. This was done three times so that each participant spoke 1-on-1 with 3 other participants. Participants were taken through recommendation made in Workshop 3. They were engaged to suggest policy interventions they thought will help deal with the Nyali fishery situation. Following the discussion in pairs, they then presented ideas back to the group in plenary.

Responses
- Management plans to discourage migrant fishers
- Stakeholders and fishers to work on an all- inclusive management plan which will preserve the environment
- NGOs should help identify ways to improve the livelihoods of fishers while giving them ideas on how to improve the fishery
- Fishermen to be assisted with the modernisation of the fishery
- Facilitate the establishment of and assist with strengthening a BMU
- Capacity building should focus on fishers not the vessel owners

Reflections 27- Discussion in Rotating Pairs

Initially participants paired up with the person they were most familiar/comfortable with (usually the other representative of their stakeholder group). However, subsequent rounds created more novel pairings. Although the team did not attempt to eavesdrop on the conversations, we observed genuine two-way interaction between potentially conflicting or differentially powerful people. However when it came to the plenary feedback, we felt that individuals proposed their own perspectives rather than reflected on each other's.

Exercise 5.4.7- Exit Interview

The team each interviewed participants from the workshop asking the following questions:

- *Do you think the model was realistic? Why?*
- *What did the model show you?*
- *Was anything from today useful for you? What? Why?*

The full record of the participants' response can be found at Appendix 5. The majority of the participants that were interviewed said that the model was a useful model to assist with fishery management. The participants reiterated the importance of changing fishing techniques to conserve the environment and improve wellbeing.

Primary Stakeholder Open Meeting

Purpose

The aim of the workshop was invite primary stakeholders at the study site to learn about the project and engage them in a discussion about trade-offs in their wellbeing that might exist in alternative futures. In turn, promoting reflection and understanding of system dynamics occurring in Mombasa coastal zone, including how linkages and feedbacks between social and ecological components and complex behaviour of this social-ecological system plays out in the context of multiple drivers of change and uncertainty.

Participants

This 'open meeting' at Nyali Landing site acted as a workshop where all participants could participate. Just over 100 stakeholders attended including representatives of each of the stakeholder groups: beach seine captains, beach seine crew, female fish traders, male fish traders, and net/speargun fishers. The workshop was run entirely in Swahili. The workshop was conducted over one afternoon.

Figure 6.1- *Nyali Landing site*

Pre-Workshop Activities

As they arrived, participants were provided with a hand-out in Swahili, describing the 4 scenarios, key definitions and the core trade-offs in the system (see Appendix 6).

Introduction

Permission was requested to record the proceedings to help with note-taking, for the subsequent use as learning models to other fisher communities. Caroline discussed how the involvement of local communities is the best approach to understand and know how local people impact and interact with the ecosystem, and explained the reasons behind Nyali landing site being the location of choice to base the research. Participants were introduced to the project and the team gave a short run-down of the progress of the project so far, as well as a definition and simple typology of trade-offs. The 4 scenarios were introduced and discussed with the participants with the aid of large posters of each.

Exercise 6.1- Toy Model

Images of a toy car and that of a real car were used to explain what a model is, in comparison with reality. The participants were asked to mention the differences and similarities between the two images.

Douglas gave an explanation of the workings of the model, including how to manipulate the drivers and how to interpret changes in the model outputs. The participants were introduced to the toy model and shown how it works. The team explained the views of the stakeholders in the previous workshops (who were present in the audience for this workshop) were consolidated together with the use of a computer to produce the toy model.

In order to explain the toy model and the trade-off concept so that everyone understood, Douglas requested for 6 volunteers to represent each stakeholder (beach seine crew, beach seine captain, other gear fishers, women fish vendors, male fish vendors, and the ecology/environment). Each representative was given a piece of paper with a happy and unhappy face on each side to represent winners and losers of a particular situation. Using the toy model, the drivers were moved to symbolise changes in the system. Looking at the toy model the representatives showed the audience whether they were winning or losing with their banner. Participants were briefed of the various emerging trade-offs in the toy model and scenarios. Douglas asked for volunteers to act as the manager and experience with changing the amount of fishing by each gear to try to achieve good outcomes for everyone.

Figure 6.2- A volunteer from the audience takes the role of 'fisheries minister' and suggests changes for the toy model. A team member implemented changes on the computer so the result was projected. Five more volunteers, representing different stakeholder groups, held up cards to show whether the predicted changes were good or bad for them.

Exercise 6.2- Interventions

The objective of the exercise was to achieve an understanding from the stakeholders/fisher groups on what strategies to be put in place and adhered to in helping sustainable resource utilization and optimization of respective livelihood needs for all. We looked forward for the participants to be able to provide remedial interventions measures for all other stakeholders, including themselves as primary stakeholders, other community members, conservation NGO's and Government. Views were collected on flip charts.

Exercise 6.3- Voting

The voting exercise aimed to lead people from appreciating trade-offs to thinking about the principles that should be considered when negotiating trade-offs.

