Fisheries Management Science Programme: An overview of developmental impact to 2005.



R. Arthur, E. Fisher, R. Mwaipopo, X. Irz and C.Thirtle

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Key lessons learned and recommendations.

Introduction

As the Programmes run under the Renewable Natural Resources Research Strategy (RNRRS) are drawing to a close in 2006 the DFID Central Research Team (CRT) are interested in establishing the impact of the Programmes. This will allow the CRT to identify lessons for future natural resources research that they may wish to commission. The central objective for DFID is that the research commissioned under the RNRRS Programmes results in significant positive impacts on the livelihoods[1] of the poor in developing countries. The goal of the Renewable Natural Resources Research Strategy (RNRRS) has been to reduce poverty, promote economic growth and mitigate environmental problems. This has been achieved by focussing on enhancing productive capacity in renewable natural resources by removing researchable constraints. While it is widely believed that the Programmes have had a positive impact, there is a need for quantitative and qualitative evidence to show that this has indeed been the case. Currently, the responsibility for establishing the impact of commissioned research lies with DFID, as the DFID RNRRS Guidance notes for Programme Managers (October 2000) state:

> '*Monitoring projects and their contribution to Programme Outputs is a function of Programme management whereas monitoring Programmes and, periodically, evaluating the impact of Programmes in whole or in part is a DFID responsibility.*'

However, in order to assist the CRT with this process the Fisheries Management Science Programme (FMSP) have decided to investigate some of the impacts that the Programme has managed to achieve, both as an overview and by looking in more detail at a number of specific projects that have been commissioned. This report outlines both how this was done and presents the results.

Evaluating performance and assessing impact.

It is important to establish from the outset what is meant by the **impact** of the research. While projects may be effective (i.e. are **efficient** in achieving the project **outputs**), they may still have little or no developmental impact (i.e. they may make little progress towards achieving the project **purpose**). Within a project, or series of projects, there is a chain of events that leads to the impact that involves the generation of information, the sharing of information and the application of the information to achieve the impact. In the first place research messages and outputs, usually the information generated by the research project, need to be packaged and promoted to encourage **uptake**. Once these messages and outputs have been **adopted,** and implemented, it can be expected that there will be some form of impact.

[1] Where livelihood is considered to comprise of the capabilities, assets (material and social) and activities contributing to a means of living.

Of course, no project is occurring in a complete vacuum and neither are all projects being implemented in similar circumstances, i.e. projects are situated and are implemented within a particular developmental context. Therefore impact needs to be assessed with reference to the context within which implementation occurs. As Herweg and Steiner (2002) note, the context is made up of the biophysical, socio-cultural, economic and political environment in which the project operates. The impact of a project, or cluster of projects, can therefore be considered to be the resulting change in the context in which they are situated that can be attributed to the project or cluster activities and the use of the associated research products.

While the idea of measuring impact at first seems fairly straightforward, this is in fact often not the case. The research messages and outputs are promoted to target organisations however these may or may not include the target beneficiaries. In order for positive impact to be achieved this process needs to result in some positive change in the context of the target beneficiaries. Where promotion is to an intermediary organisation (as is the case with enabling projects), it is therefore not enough to achieve impact that the project is effective in developing and promoting the research products. Positive beneficiary impact will also require change within these intermediary organisations and that the research products are in turn utilised effectively to bring about the desired change.

This is a series of events that may or may not occur. In addition, even if this chain of events occurs successfully, change itself can be difficult to attribute to the project. This is especially so in cases where projects are working at an enabling level. This is because other factors, both internal and external, are also acting to create changes in the context (see Figure 1). It has been recognised by a range of authors that the utilisation of the outputs of research, the outcomes of the utilisation of these outputs (intended and unintended) and resulting change in the context (the impact pathway) take time to develop (e.g. Flint and Underwood 2002; Ryan 2002; Herweg and Steiner 2002; Baur *et al*. 2001). There is often a time lag from delivery of research outputs to uptake and impact, which may be several years.

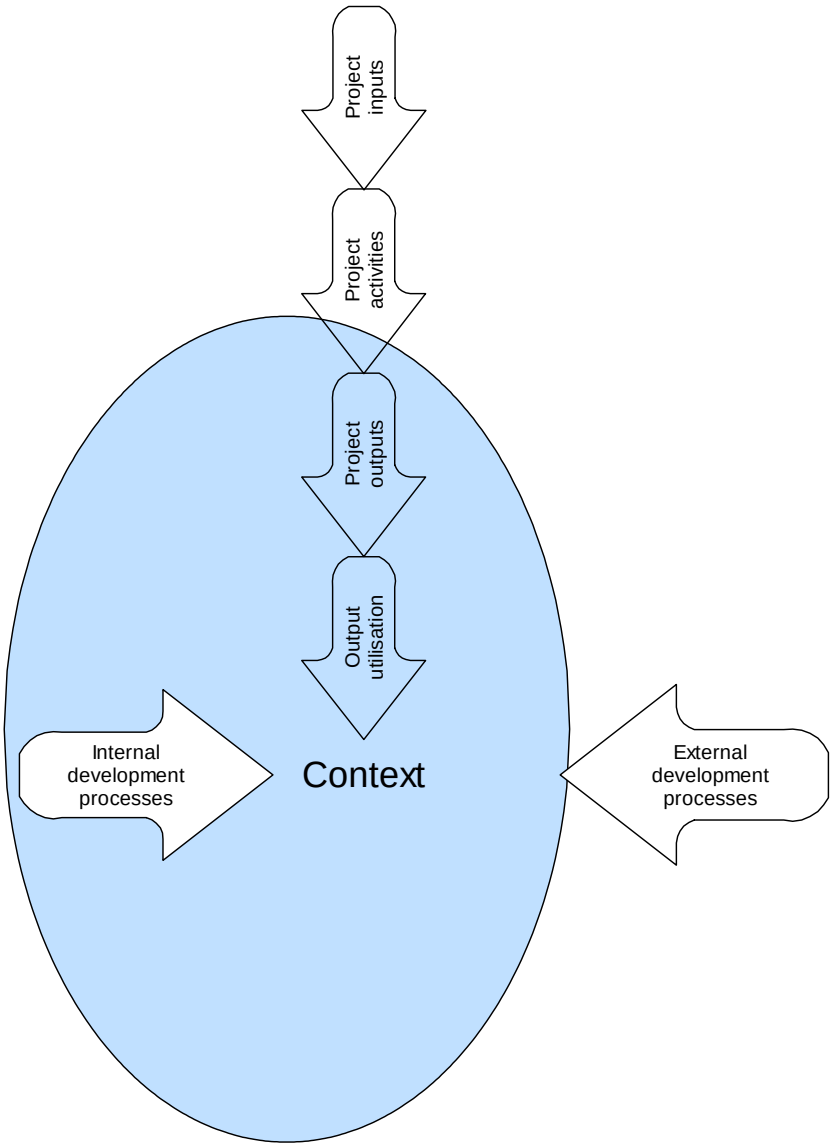


Figure 1. Factors contributing to changes in developmental context (adapted from Herweg and Steiner, 2002).

This time lag creates a difficulty in that, as illustrated in Figure 1, the context within which the project has operated is affected by not only the project but also a host of other influences both internal and external, many of which Baur *et al.* (2001) believe may be unquantifiable but which may be more significant than the project intervention, and which are likely to increase in number over time. This means that it becomes increasingly difficult to attribute any impact to a single project or group of projects. For example, where fisheries revenues have increased in the years after project intervention, it can be difficult to separate the contribution of research from those of extension efforts, changes in demand for fish or changes in employment opportunities. Indeed some of these other influences may hinder the uptake of research outputs. Together these contribute to what has been termed the 'attribution gap' (e.g. Baur *et al*. 2001, Alston and Pardey 2001 and Herweg and Steiner 2002). As time goes on it becomes increasingly difficult to establish the links between the observed changes and the project.

It should be noted that benefits may also change temporally and spatially. As a result, impact assessments may not detect increased uptake outside the initial focus

area and this may not be measured. Changing priorities can mean that there may be increased or reduced funds made available to support uptake in the intermediary organisations and amongst target beneficiaries which makes it difficult to reliably predict future impacts. The best that can be done in practice is to ensure that there is a plausible link between the project outputs and their dissemination and changes in context, though this will be largely a matter of judgement (Herweg and Steiner 2002, Baur *et al*. 2001, Roche 2000). Indeed, Baur *et al.* (2001) believe that establishing plausibility in the links between research and impact is the central task of impact assessment.

Assessment of fisheries research

There exists considerable literature on the value of agricultural research and rural development and measuring the impact such projects (e.g. Herweg and Steiner, 2002; Alston *et al*. 1998; Ryan 2002; Baur *et al.* 2001 etc.). However, there is much less literature concerning the impact of fisheries research and in particular fisheries management research. For example, in their assessment of the returns to research that examined 294 studies of returns to agricultural research, only 16 (5.4%) related to research on natural resources and of these, the majority concerned forestry research. One of the possible reasons for this is the difficulty that fisheries management science projects present when considering impact. This difficulty arises for several reasons. With few exceptions, fisheries are a common pool resource. This has particular implications for their management, and distinguishes them from either agriculture or aquaculture. While in some cases the products from the research projects may affect the beneficiaries directly (for example recommendations to users on stocking strategies in enhanced fisheries), in many cases, particularly marine capture fisheries, the research will be at an enabling rather than focussed level (Figure 2 seeks to illustrate the typical levels at which focussed, inclusive and enabling project interventions are made).

Fisheries management research generates many types of output, including technologies, management tools and frameworks, information and improved human resources (management capacity). These outputs affect intermediaries (intermediate beneficiaries) such as research and management institutions (through training and collaborative activities) mainly at the national or district level, and may also affect the target beneficiaries (through information and new technologies). These will then ultimately lead to changes in the livelihoods of the poor.

In the case of the FMSP, the means by which the contribution to changes in the livelihoods of the poor is realised is made is set out in the Programme logframe agreed with DFID. The means by which the outputs from individual projects feed into and contribute to these changes is illustrated in Figure 2 below. As can be seen, the ability to contribute is affected at each stage by external enabling and constraining factors. These may, in the first instance, affect the effectiveness with which the project is able to produce the desired outputs and the extent and effectiveness of the application of this new knowledge.

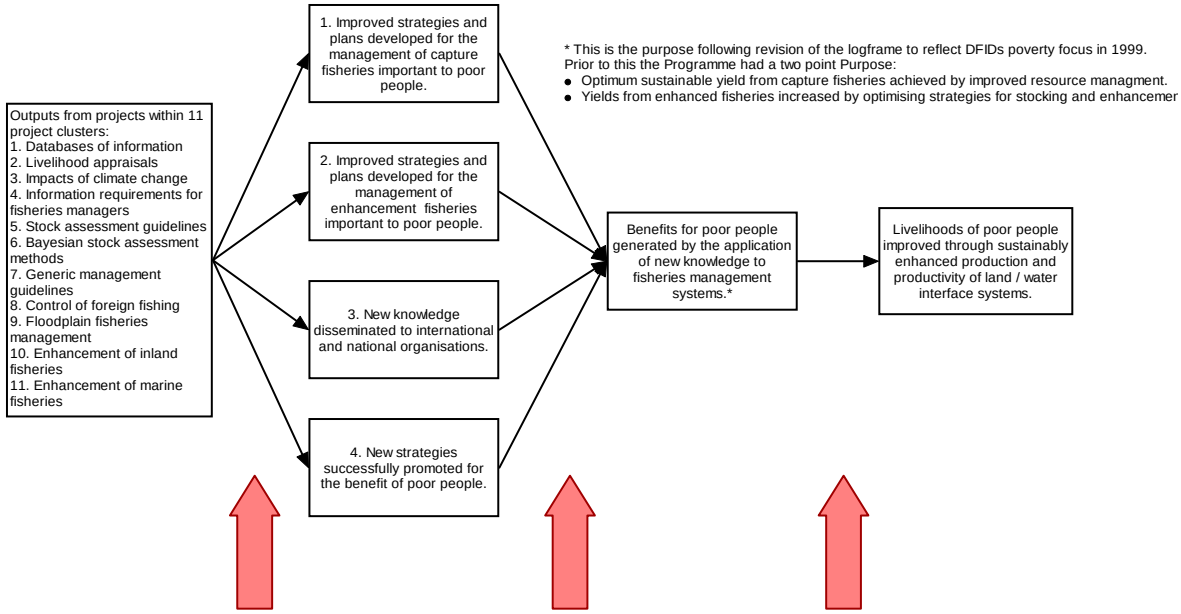


Figure 2. An illustration of how the projects commissioned under the Fisheries Management Science Programme contribute to the developmental goal set by DFID and are affected by enabling/constraining factors (red arrows). This framework is based on the FMSP logframe.

As a result of the contribution to the goal specified by DFID (Figure 2 above), achievement of this goal the research commissioned can be expected to contribute to the achievement of the Millennium Development Goals (MDGs). Fishing, and fish production, can contribute to a number of the goals. Increasing the productivity of, or production from, the fishery systems on which so many poor people depend and ensuring that fisheries policies are suitably pro-poor and ensure equitable distribution of the benefits from the system can contribute to eradicating extreme poverty and hunger (MDG 1). Better management of fisheries resources can also contribute to improving the incomes of households or communities, crucial in those cases where fisheries represent one of the few potential income generating options. Increased income can increase the likelihood of child education (MDG 2).

Given the important nutritional benefits of fish, fish can make an important direct contribution to achieving this goal. In large areas of South and Southeast Asia, the Pacific, Caribbean and West Africa, fish is a vital component of the diet complementing the carbohydrate-based (mainly rice) diets of the poor. Again, increased income from well managed fisheries can also lead to improved access to food (MDG 4). As with MDG 4, fish as a foodstuff, a rich source of protein, and income from fisheries can both contribute to achieving this goal (MDG 5).