Stakeholders were introduced to six key principles one by one before being asked to vote what they consider high priority. Every participant with 1 sticker to stick on their preferred priority:

- Total catch landed
- Catch/earnings per fisher
- Employment for many
- Total profitability
- Environmental conservation
- Justice, fairness and equity for all people
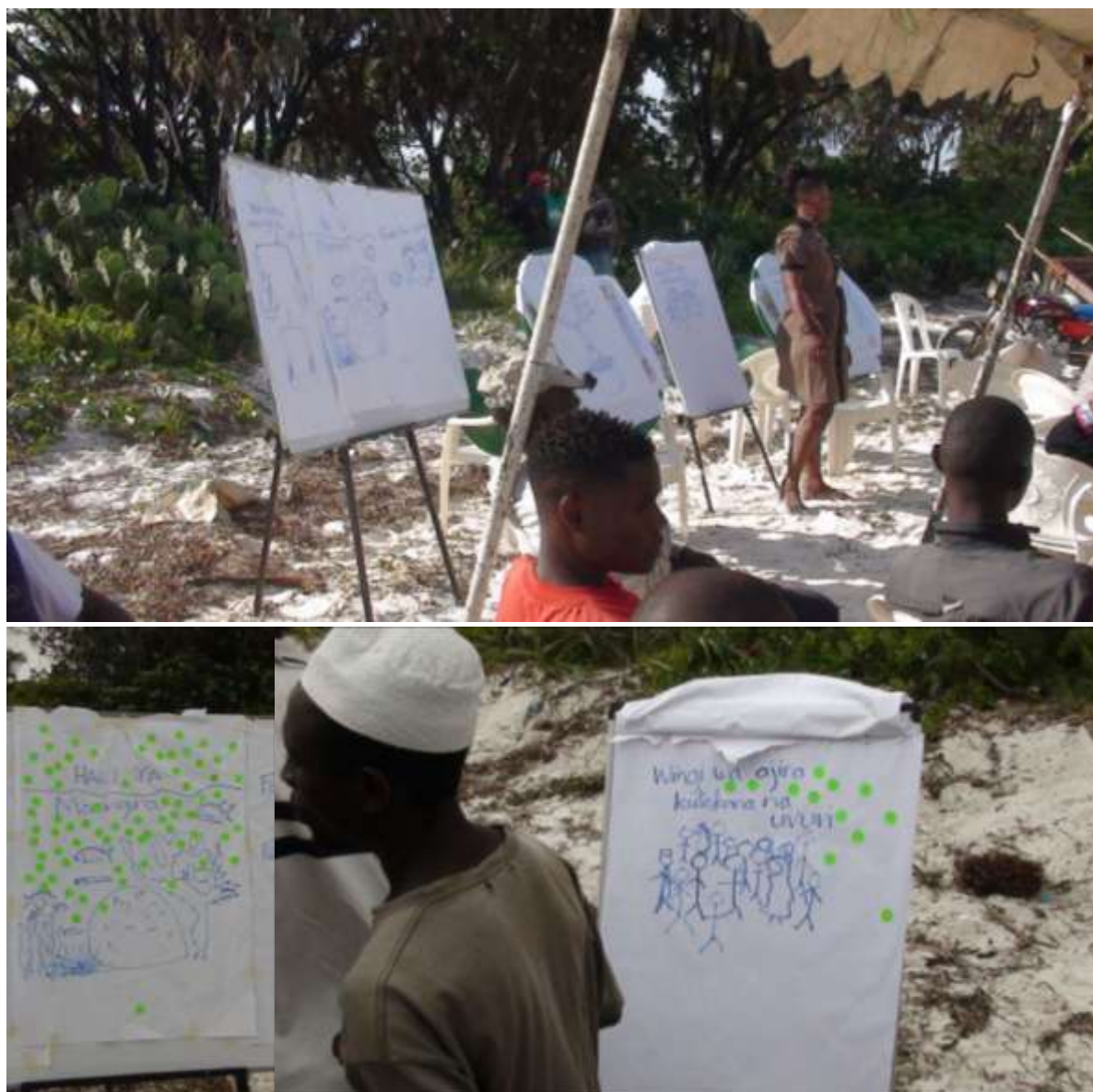
Figure 6.3- *Stakeholders taking part in the voting exercise with stickers*

Results

From a total of about 112 votes noted on the flip charts, around 75 participants voted environmental conservation as a preferred priority, followed by justice, fairness and equity for all people (18), then employment for many (13), total catch landed (5), catch/earnings per fisher (1) and total profitability (0).

Reflections 28- The politics of public voting exercises

The exercise was intended to provoke participants to think of the values that are important to them in addressing tradeoffs. However, the context of the exercise and potential implications for future decisions meant that some stakeholders objected to the exercise seeing it as specifically linked to policy choices rather than priority values. In particular, some felt that the exercise would result in imposing a ban on beach seining and interfering with their livelihood opportunities and left to the side of the meeting to discuss their concerns. The research team emphasised the objective of the exercise and that Beach seining was not factored as an item in the proposed voting. Other participants were vocally in support of the voting exercise and objected to a side discussion forming, demanding that this faction address their issues within the venue and not elsewhere. Following a extended discussion, the meeting participants insisted that they wanted to continue with the voting

Exercise 6.4- Invited Feedback

At the end of the open meeting, the team asked the participants to provide information on their perspectives of the fishing situation in Nyali, and whether their thoughts had changed. This was conducted with three flipcharts and three members of the team. Each team member allowed participants to provide their thoughts and ideas to be written on the flipchart for dissemination.

Figure 6.4 – *Participants providing feedback for the flipchart*

Exercise 6.5- Café Discussion

Douglas sat with chairs around him where participants could join him. He facilitated discussion with the participants regarding the project. Douglas also asked questions regarding the open meeting; what they had learnt during the session, and what they thought of the toy model. The entire discussion was filmed.

Responses- Exercise 5.4.7 Exit Interview and Exercise 6.5 Café Discussion - Primary Stakeholder Feedback

At the end of the dissemination meeting, participants stated that this sort of event should be organised periodically as a way of building the fishers; capacity as well as giving them a channel to voice their ideas. Most of the women participants identified the need for organized groups through which education (on topics such as marketing, human rights, and governance) can be disseminated.