Finally, fishing activities can have substantial negative impacts on both stocks and habitats, particularly in marine environments (e.g. Fox *et al.* 2003). In addition, much of the subsistence catch worldwide comes from wild stocks. Together this highlights the pressing need for good, well founded, management measures to ensure that habitats are maintained and stocks sustained, contributing also to ensuring environmental sustainability (MDG 7).

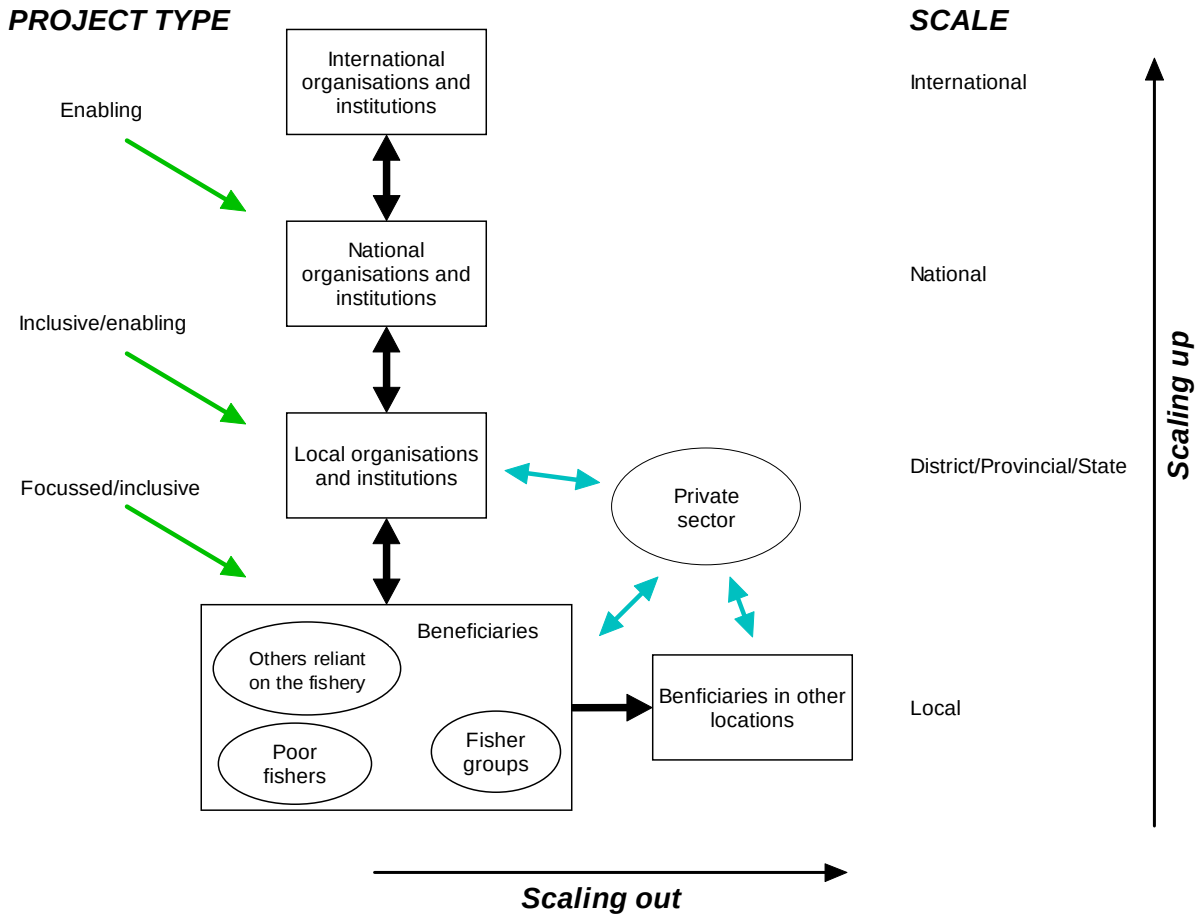


Figure 3. Types of project intervention and the concept of scaling up and scaling out (adapted from Douthwaite *et al.* 2003)

For fisheries research the enabling nature of much of the research creates particular problems in both ensuring and attributing changes in context. In these research projects, increasing capacity of local institutions, government and/or community-based, to manage their resources is the means for ultimately delivering benefits to the poor. This type of project typically has an indirect effect on the target beneficiary (see Figure 3) and this, together with the inevitable time-lag that will exist between product utilisation and change in context make it much harder to establish plausible links. In the first place, it often requires that intermediary beneficiaries utilise the outputs in order to produce the desired impact, i.e. positive impact on the resource system (e.g. conservation of fish stocks) or increased food supply to the poor. It was found during an assessment by Cambridge Resource Economics (CRE), that within fisheries research many of the projects had a time lag between use by intermediary organisations and developmental impact that was due to their enabling nature (CRE 1998).

As well as the time-lag between research and impact, in order for the intermediaries to utilise the outputs there is often a requirement for additional resources. Thus the attribution of the impacts can often not be directly attributed to the research project rather the project can be shown to have contributed to the impact. It is also clear that the conditions within which the intermediaries operate can also affect whether or not impact is achieved. This differentiates these enabling projects from projects with a more direct link to the production system – such as aquaculture and farming systems. A large amount of this type of research is concerned with the development and application of new technologies and as such, the projects commissioned are

largely focussed or inclusive. This provides a more direct link to the target beneficiaries and it is therefore relatively easier to attribute changes in the development context to the project or project cluster (See Figure 3).

In summary then, because the application of management tools informs decision making, a process that is informed and supported in a number of other ways (other internal processes), and which is then subject to further uncertainty and external processes affecting the implementation of the management plan, it is difficult to attribute the outcomes, or portion of the outcome to the projects alone. This would be the case even if the data were available, which it often isn't. This brings us to a second problem. This is that in fisheries it is preventing overexploitation rather than increasing production that is often a key aim. Therefore the effect of implementing effectively a management plan may not be increased incomes or yields but a more resilient resource system. The impacts therefore can often be prohibitively expensive to assess, even where it would be possible to attribute them.

Impact assessment within the RNRRS

Within the RNRRS, the existing reporting of impact relies on the A-H scale (DFID, 2000 – notes to Programme leaders) across all the RNRRS Programmes. Programmes are required to report annually on the progress of individual projects against this scale. The use of the A-H scale as a measure has been criticised (e.g. CRE 1998) because it is non–linear and to be useful requires post-project assessments. In addition, or as an alternative to the A-H scale, impact can be measured against both the Programme purpose that 'benefits for poor people are generated by application of new knowledge to fisheries management systems' (see Figure 2).

Impact assessments have traditionally looked at economic measures of impact and such approaches have included 'value for money' measures such as the project cost per beneficiary (directly involved or benefiting) as used by Cambridge Resource Economics (CRE 1998) and rate of return and value of benefits compared to project cost (CRE, 1998; Garaway *et al.* 2002; Townsend and Thirtle 2001; Alston *et al*. 1998). Using these measures as a basis, Alston *et al.* (1998) found that the estimated annual rate of return from agricultural research projects was about 73% (though natural resources management showed a negative return – mainly due to the long generation times in forest management) while Evenson (1998) found a median return from livestock research of around 40%. However, in assessing impact in terms of the benefits to poor people, a range of benefits need to be considered.