The team was surprised how it was possible to involve 100+ people in playing with the toy model. What could have been a rather dry presentation was brought to life by physically involving members of the audience to participate, as indicators of outcomes of each stakeholder group, as minister of fisheries with power to adjust the model and as onlookers who shouted responses or raised their hands to contribute.

Although change has been signified as essential by most of the primary stakeholders, responses have mainly focused on the modernisation and changing of gears in order to increase the total catch of fish. The majority could not see a future where all benefit without any changes to their fishing methods.

Few of the participants described idea of trade-offs present in the system in the way in which the team had attempted to communicate them, which differs to the level of understanding that the secondary stakeholders had. Thus, the primary stakeholders may not have managed to fully gain the intended messages regarding trade-offs. However, the experience of the meeting seemed to engender and engagement and agency in terms of understanding the system. To some, it provided a trajectory into the future, which in turn stressed the idea that the situation at Nyali must change. This change has been suggested by some participants to be community-involved rather than directed by the government or the KWS. For example one participant suggested that the community should perform their own research to practically understand and witness the potential changes to the system at Nyali.

The toy model employment was not apparently understood by all the participants. When participants were asked about whether the toy model was realistic and if it showed anything, some participants misunderstood the relevance and rationale behind the toy car/ real car analogy at the beginning of the Open Meeting and Focus Group 4, as they believed the toy care demonstrated possible progression towards purchasing a car.

Table of Participatory Methods used and key pros and cons

Participatory Method	Advantages	Challenges
Exercise 1.1- Presentations	Allowed the team to explore different approaches and ascertain the best techniques for the project's specific needs.	Difficult to combine with early stakeholder engagement.
Exercise 2.1- Identifying Primary Stakeholder Groups	Improved the level of participation and co-operation. The topic of trade-offs became more clear by inluding all primary stakeholders	Requires a solid definition of 'Primary Stakeholder' to be identified to prevent confusion
Exercise 2.2- Mental Model 1: Primary Stakeholder Wellbeing Matrix	Emphasises the trade-offs between stakeholders	The size of the matrix, depending on the amount of factors identified, may take up a lot of time
Exercise 2.3- System Model	Involved each participant	Stakeholders tended to devote more energy in adding links between existing concepts rather than adding new concepts
Exercise 2.4- Mental Model 2: Bringing in the Ecosystems	If ecosystem conditions were mentioned in Exercise 2.2, this exercise can be skipped	
Exercise 2.5- Presenting the Model and reviewing Importance and Uncertainty of Linkages	Presenting the large collectively derived model gave the participants a shared sense of achievement. Emphasises the interactions between factors rather than the factors themselves	The task of identifying most important or uncertain links in a complex network diagram is quite difficult
Exercise 2.6- Drivers Analysis	Broadens paprticipant's perspective of the socio-ecoligical system	Requires a solid definition of 'uncertainty'; whether people were uncertain about whether it really was a driver, or that the future patterns of change in the driver are uncertain.
Exercise 2.7- Shocks Analysis	Enables paprticipants to acknowledge their fears and those of other participants	Important to emphasise the possibility of positive shocks. Shocks tend to be understood as a negative influence
Exercise 2.8- Qualitative Scenarios	Participants carried facts from previous exercises into this exercise, illustrating its suitability	Important to limit the scenarios to unrelated drivers, rather than outcomes. A lot of guidance was needed for participants to think of the scenarios in terms of -ve and +ve drivers or outcomes
Exercise 2.10- Systems Affecting the Fishery	Purely participants suggestions were added to the whiteboard	Tended to be dominated by one stakeholder with good knowledge of the fishery
Exercise 2.11- Detailed linkage between Ecological Outputs and Wellbeing	Focussed directly on the WB ecology links that were the modelling aim of the project.	This exercise was the most difficult, probably as it was at the end of the day and participants were expecting tasks to be completed.

Participatory Method	Advantages	Challenges
Exercise 3.1- Carousel to Report on Project Findings	Useful for introducing lots of information in a reduced amount of time. Discussion time provided lots of communication and interaction of participants	May be distracting to start with 3 people talking at the same time. Need to ensure each explanation is the same length, and includes opportunity for discussion. Needs a large or separate room, or it can be difficult for group members to hear each other
Exercise 3.2- Introduction to Toy Model	Raises intriguing questions. Poses the question of validity, which is an opportunity to show that the model is more useful as a heuristic tool for learning about system dynamics rather than a representation of the truth.	Requires a sufficient amount of helpers for all computers. Ensure that there are no differences between the versions of the Toy Model.
Exercise 3.3- Model Feedback	Drawing out the model structure and causal links from scratch was a more pedagogic way of explaining the workings of the model than presenting an image of the complete model. Emphasised the contingent/partial nature of the model	Although this exercise explicitly deconstructs the links behind the model, some participants still had a tendency to see the model as a black box in later exercises. Possible to end up with a long list of extra factors that participants want to include which would make the model too complex and intractable.
Exercise 3.4- Scenarios presentation and discussion	Provides great feedback on the reality of the scenarios, as parts of the scenarios were familiar to some of the participants. The use of imagery of the scenarios was very helpful to visualise the various factors involved	Requires lots of time. Took approximately twice as long as planned.
Exercise 3.5- Plenary Experimentation with the adjusted Model	Particularly useful for those who did not understand in the previous days Provides a shared, step-by-step explanation of the model	
Exercise 3.6- Optimisations- Single Stakeholder Wellbeing Maximisation	Participants were highly engaged in the task to engineer their stakeholders' maximum possible wellbeing. Possible to get stakeholders to focus on perspective of unfamiliar actors	Follow up discussion can emphasise that models should not be taken as the perfect guide
Exercise 3.7- Optimisations- Paired Stakeholder Wellbeing Maximisation	Very clearly illustrates tradeoffs. Allows discussions of types of tradeoffs as well as synergies.	