As mentioned, the context in which the project is situated consists of a number of aspects and it is important that these are considered together with the economic analysis. Within the RNRRS, the impact of projects on livelihoods aspects was considered in the CRE study (CRE 1998) and information on these has also been collected recently by the Programme management (MRAG 2004). Flint and Underwood (2002) also chose to focus on impact across a range of aspects including economic growth, equity, gender, security, human capability, empowerment and rights, environmental sustainability, institutional impact and policy impact.

These aspects are important to consider as a project may have only a small positive economic benefit or indeed may lead to lower yield and incomes. However this may be because the beneficiaries' objectives are not to maximise yield or income and instead they may be managing to maximise user solidarity or increase the resilience

of the system. Hence it is also important to get the perspective of these stakeholders when considering the overall impact of the projects or clusters.

Given the issues and the difficulties with demonstrating the impact of fisheries management science on either the identified target beneficiaries or the resources upon which they depend, it will be important not only to consider the actual impacts, where they can be determined, but also the uptake pathway from project output through dissemination, uptake and adoption (the extent of knowledge transfer). This will provide a picture that will not only assist in establishing the plausibility of attribution but should also help to identify potential constraints to impact and where there is potential for future impact. The study will hopefully capture a selection of the range of impacts that have resulted from FMSP research so that these can be presented in ways that would be useful for the DFID Central Research Team.

The Fisheries Management Science Programme.

The Fisheries Management Science Programme has, over the past nine years of the Renewable Natural Resources Research Strategy (RNRRS) changed in line with the policy changes outlined in two International Development White Papers. The current FMSP strategy and log-frame reflect both the requirements of DFID and demand for research expressed by the geographic target countries. The FMSP component of the RNRRS has been implemented through the targeted commissioning of projects with support through programme development activities. While there are specific examples of adaptive research leading to focussed impacts within the FMSP, most Programme activities act to create an enabling environment.

At the time of writing the Programme purpose, as stated is to provide “Benefits for poor people generated by application of new knowledge to fisheries management systems”. As outlined in Figure 2, to achieve the Programme purpose, the Programme logframe contains four Outputs, representing three core research areas, or themes, against which projects are clustered that have been identified by the Programme. The fourth Programme Output recognises the importance of disseminating and promoting research products generated under the first three theme areas and recently, as the RNRRS comes to a close, the nature of projects commissioned has changed towards projects that promote the uptake of existing research messages in support of this fourth Output. The Outputs are:

1. Improved understanding of marine and freshwater capture and enhancement fisheries and their contribution to the livelihoods of the poor developed and promoted.

2. Management tools and strategies for marine and freshwater capture and enhancement fisheries that are most likely to support improved livelihood outcomes of the poor developed and promoted.

3. Mechanisms for the implementation of pro-poor capture and enhancement fisheries management developed and promoted.

4. FMSP research outputs disseminated and promoted to relevant stakeholders at all levels.

These four logframe Outputs (themes) include projects and project activities related to both *capture* and *enhancement* fisheries management systems. The approach that

the FMSP has taken considers the role that fisheries play in people's livelihoods (Output 1) and constraints to improved livelihood benefits. Technical management strategies for capture and enhancement fisheries that will benefit the poor (Output 2) need to be placed in the appropriate institutional context, and mechanisms for implementing pro-poor management developed (Output 3). Output 4, recognises that the existing management tools developed by the Programme and the existing and new knowledge need to be developed and promoted in order to achieve wider developmental impact.

Methodology

The study will provide an overview of the impact of the FMSP by assessing and summarising the impact of the 11 project clusters. Overall the aim being to indicate where we feel that the projects have had, or are likely to have, a positive effect on poverty reduction. The study has concentrated on assessing impact as projects have been evaluated at the output level within the Programme and this is reported in the annual reports. Impact has been assessed by utilising existing information collected and collated by the Programme as well as information collected from project leaders of existing and completed projects to give a fuller picture of the impact and likely impact of the Programme. In addition the study will focus on particular projects and clusters of projects within the FMSP portfolio.

As CRE have noted, some projects have been started and then extended and funded under a new 'R' number. It is also the case that some projects' experiences have fed into subsequent project design so that to assess impact it is more meaningful to consider the projects in clusters (CRE 1998). The project clusters (see Annex 1 for details of the project clusters) that have been selected as the focus of the study are cluster 6 (Bayesian stock assessment and management with limited data) and cluster 10 (Enhancement of inland fisheries). Projects within these clusters have been selected as representative of the Programme in that they embody projects undertaken in both marine and inland fisheries as well as capture and enhancement fisheries. The selected clusters together represent 24.85% of Programme funding and as such account for a fairly significant amount of FMSP spending. In addition, the projects within these clusters have been undertaken by a variety of organisations in a range of locations including South and Southeast Asia, Africa and the Caribbean. At the same time, in selecting the clusters and specific projects it was also important, given the length of the study and available funds, both that some information is already available and that the number of projects in the clusters was not so great that it would make data collection effectively impossible.

To further focus the study, and working within the stated criteria, it was decided that within Cluster 6 to concentrate on projects R6437 (Management strategies for new or lightly exploited fisheries in developing countries), R7947 (Integrated fisheries management using Bayesian multi-criterion decision making) and R8397 (Uptake of Participatory Fish Stock Assessment (PFSA) toolkit. All three of these projects represent marine capture fisheries related projects. The first of these (R6437) is an enabling project while R7947, and the follow-on (R8397) work at an enabling and inclusive level. Within Cluster 10 it was decided that the focus would be on R7335 (Adaptive learning approaches to fisheries management). This project was working primarily at the inclusive and focussed levels with a focus on inland enhancement fisheries. This mix of projects should illustrate how projects work at the different levels and provide some useful lessons for the DFID CRT.

Having established the clusters and projects to be assessed, the next stage was to establish the projects within the clusters that could be studied and that might provide some insight into impact and potential uptake and future impact. The focus of the study was on four cross-cutting themes:

- Knowledge transfer: The extent to which the dissemination pathways that were used in the project were able to lead to access to the research messages by the key communications stakeholders.

- Assets and livelihoods: The extent to which the capacity to manage, or in the case of the poor, access and manage, livelihoods assets (e.g. natural resources and physical assets) has increased due to the project activities and whether this has resulted in positive livelihood streams.

- Institutions and processes: The extent to which the research has had any effect upon policies, institutions and organisations and whether any identified changes have resulted in increased benefits to the poor.

- Sustainability: An assessment of the sustainability of any changes or positive livelihood streams that have resulted from the project activities and outputs.

Examining knowledge generation and transfer within the projects required reviewing what new knowledge had been generated by the projects and then identifying who was involved in the uptake of a research product, how the research messages were intended to affect the beneficiaries and the links, communication and dissemination chains between stakeholders – both vertical and horizontal. The information was also used to attempt to establish whether the ultimate beneficiaries (the poor) were able to, or would be able to, access the new knowledge (either directly or indirectly through others representing them).

Considering assets and livelihoods in the first instance meant looking at how the beneficiaries had been affected by the research as well as whether there had been any social or economic benefits from the project, or whether there might be in the future, and who had/would benefited, with particular reference to the poor. This requires care as the benefits of the research can be enhanced or restricted by the context in which the beneficiaries operate. While it is not possible to be exhaustive, it was decided that some effort should be made to examine the impact and extent of impact outside the sites in which the project operated.

Institutions and processes are important aspects of project interventions and span a range of aspects from the extent to which a project is able to contribute to the creation of an enabling environment that allows for more positive management outcomes to changes in institutions affecting use, access to and control over the resources at the household level. Additionally, and cross-cutting to knowledge generation and transfer, is the extent to which decision-makers have access to and are using the results from the research.

Sustainability had several aspects and while the sustainability of changes in livelihoods or livelihoods assets of the poor was the main subject of interest it was not the only one. It was also important to consider whether the means of access to the information generated were also sustainable and the extent to which the communications channels used might contribute to further uptake and potential impact.

An assessment of the selected projects, involving a review of the available project and other literature and discussions with persons involved in the selected projects, allowed the pathways between project activities and outputs and the potential impact to be identified together with some initial indicators that can be used to evaluate the process and assess impact. This will include both the economic and other livelihood impacts.

Data for the study came, in the first instance, from annual reports and project reports, in addition data was collected from the leaders of current and recently completed projects through a questionnaire (see Annex 2) sent out in collaboration with the Programme annual report data collection. For the more detailed studies of the projects in clusters 6 and 10, interviews were conducted with key informants in each case (see individual annexes for more detail).

Results

In this section the impact of FMSP project clusters and the impact of individual projects within these clusters are described. The efforts of the Programme to assess impact and to encourage uptake of technologies developed is considered and, in addition, the impact of the selected projects within Clusters 6 and 10 are also examined. In each case efforts have been made to ensure that the impact described can be attributed to the most part to the project or cluster in question.

Impact assessment and uptake promotion at Programme level

While it was not originally envisaged that the Programme would be monitoring and assessing impact, the Programme management have made use of a number of tools for recording impact. With DFID support, PARC considered the monitoring of impact and provided these tools to the RNRRS Programmes. Of the proposed tools, FMSP has adopted the use of the PARC matrix for recording the information that is available on the impact of each project. The Programme has also adapted and adopted the use of an impact questionnaire. On the basis of responses from project leaders and collaborating organisations, the Programme has developed impact timelines to record the impact and impact pathways to indicate the potential for future impact. Both of these are reported by project cluster (see Annex 3 for example). The Programme also now provides regular reporting against Programme purpose as well as outputs in the annual report (see Annex 4 for the latest example).

In terms of uptake promotion in order to maximise the impact of FMSP knowledge, the FMSP has undertaken both an analysis of uptake potential for existing projects and project outputs and a demand assessment in each of the target geographical areas (East Africa, South Asia and Southeast Asia). The results of both of these exercises were used to in the commissioning of projects with a specific uptake objective that should contribute to and enhance the impact and impact potential of each of the project clusters.

Descriptions of impact by cluster

The following is a commentary on each cluster that provides details of the research conducted in each project within the cluster, the main products developed and the

uptake and results of application of the research outputs where these have been identified.

Cluster 1: Databases of information.

R5030: Synthesis of simple predictive models for river fish yields in major tropical rivers
R5485: River and Floodplain Fisheries in the Ganges
R6178: Synthesis of simple predictive models for fisheries in tropical lakes

While the ultimate beneficiaries will be mainly small scale artisanal fishers in developing countries in all warm waters of the world, fish processors and those relying upon fish products these stakeholders were not the immediate beneficiaries of what was a series of enabling projects. The immediate beneficiaries, i.e. those who are expected, in the first instance, to benefit from the findings of the projects within this cluster are fisheries research agencies, national policy makers and planners. These stakeholders were targeted largely through the production of written materials. The projects were successful in generating and compiling information and data sets and in presenting these. The information provided was used to inform management systems and policy and contribute to larger datasets (e.g. those held by FAO).

Looking more closely at the individual projects in this cluster, project R5030[2] reviewed the existing literature and used this to derive appropriate relationships that could be used to predict the yield of river fish catch. The project also used the opportunity of this review to identify whether earlier work along these lines in Africa was in need of significant revision for other geographical areas and for different types of river. The project used the existing literature to create a database of all tropical rivers in South America and Asia and their fisheries. This database was subsequently used in analysis to determine relationships between catches and biophysical parameters. The project was extended when further data on Asian rivers was produced by FAO to allow more meaningful relationships to be developed for Asian rivers including those in Bangladesh, a country that alone is home to over 1,700,000 poor fishers. Significant predictive relationships were found and tested. Demand for this database (Riverbase) and Manual has come from South America, India, Bangladesh, Thailand and FAO, Rome amongst others. These results have an immediate application in management planning. FAO has already utilised them together with the relational database constructed by the project, to provide a basis for a Geographical Information System they are producing for freshwater fisheries.

Project R5485[1] built on the work of R5030 and expanded the concept of the resource system to examine the functioning of entire river basins by including models for interaction of both environmental and human influences on fisheries over whole basins. This was then used to identify and highlight potentially major planning constraints. The aim of the project has been to assemble and make available through the project information and models that should enable management strategies for fisheries and aquatic resources in whole major river basins to be developed. The application of the results could potentially ultimately benefit many thousands of small scale artisanal fishers in India as well as fish processors and those relying upon fish products. While it has not been possible to assess the impacts at this level, the information was compiled and demonstrated during the first multinational NGO/Academic workshop of Ganges Basin countries, supported by World Bank, held to start cooperation on the issues associated with the management of this crucial

[2] R5030 and R5485 also cross-cut to cluster 9 (Floodplain fisheries management)

river basin system on which so many and so much depends between the many agencies with a stake in management.

While the projects R5030 and R5485 had concentrated on river systems, project R6178 was concerned with similar aspects of tropical lake fisheries and sought to provide models for estimation of potential sustainable. As with R5030, the ultimate beneficiaries will be mainly small scale artisanal fishers in developing countries in all warm waters of the world as well as fish processors and those relying upon fish products. The immediate beneficiaries will be regional fisheries managers, policy makers and fisheries institutions who will be able to better manage the resources. Similarly to the river projects, the outputs from R6178, which included a database and models for tropical lake fisheries, were designed to be available for planning and management purposes and have been incorporated in FAO data sets, a resource that is widely available to fisheries managers throughout Africa and beyond.

It has been encouraging with all the projects in this cluster that there has been uptake achieved by institutions outside of those directly funded through the projects or by the Programme. However, the incorporation of the datasets into larger datasets, while making the information more useful and increasing the promotion of FMSP funded findings, makes it much more difficult to assess the impact from the point of view of FMSP alone as it is impossible to allocate the proportion of the impact resulting from the use of these datasets that is due to the FMSP research alone.

Cluster 2: Livelihood appraisals.