Participatory Method	Advantages	Challenges
Exercise 3.8- Management Optimisations		Participants may not have wished to be choosing a group that is illegal; may have been swayed by previous discussions; and were able to see choices by others, which may have changed their vote.
Exercise 3.9- 'Trade-Off' Lens	Each group produced different ideas to managed the particular issues in the scenarios. They chose innovative strategies and evaluated the wellbeing trade-offs that could result.	
Pre- and Post-Workshop Questionnaires	Direct evidence of how perceptions have changed over the duration of the workshops.	Limited ability in a questionnaire to capture deeper learning
Post-Workshop Telephone Interviews (WS2 and WS3)	Conducting them a few months later, allowed evidence of longer term impact the workshop. Conducting a few weeks after the workshop acts as reinforcing process for participants' learning. Qualitative self-reporting allowed nuanced expression of individual learning and perception change.	Conducting a few months later, may result in vague reflections from the workshop. Whereas conducting a few weeks after the workshop cannot provide concrete information of the kind of impact the workshop has had on participants' work.

Relies on self reporting, of self conscious learning |
Exercise 4.1- Model Introduction		Two models were introduced, may have led to an overload of information.
Exercise 4.2- Model-Stakeholder Optimisation	Interesting insights developed from this activity. Stimulates discussions and detailed thinking about the system from the decision makers	Elicited many suggestions for extensions to the model rather than focussing on the dynamics which *are* represented.
FG1- Wellbeing Focus Group	Allows an understanding of how different groups of people perceive wellbeing, subjectively experience it and how it is changing	
FG2- Focus group on Linkages between components of Wellbeing	Reveals multiple linkages between aspects of wellbeing and complex means/ends reasoning	
FG3- Scenarios	Scenarios draw out people's feelings and aspirations about the future, giving insights into how wellbeing is perceived and pursued	

Participatory Method	Advantages	Challenges
FG4- Toy Model	Brings the stakeholders' perspectives together with activities and exercises so that different stakeholder groups work together and shared perspectives	Power imbalances may exist between different stakeholders. Selection of competent individuals can help even participation.
Exercise 6.1- Toy Model	With a large audience, plenary discussion creates a great environment for learning. Physically involving the audience enhances engagement	Concepts may be difficult to understand, consider using volunteers to represent different stakeholders, to allow a comprehension of trade-offs Projection outside or at large meetings can be challenging.
Exercise 6.2- Interventions	Helps primary stakeholders think about sustainable resource utilisaton and optimisation of respective livelihoods for all	Try to choose volunteers from different stakeholder groups to allow a participants to understand that everyone is involved in the same situation
Exercise 6.3- Voting	Encourages debate and consideration of core values that underlie trade-offs decisions	Participants may be influenced by others, and by what has been previously discussed by the team. May be sensitive if particular livelihoods are associated with certain principles.
Exercise 6.4- Invited feedback	Provides useful information from the primary stakeholders and allows them a voice	May create expectation of action on all contributed points
Exercise 6.5- Café Discussion	Relaxed environment may encourage participation. Flexible and quick allowing participation from any participants willing to join.	May be dominated by particular participants. Requires a good mediator to encourage participation and ensure a range of contributions

Appendix 1- Stakeholder analysis approach and outline

For each stakeholder:
- importance of our scenarios for their wellbeing
- agency over future scenarios, and how this can be exercised
- amount and type of knowledge held of importance to project

Methodology

As outlined in the conceptual workshop, stakeholders are defined dependent on what is 'at stake'. For the stakeholder analysis the problem was defined as:

The use and governance of marine and coastal ecosystem services, particularly fisheries, from Mombasa north to Takaungu, and the implications for the wellbeing of poor people.

Following Brown et al. (2001), we allocated semi-quantitative scores (on a scale of 0-3) for each stakeholder's Importance, and influence. To apply the method to this study, we defined **importance** as the extent to which a stakeholder's wellbeing is affected by governance of and/or access to the fishery, or the resultant fish. Given the objectives of this study and of ESPA, we also considered the level of poverty of the stakeholder. This importance was mostly related to the degree of dependence of their livelihood on fishery related activities, and their possible alternative opportunities. Importance was also given to stakeholders whose wellbeing is affected by fishery governance even if their livelihoods are not directly related to fishing. For example, the livelihoods of glass bottom boat owners are enhanced by the Mombasa marine park, which can be considered a feature of fisheries governance in the region.

Influence was defined as the agency to affect change in the fishery and influence the livelihoods and wellbeing of stakeholders with a high importance. Given the ultimate focus of workshops to inform policy, the emphasis was on political agency.

Importance
0 – Negligible influence of change (in coastal ecosystem services or fisheries) on the wellbeing of this stakeholder

1 – Minor influence of change on wellbeing e.g. aesthetic impact, or related to livelihood but stakeholder is not poor or without options (e.g. researcher)

2 – Significant influence of change on wellbeing, and stakeholder can be considered 'poor' in terms of assets, vulnerability to change or low standards of living (in terms of education/health/nutrition etc). E.g. works in a sector which is indirectly affected by fisheries management, or which relies on ecosystem services (e.g. tour boat operator)

3 – Wellbeing directly influenced by change, and stakeholder is 'poor'. E.g. fisher, poor fish trader.

They sort of argue that we're moving into a more "holistic" as we move into more adaptive forms of management.. and that the so called command-and-control has to be

Influence
0 – No influence on governance of fisheries or processes affecting coastal ecosystem services.

1 – Minor or indirect influence, including policy or science dialogue, minor representation within participatory governance, OR influential stakeholders are accountable to this group.

2 – Significant influence on policy, through regular high level communication with influential stakeholders, or powerful positions within deliberative forums. Alternatively has agency to directly influence change in the system.

3 – Direct responsibility and power to develop or implement policy or agency to significantly change the system through political, managerial or direct actions.

The following documents were consulted to identify stakeholders who were relevant to the project:

Matsue, Naomi. (2009) Gender, Trade and Development in Kenya's Marine Fishery. MS, Norwich: University of East Anglia, School of International Development.

Evans, L. S., (2009). 'Understanding divergent perspectives in marine governance in Kenya', *Marine Policy*, 33, 784-793

Evans, L. S., Brown, K., and Allison, E. H., (2011). 'Factors Influencing Adaptive Marine Governance in a Developing Country Context: a Case Study of Southern Kenya'. *Ecology and Society* 16:21.

Tuda, A. O., (2007). Environmental Conflict Management in the Mombasa Marine National Park and Reserve, Kenya: A Multi-objective Spatial Approach (MSc).

List of stakeholders inversely ranked by influence. Only stakeholders with at least 'moderate' influence included as potential invitees to the 'Elite stakeholders workshop'.

Stakeholder group/organisation	Importance	Influence	Type
County Council	?	?	Govt
Kenya Marine Forum	?	?	?
Kenyan Fisheries Department	1	3	Govt
Kenya Wildlife Services - coastal unit	1	3	Govt
Kuruwitu Development organisation	3	2	LocalOrg
Mombasa Boat Owners Association	2	2	LocalOrg
Kenya Association for Hoteliers and Caterers	2	2	NationalOrg
ARC Centre of Excellence in Coral Reef Research, James Cook Uni	1	2	Research
Coast Development Authority	1	2	Govt
National Environmental Management Authority	1	2	Govt
Hotelliers	1	2	User
PACT Kenya	1	2	NGO
Coral Reef Conservation Project of WCS	1	2	Research
Coastal Oceans Reseasrch and Development in the Indian Ocean	1	2	Research
Kenya Marine and Fisheries Research Institute	1	2	Research
hawkers, curios etc	1	2	User
Mombasa Municipal Council	1	2	Govt
Coastal Rural development organization	1	2	LocalOrg
East Africa Wildlife Society	1	2	NGO
Kenya Sea Turtle Conservation Organisation	1	2	LocalOrg

Eco-ethics International Union Kenya Chapter	1	2	NGO
International Union for the Conservation of Nature	1	2	Donor
United Nations Environment Programme	1	2	Donor
USAID	0	2	Donor
ReCoMap	0	2	Donor
Mama Karanga	3	1	User
Fisher groups	3	1	LocalOrg
Migrant fishers	2	1	User
Tajiris (fish traders)	2	1	User
Tourism Department	1	1	Govt
Beach operator organisations	1	1	LocalOrg
Divers	1	1	User
Watersports	1	1	User
Kenya Association of Tour Agencies	1	1	NationalOrg
Kenya Association of Tour Operators	1	1	NationalOrg
Dept Systems Ecology, Stockholm Uni	0	1	Research
WIOMSA	0	1	Research
Local MPs	0	1	Govt

Appendix 2- WS2 Pre-Workshop Questionnaire

This project aims to use participatory modelling and scenario tools to investigate the question of:

How can the coastal ecosystems of Mombasa, and the benefits they provide support the well-being of the poor, now and in the future?
(*By 'well-being' we mean having basic human needs met, and being able to pursue one's goals, and enjoy a satisfactory quality of life. It is related to concepts of happiness as well as material wealth.*)

In preparation for this workshop, please answer the following three questions based on your own views and perspectives. There are no correct answers and your responses will only be anonymously used by the project.

Q1. In your opinion, who's well-being is most affected by the status and management of marine and coastal ecosystems, near Mombasa? (List up to five groups of people)

Q2. What are the key things (factors, processes, institutions or resources etc) that determine the well-being of these people (these may or may not be related to ecosystems and their management). (List up to five factors)

Q3. In your opinion, what are the biggest changes that might influence their well-being in the next 10 years?

Q4. What do you think is the most important interventions or policy opportunities that could improve the well-being of these people?

Appendix 3- WS2 Post-Workshop Questionnaire

Thank you for participating in our workshop. It will be really helpful to us in our research and planning further interactions if you can answer a few questions about how you think it went.

1. **Your opinion of the workshop process**

1.1 Did you find this two-day workshop useful for your own work?

Please score it 1-5 where 5 is very useful, 1 is not useful at all

| 1 | 2 | 3 | 4 | 5 |

Please can you explain how and why?

1.2 What was the most surprising or new thing you learned during the 2 days?

2. **Your opinion of the collective model :**
   2.1. How far does the conceptual model that was produced on day 1 reflect your own perception and understanding of the coastal system?

   Please score it between 1 and 5 where 1 is very different and 5 is very close to your own perception of the system

   | 1 | 2 | 3 | 4 | 5 |

   Please explain your score and how the model compares with your own understanding.