R6436: The performance of Customary Marine Tenure (CMT) in the management of community fishery resources in Melanesia
R7336: Sustainable livelihoods from fluctuating fisheries resources
R8118: Understanding livelihoods dependant on inland fisheries in Bangladesh and South East Asia.
R8196: Understanding Fisheries Associated Livelihoods and the Constraints to their Development in Kenya and Tanzania.
R8294: Enabling better management of fisheries conflicts.
R8467: Incorporating Common Pool Resource (CPR) issues into fisheries management policy

Over recent years thinking has developed and the awareness that there is a need to examine the role of fisheries in a wider livelihood context has increased. As a result, this cluster of projects has been commissioned in order to develop a greater understanding of the role and importance of fisheries and dependence on fisheries within the DFID target geographical areas. This information has been made available to decision-makers, such as fisheries research agencies and national policy makers and planners, in these target areas using means that make the information accessible to them.

Project R6436[3] examined fisheries dependent livelihoods as an element of a co-management framework. Within this project the study of livelihoods was a component in a wider study. The purpose of this project was to describe and evaluate the performance (including social equity and ecological sustainability) of a number of customary management regimes in Fiji and Vanuatu, and to identify the ways in which co-operation with government (co-management) could enhance the current management systems. This project has led to the development of a set of co-

[3] Project R6436 also cross-cuts to cluster 7 (Generic management guidelines)

management guidelines and informal requests to implement the guidelines have been received from the Government of Vanuatu and from NGO representatives based in the Pacific region.

During the project, locally recruited staff were trained in data collection techniques at all research sites. Additionally, the two national field managers were further trained in the use of databases and spreadsheets. Both national field managers were extensively involved in the rural appraisal work throughout the project lifetime. These two individuals have, since the completion of the field research, gone on to take further education at University of the South Pacific, Fiji and in Australia. A third individual in Fiji has taken up a full-time post with Fiji Fisheries Division. To ensure wider dissemination, discussions were held with Professor Robin South of the Marine Studies Programme (MSP) at the University of the South Pacific with respect to publishing project outputs through the MSP Technical Report Series. Various parts of the FTR were adapted and disseminated in this way. That series has an international distribution of over 100 organisations. The development of co-management within DFID's Regional Fisheries Information Systems (RFIS) project with the Southern African Development community (SADC) has drawn on the outputs and lessons learnt from project R6436 as well as R7042 in Cluster 4 (information systems for co-management of artisanal fisheries).

Project R7336[4] also examined livelihood strategies, this time of small-scale fishers dependent upon fluctuating resources in both Indonesia and Malawi. Again, as with project R6436, the study of livelihoods was part of a wider study. While the ultimate beneficiaries of this project range from small scale artisanal to industrial fisheries in developing a countries, the immediate beneficiaries have been regional fisheries managers, policy makers and fisheries institutions who are better able to inform management decision-making.

The project described the livelihood strategies of small-scale fishers dependent upon fluctuating resources in Indonesia and Malawi and developed bio-economic models that could inform the choice of management strategies for fisheries with uncertain dynamics. A method that could contribute to a typology of fisheries based upon patterns of variability in catches and fish biomass was also developed. The project has highlighted how fishers' geographical and occupational mobility has led to the development of flexible livelihood strategies and resilient institutions that are worthy of policy support. The project used the results of the studies to develop, along with other management tools, bio-economic models that could inform the choice of management strategies for fisheries with uncertain dynamics. The theoretical insights generated from this project have been used to inform policy reform in Eastern and Southern African fisheries, through follow-up research that links fishing to macro-policy processes such as poverty reduction strategy plans and political decentralisation.

Outputs developed by this project have been used by policy research centres in Malawi, Kenya, and Uganda, and the DFID-funded Integrated Lake Management project in Uganda is building on work originally initiated in this project. The outputs are influencing policy and design of co-management in Malawi, and have generated requests for implementation from Indonesia. Outputs from Project R7336 (Fluctuating fisheries) have been used in the DFID-funded ODG project 'Livelihood Diversification Directions Explored by Research'. The Malawi National Economic Council is using data on fishers' incomes (not previously available) in helping to advise on prioritisation of development activities in lakeshore regions). During the project data

[4] Project R7336 also cross-cuts to cluster 5 (Stock assessment guidelines)

sharing occurred with both EU and GTZ projects in Malawi, contributing to these projects achievements.

In addition to the research outputs above, the project also successfully developed and tested a livelihoods research methodology, previously used in agricultural research. Training and awareness-building activities conducted by the project contributed to capacity building of the project partners in both Malawi and Indonesia. Trained staff in each location went on to train other practitioners in the methodology. Through project activities and publications the project was also able to raise awareness among the wider development community of the utility of using a livelihoods approach for fisheries policy-making.

While projects R6436 and R7336 both had livelihoods components, for projects R8118, R8196 and R8249, it was the understanding of the livelihoods and associated constraints that was the focus of the research. Project R8118 focussed on understanding fisheries dependent livelihoods in Bangladesh and Southeast Asia. The aim of this project was to increase understanding within target institutions, principally government and research agencies, of livelihoods issues and highlight levels of poverty among fishers. The purpose was to enable those in a position to do so to prioritise poor peoples' issues when considering management interventions and enable them to design pro-poor research that addresses fisheries issues and needs of fishing communities.

While R8118 identified key areas and problems for research, implementation of these outputs requires agencies in the target countries and potential funding agencies to further develop these into funded research activities. The potential for application of the project outputs is considered to be good as the agencies that have been targeted as communications stakeholders to receive the outputs are either line agencies for implementation of policies in fisheries (such as the Department of Fisheries, Cambodia) or those providing an analysis of issues, and who work directly with the poor on technology and resource management issues.

The outputs from this project included a description of the livelihoods of major stakeholder groups that were dependent upon either capture or enhancement fisheries. In addition the project described the links between fish resources and livelihood strategies and identified constraints and researchable issues for Bangladesh and South East Asia. The analysis clearly highlighted the need for poor peoples' participation in resource management decisions and this has already had an impact on incomes and employment in Bangladesh.

Project R8196[5] was similar to R8118 but was undertaken to study fisheries dependent livelihoods in Kenya and Tanzania (the East Africa geographical target). Again, outputs were aimed primarily at government and research agencies in order to enable them to address fisheries issues and understand the needs and priorities of fishers and those who are dependent on fisheries resources. As with R8118, the information generated from this project has also been passed on to those agencies identified as researching livelihoods issues or responsible for implementing policies in the region. The research has identified a number of opportunities and constraints and this knowledge has already influenced the activities of a number of agencies in Kenya and Tanzania.

Project R8249 also examined livelihoods in East Africa, but looked more specifically at the possible livelihoods benefits from the deployment of Fish Aggregating Devices

[5] Project R8196 also cross-cuts to cluster 11 (Enhancement of marine fisheries)

(FADs). The outputs of this project included a description of the livelihoods of major stakeholder groups who are dependent upon capture fisheries in East Africa. In addition the project described the links between fish resources and livelihood strategies and identified constraints and researchable issues. A number of opportunities for benefits were identified during the research and this information was presented to local decision-makers through a Policy Brief. More recently the information provided has helped in the planning of FAD deployments in Tanzania and as background to FMSP project R8331.