2.2 Is there something about this model that is missing, or wrong, in your opinion?

3. **Following all our discussion what would you now say are the key things (factors, processes, institutions or resources etc) that determine the well-being of our primary stakeholders (List up to five)**

Would you be willing to take part in a telephone interview to ask you more about this process?

YES / NO

Please add your contact details

Name   ………..

Email   ………

Appendix 4- WS 3 Pre-workshop questionnaire – May 2012.

This project aims to use participatory modelling and scenario tools to investigate the question of: *How can the coastal ecosystems of Mombasa, and the benefits they provide support the well-being of the poor, now and in the future?* The aim of this workshop is to explore the dynamics of this 'socio-ecological system' indentifying tradeoffs and to discuss responses to them.

Please answer the following questions based on your own views and perspectives. There are no correct answers and your responses will only be anonymously used by the project.

Names: --

Organisation Represented: --

How long have you worked there: --

Q1. In your opinion, who are the key groups of people who are dependent upon the marine and coastal ecosystems near Mombasa? (List up to five groups of people)

1

2

3

4

5

Q2. Of the groups listed, please rank them in order of who you think derives the most benefit from the marine and coastal ecosystems near Mombasa *(No 1 derives the most, no 5 derives the least)*

1

2

3

4

5

Q3. Are there conflicts of interests between these groups, which groups are in conflict?

Q4. Given your work experience how might these conflicts be mitigated?

Appendix 5- WS3 Post-Workshop Questionnaire

Participatory modelling of well-being trade-offs in coastal Kenya
Stakeholder Workshop 02-03 May 2012
Post-workshop questionnaire

Thank you for participating in our workshop. It will be really helpful to us in our research and planning further interactions if you can answer a few questions about how you think it went.

- **Your opinion of the workshop process**

1.1 Did you find this two-day workshop useful for your own work?

Please score it 1-5 where 1 is not useful at all and 5 is very useful:

| not useful | 1 | 2 | 3 | 4 | 5 | very useful |

Please can you explain how and why?

……

……

How would you rate the usefulness and/or interest of the following sections:

Please score each (where 1 is not useful at all and 5 is very useful). Please also note any particularly interesting learning or problem you had each in particular sessions.:

DAY ONE:

Feedback on primary stakeholders' wellbeing (subgroup with Sarah and Amini):

| not useful | 1 | 2 | 3 | 4 | 5 | very useful |

Comment (optional)…………….………...……….…....……………………………………………………………

……

The Ecopath model of the fishery (subgroup with William and Omukoto)

| not useful | 1 | 2 | 3 | 4 | 5 | very useful |

Comment (optional)…………….……………………….…....……………………………………………………………

……

From previous workshop to social ecological model (subgroup with Diego)

| not useful | 1 | 2 | 3 | 4 | 5 | very useful |

Comment (optional)…………….………...……….…....……………………………………………………………

……

Initial playing with the 'toy model' on computers (introduced by Diego)

| not useful | 1 | 2 | 3 | 4 | 5 | very useful |

Comment (optional)…………….………...……….…....……………………………………………………………

....

Suggestions for changes to the 'toy model' (in sub groups):

not useful   1   2   3   4   5   very useful

Comment (optional)...

....

Introducing and discussing the scenarios (in sub groups):

not useful   1   2   3   4   5   very useful

Comment (optional)...

....

DAY TWO:

Exploring trade-offs in the social-ecological model (on computers):

not useful   1   2   3   4   5   very useful

Comment (optional)...

....

Possible responses to scenarios and tradeoffs (discussion):

not useful   1   2   3   4   5   very useful

Comment (optional)...

....

Reflections on the workshop (discussion in small groups):

not useful   1   2   3   4   5   very useful

Comment (optional)...

....

1.2.3 From any other discussions? ....

....

- **Your opinion of the Toy model :**
  1. How far does the toy model presented on day 2 reflect your own perception and understanding of the coastal social-ecological system?
  Please score it between 1 and 5 where 1 is very different and 5 is very close to your own perception of the system

          1   2   3   4   5

  Please explain your score and how the model compares with your own understanding

....

....

....

- Is there something about the toy model presented in day 2 that is missing, or wrong, in your opinion?

....

....

....

- **What would you say were the pros and cons of using the scenarios approach?**
3.1Pros:...

....

3.2 Cons: ....

....

- **Following all our discussion please explain what would you say are the key tradeoffs which exist in terms of poverty and ecosystems services in this coastal system?**

1

2

3

5. **Are you okay with the discussions and findings from this workshop to be published in a report? (Please state yes / no and why)**

Would you be willing to take part in a brief telephone interview with Lydiah Munyi to ask you more about this process?

YES / NO

Please add your contact details:

Name ....

Mobile / Tel Number: ....

Email ....

Availability between 5th – 10th May *(Please state date and appropriate time e.g. am / pm)*

....

Appendix 6- Focus Group 4 Exit Interview Responses

Q1: Do you think the model was realistic? Why?

Participant 1 (Spear gun fisher): Yes. Because from the look of things, the lack of taking care for the marine environment and the use of many fishing gears especially by foreign/migrant fishers reduces our catches.

Participant 2 (Boat and Net fisher): Yes. For example this model has shown that our objective to change our wellbeing is difficult but can we practically apply and use it to determine how we can benefit in the long term?

Participant 3 (Beach Seine fisher): I agree with the model. I would like to change my life (wellbeing) if I get a new fishing technology that can help fish more. But this needs people who can maintain the fishery at a sustainable level. Who can do this?

Participant 4: Yes, I may say that the toy has some reality in it, because if you have a better beginning, then you have the ability to buy a car in the future.

Participant 5 (Beach Seine captain): Yes, when a child is born, it cannot walk straight, it must have time to crawl. For example, you much clear your farm, and then plant or sow seeds later.

Q2: What did the model show you?

Participant 1 (Spear gun fisher): A very bad/grim picture. We need to engage each other and come up with tengefus (community managed marine areas, CMMAs) to conserve Nyali by ourselves not KWS or government.

Participant 2 (Boat and Net fisher): That if I have an objective, I can explore this using the toy model to see what happens in the system. But the challenge is how the toy truly represents the reality/nature.

Participant 3 (Beach Seine fisher): That if the model is followed, it can help present nature and help in management.

Participant 4: The model shows that the future will be good. It shows that if you have a good start and understanding knowledge, you will be able to buy a car in the future. The toy shows me the direction of the good future that will enable me buy a car in the future

Participant 5 (Beach Seine captain): If you do not know your way/direction, and you get someone to show the way. You see, someone is showing you the way, get it? The toy car shows you that at the end you will the really car.

Other feedback:
- It is useful as it acts as a plan to help manage fisheries. It correctly depicted the reality in the fisheries
- As the model helps translate reality, understanding of the state of things and what can be done to change them is easy
- It provides a roadmap/pathway to map the future
- It helps users map out important objectives

- It is useful, but it will be more beneficial if what is depicted in the model can be put into practice as a way of adaptive management of the fisheries
- It may be more useful if all the important factors were put into consideration, for instance degradation of environment is not caused by only fishing activity but other things such as pollution

Q3: Was anything from today useful for you? What? Why?

Participant 1 (Spear gun fisher): Yes. The importance of changing beach seine and conserving the environment.

Participant 2 (Boat and Net fisher): Yes. The issue of changing from old to new fishing ways (the offshore fishery development scenario) and also the importance of proper use of our marine resources to better our lives.

Participant 3 (Beach Seine fisher): Yes. The understanding that it is important to have my own fishing gear because I have seen the captain gain and I lose out yet I fish for him. Also that fishers can be exploited but that there is a way that issues around the fishery can be managed to bring about fairness.

Participant 4: Yes, I have learnt something. There is a saying which goes like this " if you protect your environment, protect your environment , you will reap benefits in the future". If today I understand that I am suffering, and pledge and sacrifice that I have to maintain this thing to help me in the future, then I will have that faith and wish. I will have the faith that I keep well this thing, and then my future will be very successful.

Other feedback:
- As an organized group, fishermen can be involved in policy making. It is only as a group that their voices can be heard
- It is possible to address policy makers through projects such as ESPA as well as through such forums such as workshops
- That current fishing methods are outdated and need to be modernized in order for everyone to benefit from the resource
- It is important to conserve the environment, since the benefits accrue now and into the future. Environmental degradation will be detrimental to all resource users
- There is need for stakeholder involvement in conservation and management of resources
- Fishers' capacity should be built in order for them to contribute to policy making and development initiatives.
- That's more can be learnt by capacity building that brings together many groups of stakeholders, since it

Thoughts on the scenarios:
- In the ringnet scenario, the biggest problem will be lack of market for the abundant fish
- The same scenario might not be as beneficial to mama karanga as thought, because the tajiri (owner of equipment) has a big role to play in who-gets-what
- In this scenario, it should be put into consideration that the catch will reduce during the South East Monsoon (kusi) period.
- In the scenario where people have taken up loans, repayment may be a burden and could act against them
- What makes the scenario 'Vision 2030' better, is because there are alternative jobs, something that is lacking in the economy today

Participatory Modelling of Wellbeing Trade-offs in Coastal Kenya

(Muundo shirikishi juu ya maisha ya pata-potea(trade-off), katika kanda ya Pwani Kenya)

Tuliunda hizi picha nne kuleta hisia na mtazamo wa Mombasa na viunga vyake, na kuwezesha watu kufikiria maisha yao ya usoni. Jee picha hizi zina ukweli? Ni nani atakaye ishi vizuri katika picha hizi? Ni picha ipi yenye matumaini yako ya mbeleni

Serikali iko tabithi kulinda rasilimali za nchi kwa manufaa ya raiya wake na maslahi ya viumbe vya siku zijazo.

Matumizi ya nyavu ya juya imepungua. Hata hivyo serikali imeanzisha ufugaji wa samaki kwenye vidimbwi (aquaculture).

Mavuno ya samaki ni ya kuridhisha, samaki ni wa kutosha na wafaao kwa wale wote wanaojihusisha katika biashara katika sekta hii lakini soko ndiyo hakuna kwa sababu ya kuzorota kwa sekta ya utalii..

"Kenya Huru" na, mume nguvuze.
Mtazamo huu, kila mtu ana uhuru wa kufanya atakavyo bila kujali wenzake, ilimradi aweze kupata pato la maisha. Katika fikra hii, japo kila mtu apata fidia, lakini kwa kima kidogo mno, na hatari ya wote kukosa pato la kuendeleza maisha ya mbeleni kuwa ndoto ya kweli.
Kutowajibika kwa usimamizi wa rasilimali kunachangia uharibifu na kudhohofikwa kwa matumbawe na haswa sehemu za kuzaana kwa samaki.. Kwao hawa ni leo leo, kesho ina mungu na wakisahau kwa madhara wanayasabisha wao wenyewe.