From the commissioning of the above projects, the FMSP has been able to generate a sizeable amount of information on fisher livelihoods in Africa and Asia. In order to make the best use of this wealth of information, the programme has commissioned a project to synthesise the information from the livelihoods studies (R8467). This project will promote some of the key research findings and policy messages, including the role of fisheries in the livelihoods of the poor and the complexity of this role, especially given the common-pool nature of so many fisheries systems. This project should ensure that the information that has been generated will be utilised to provide more relevant policies and interventions that will lead to increased benefits for those dependent on fisheries.

***Cluster 3: Impacts of climate change*.**

R4778J: Vulnerability of fisherfolk living in poverty to climate change.
R8475: Promoting new knowledge of climate change impacts on fisheries

Climate change issues have assumed greater importance during the lifetime of the Programme. Responding to this, the Programme commissioned project R4778J. This project has attempted to link research on climate change and provide an assessment of the vulnerability of the fisheries sector in developing countries to predicted future climate change. In doing so the project has developed a methodology for assessing the vulnerability of fishers living in poverty to climate change and identified future research priorities. The project has highlighted the potential impacts on fisheries dependent livelihoods of climate change and sought to provide this information in a useful way, e.g. through maps, to decision-makers.

While the research and policy messages from R4778J will be important for future planning and policy development, and have been communicated to fisheries research agencies and national policy makers and planners, it is still too early to assess any impact or even to gauge uptake in a meaningful way. However the programme has recognised the potential importance of the messages and sought to maximise the potential by commissioning an uptake promotion project (R8475) that will take a systematic approach to further promoting the key messages and recommendations. The involvement of CEFAS (UK) in this project is likely to enhance the potential for uptake, which is likely to occur over the next few years. Any incorporation of the messages into policies and impact from the implementation of these policies will not be felt until a few years down the line. The amount of climate change information and communications, together with the long pathway from project outputs to impact on livelihoods mean that while the uptake pathways can be determined, it may be difficult to attribute any changes in circumstances of the target beneficiaries to the project(s) alone.

Cluster 4: Information requirements for fisheries managers.

R7042: Information systems for co-management of artisanal fisheries

R7834: Interdisciplinary multivariate analysis (IMA) for adaptive co-management
R7947: Integrated fisheries management using Baysian multi-criterion decision making
R8285: Fisheries data collection and sharing mechanisms for (co-) management
R8397: Uptake of Participatory Fisheries Stock Assessment (PFSA) Tool Kit
R8462: Evaluation and uptake promotion of data collection guidelines for co-managed fisheries
R8464: Application and promotion of FMSP Participatory Fish Stock Assessment (ParFish)

This cluster has generated a range of products that can be expected to provide impact in a wide range of fisheries, including both inland and marine, worldwide in the future. There are essentially two threads within this cluster: information systems and participatory stock assessment methods. In both cases there is on-going work that is seeking to refine products and promote uptake. Hence it is likely that impacts from the application of the products will be seen beyond the lifetime of the Programme.

Looking at each of the threads in turn: Project R7042[6] demonstrated the feasibility of developing a generic database that could be used to support the roles of stakeholders in monitoring and evaluating the performance of co-management. The target beneficiaries of this project in the first instance are agencies with a remit to support management such as a fisheries department. The software developed by the project has been designed to be capable of storing details of specific management plans developed by the stakeholders and supporting the coordination and evaluation of these management plans, capable of supporting the monitoring and evaluation of national management plans that have been designed to achieve common management objectives, to be able to support control and surveillance activities and to provide information required for international reporting responsibilities. A major advantage of the software is that it can be installed and working within six weeks compared to the six months typically required to develop a bespoke system.

A number of requests for the software have been received and it is in operation in a number of fisheries worldwide. In the Turks and Caicos, the Department for Environment and Coastal Resources is currently using the software developed under this project to support the co-management of the spiny lobster and conch fisheries on which some 400 people in fishing and processing jobs depend. Several requests for the software have also been received from Fisheries Departments including those of Tanzania, Uganda and Barbados. The Cambodian Department of Fisheries has recently explored the potential to use the software to support their evolving co-management programme and the NGO CARE Bangladesh has indicated that they wish to use the systems. The development of co-management within DFID's Regional Fisheries Information Systems (RFIS) project with the Southern African Development community (SADC) also drew on the outputs and lessons learnt from projects R6436 (Customary Marine Tenure project) and R7042 (information systems for co-management of artisanal fisheries).

Following on from R7042, information and co-management was also the focus of project R7834[7]. This project examined the performance of fisheries co-management

[6] Project R7042 also cross-cuts to cluster 7 (Generic management guidelines)
[7] Project R7834 also cross-cuts to cluster 6 (Bayesian stock assessment and management with limited data)

and what sort of information is needed to monitor performance. Based upon reviews of existing co-management initiatives worldwide, and a consideration of the merits of alternative approaches, it was concluded that General Linear Models and Bayesian Network Models offered the most scope for constructing models of co-management performance given the data structures and types of variables that are typically part of a co-management monitoring system. Using simple multi-disciplinary measures and indicators of co-management strategies, arrangements and outcomes, the methodologies developed enable those involved in management of the resources to track the performance of co-management arrangements.

Recent applications of the methodologies developed in R7834 include a risk assessment of fisheries activities on Pacific groundfish habitat by the National Marine Fisheries Service (MRAG Americas 2003), modelling the effects of environmental factors on fisheries production in the Lower Mekong basin by the World Fish Center (Baran *et al.* 2003), and management performance evaluation in the Tonle Sap/Grand Lac for the Mekong River Commission (Varis *et al.* 2003). This resource system, including the flooded forests, grasslands, rice fields and swamps, supports extensive capture fisheries supplying more than 75% of the total animal protein intake for the estimated 9.8 million people living in Cambodia (Thuok 1998). In addition, it has been estimated by Thuok (1998) that some 78.52% of people around the Tonle Sap earn their living from fishing. The methodology developed is also being adopted by a Land Water Interface project under the Natural Resources Systems Programme that explores co-management strategies in the Caribbean.

As part of this developing thread, project R8285[8] , has undertaken consultations with key stakeholders and target institutions from the five Mekong Basin Countries as well as the Philippines, Bangladesh, Mozambique and Uganda. These consultations have been used to develop guidelines, aimed primarily at fisheries departments, for designing and implementing locally appropriate data collection and sharing systems to support co-management. The guidelines have drawn not only on the consultations but have also incorporated aspects of projects R7834, R7335 and R7947.

Uptake of the guidelines by the Mekong River Commission within their MRRF programme in Thailand has already begun to improve existing data collection systems employed by reservoir fishers, the local management institutions and the Inland Fisheries Research and Development Center. The methods developed were able to contribute to improved management planning at the reservoirs through agreement among the stakeholders to update the reservoir management plan and address the obstacles identified for its effective implementation. Implementing the guidelines has contributed to increasing management capacity among local stakeholders. Participants in workshops held as part of the implementation process reported an improved understanding of data and information needs of different stakeholders involved in the management of the reservoir. They also reported improved knowledge of reservoir resources management and raised awareness of the need to consider other sectors when formulating and evaluating management plans and activities (Hartmann, pers. comm.). The impact of this improved planning process and increased knowledge is likely to become apparent over the next few years. Again it is not possible to attribute any management impact to the project alone as the management planning process is based on information from a number of sources and information and data collection is only one component of the management planning process. However improved data collection and information sharing should lead to more effective evaluation.