"Kenya Mpya" tenda kazi, panga mikakati ya maendelo, vutia wafadhili wa maendelo kama njia ya kubuni nafasi nyingi za kazi. Wavuvi wengine wameacha uvuvi na kuajiriwa kwenye sekta zingine.Hii imepunguza idadi ya wavuvi na hali ya mazingira kunawiri.

BMU (almashauri ya bandari) imeundwa na kuimarika. Hii imewawezesha kupata ufadhili na kuimarisha usimamizi wa hali ya rasilmali ya baharini.

Sekta ya uvuvi umeimarishwa na vifaa vya uvuvi vya kisasa, (Ringnet). Samaki wanapatikana kwa wingi kutosheleza mahitaji ya washikadau wote hivyo basi wavuvi wadogo kama (bunduki,Malema, mshipi) wale ambao hawakujiunga na ringnet, wanaathirika kisoko.

Kwasababu vifaa hivi ni vya deni, inawalazimu wavuvi kufanya kazi ya ziada kulipia deni ya vifaa hivi ndiyo waweze kuvimiliki kikamilifu.

Mradi wa P-mowtick

Tulibainisha habari kutoka kwa haya makundi ya wadau (watu kutoka katika bandari, wataalamu kutoka mashirika mbalimbali na waakilishi wa serikali) na sayansi kuhusu idadi ya samaki ili kutoa muundo-mfano. Huu muundo-mfano unaashiria hali halisi ya maisha na tuneweza kucheza nayo kujielimisha kuhusu hali ya uvuvi. Lengo kuu la mradi huu ni kuangazia ubora wa maisha ya wavuvi na washikadau muhimu katika shughuli ya uvuvi. Matokeo ya utafiti huu yanaonyesha kwamba maisha bora yana ambatana na kipato, uwepo na raslimali, fikra za maendeleo n.k.

Muundo huu unaonyesha hali ya pata-potea (trade-offs: hali ya kupata hapa na kupoteza pale) iliyopo katika shughuli za uvuvi. Inamaanisha kwamba ili kuimarisha sehemu moja ya uvuvi, inabidi kupoteza sehemu nyingine. Kwa mfano, manufaa kutoka kwa uvuvi, na anayestawi kimaisha vinategemea nguvu kazi katika shughuli ya uvuvi.
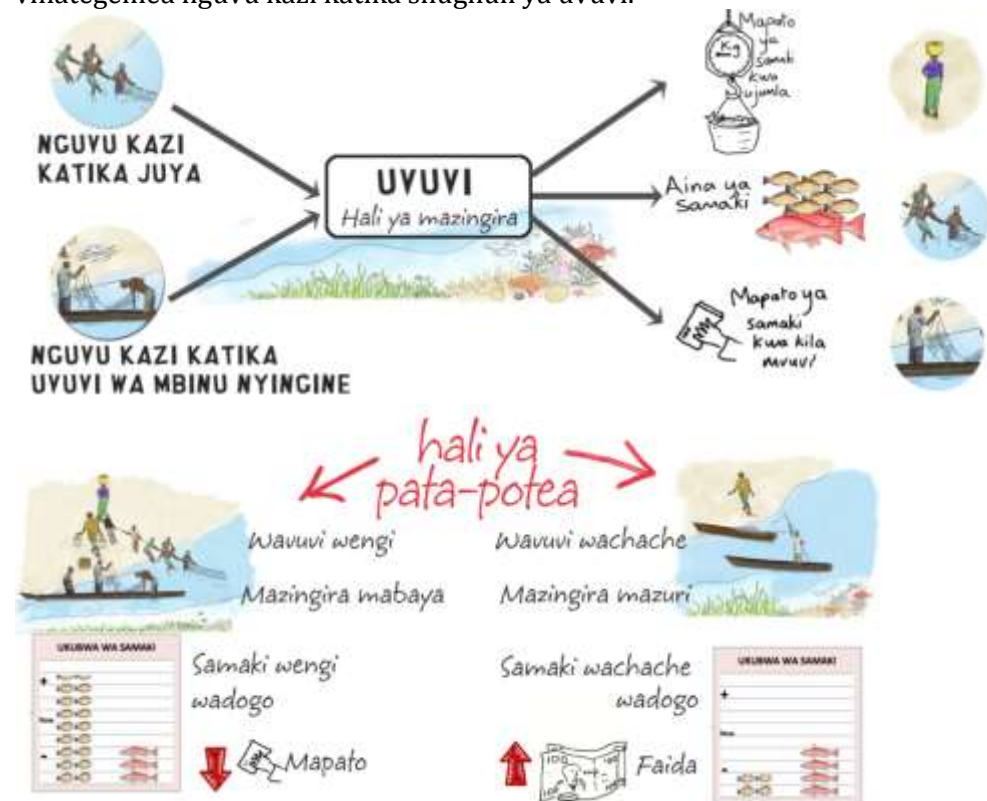
Ni kwa njia gani jamii na serikali zinaweza kuamua hii hali ya pata-potea (trade-off)?
Katika uvuvi, ni malengo gani ndio muhimu zaidi?
Ni vipi tunaweza kupata usawa kati ya usalama wa chakula, usawa kwa watu wote, hali bora ya mazingira na ustawi wa kiuchumi?
Ni watu wangapi wanategemea raslimali ya bahari?
P-mowtick ni mradi ambao umetekelezwa na WCS pamoja na vyuo vikuu vya East Anglia, Ulster, British Columbia na Stockholm Resilience Centre. Kwa maelezo zaidi, tembelea tovuti:
http://tinyurl.com/p-mowtick