[8] Project R8285 also cross-cuts to clusters 6 (Bayesian stock assessment and management with limited data) and 7 (Generic management guidelines)

As a result of the use of the guidelines in R8285, it became evident that while the methodologies for data collection and information sharing had value, the format of the guidelines meant that they were not accessible to field level operatives and agencies such as extension workers. In order to build on the existing successes, project R8462 was commissioned to develop and test appropriate field level products and also promote uptake of the research findings. This project will evaluate the utility of the guides through field-testing in a variety of co-management settings. The project will also look to promote the methodologies and the products to a wide range of implementing agencies and policy-makers. It is expected that there will be some impact during the lifespan of the project but that this will be limited to increased capacity within the implementing agencies and possibly resource user groups. However, as was evident from R8285, this increased capacity can lead to the formulation of more effective management plans and an improved planning process. It is therefore likely that there will be a positive impact on the resource system and the resource users as a result. Again though, it is unlikely that any changes and benefits accruing will be solely attributable to the project. The promotion activities should help to ensure that the methodologies are taken up and applied widely and successful case studies should assist this process.

The second thread within this cluster was the development of participatory fish stock assessment methodologies. The ultimate beneficiaries of the projects commissioned under this thread will be those dependent on the resources through greater participation in management, increased knowledge of their resources, and the potential to formulate management plans that better reflect the objectives of those dependent on the resource. The immediate beneficiaries will be regional fisheries managers, policy makers and fisheries institutions who will be able to better assess fisheries resources even in cases where there is only limited scientific data available and will be better equipped to identify and engage with fisher groups and develop management plans with these groups. Project R7947[9] developed and tested an innovative multi-criterion management decision-making methodology, based on Bayesian statistical techniques, for the provision of management advice in data-poor, artisanal fisheries in developing countries. The methodology that was developed was based on a software package for the assessment procedure together with tools including cards for ranking fisher preferences and a questionnaire that would allow fisher information and preferences to be incorporated into the assessment procedure, important in situations, not uncommon in small-scale fisheries, where there is little data available to assess the fishery. The methodology was tested in Turks and Caicos and in Zanzibar. In both cases the testing was limited to the data collection and assessment methods and on producing an assessment of the fishery rather than putting management plans into operation. While the project was successful in meeting the objective of testing the methodology, because the assessments were not translated into implemented management plans the impact was limited to capacity building within the intermediary beneficiaries and potential for impact in the future should the plans be put into operation (see also Annexes 5 and 6).

Recognising the limited scope of the development process, a further project (R8397[10])was commissioned that would develop a framework around the software and data collection tools that would allow users of the methodology to identify and engage the fishers and provide tools for communicating, developing management

[9] Project R7947 also cross-cuts to clusters 5 (Stock assessment guidelines) and 6 (Bayesian stock assessment and management with limited data)

[10] Project R8397 also cross-cuts to clusters 5 (Stock assessment guidelines) and 6 (Bayesian stock assessment and management with limited data)

plans with fishers and for implementing these plans. At the same time as developing the framework, the project sought to test and refine the methodologies developed in R7947. The project tested the framework (based on the adaptive learning framework developed in R7335) in Zanzibar, East Africa. This is a location where there are 23,000 fishers and 2300 traders directly dependent on fisheries and where the fisher families form part of the poorest and most disadvantaged communities on the island.

The project was successful in providing assessments of the two target fisheries in Zanzibar and in providing management advice to the fisher communities and to the fisheries department. However the project timeframe was not sufficient to allow this advice to be incorporated into a management plan and implemented. The impact of the project was therefore limited to an increase in capacity within the intermediate agency and increased knowledge about the fishery among those dependent on the resources. However it is possible to suggest that if management plans based on the assessments could be implemented then there is the potential to increase the benefits from the fishery and meet the objectives of the management group. Further details on the impact of this project can be found in Annexes 5 and 6. The project was very active in raising awareness about the approach amongst organisations such as FAO and World Bank.

In order to build on the promotions activities and to provide further case studies that would provide evidence of more global applicability, a further project was commissioned (R8464). This project will be testing elements of the approach in West Africa and India, refining methodologies in the light of this testing and producing a number of communications products that will raise awareness of the ParFish methodology and the potential benefits from its application. The project also provides an opportunity to train a larger number of scientists in the use of the ParFish methodology and to further increase the uptake potential so the potential for uptake is currently quite high. This suggests that there is likely to be impact seen over the next few years. Because the methodology is more focussed and inclusive and utilisation of the outputs is much closer to the ultimate beneficiaries, it will be much easier to attribute the outcomes of management actions to the research products.

Cluster 5: Stock assessment guidelines.

R4517: Development of Computer Aids for Fish Stock Assessment and Management Policy
R4823: Guidelines for harvesting species of different lifespans
R5050CB: Computer Aids in fish stock assessment - Field development
R5484: Analysis of Multispecies Tropical Fisheries.
R6437: Management strategies for new or lightly exploited fisheries in developing countries
R6465: Growth parameter estimation and the effect of fishing on size composition and growth of snappers and groupers: implications for management - Phase I and II.
R7040: Strategic assessment of tropical coastal fisheries management
R7041: Software for estimating potential yield under uncertainty
R7336: Sustainable livelihoods from fluctuating fisheries resources
R7521: Implementing management guidelines arising from project R6465 - an assessment of the utility. Assessment of additional otoliths from *L. mahsena* and *A. virescens* collected during the 1999 BIOT inshore observer programme.
R7522: The potential for improved management performance with fully age-based stock assessments: Extension of the management strategy simulations to incorporate age-based assessments.

R7835: Investigation of the implications of different fish life history strategies on fisheries management.
R7947: Integrated fisheries management using Baysian multi-criterion decision making
R8360: Synthesis and uptake promotion of FMSP stock assessment tools and guidelines
R4778G: Software training courses
R8397: Uptake of Participatory Fisheries Stock Assessment (PFSA) Tool Kit
R8464: Application and promotion of FMSP Participatory Fish Stock Assessment (ParFish)
R8468: Capacity building in the use of FMSP stock assessment tools and management guide

There have been a large number of projects that have been commissioned to address the need for better assessment procedures and capacity in developing countries. The resulting FMSP stock assessment tools, including methods and software, and guidelines have had widespread uptake and have been employed in a number of fisheries. With the partial exception of R8468, the projects are very much enabling in nature. This means that while the ultimate beneficiaries range from small-scale artisanal to industrial fisheries and fish processors up to national economies, the immediate beneficiaries will be fisheries managers and fisheries agencies nationally and regionally who will be able to better inform and contribute to the management of their resources.

The software packages that have been developed provide significant benefits over many commercial packages and should increase the likelihood of fishery analysts providing good advice to their managers. Some of the earlier FMSP models and software packages, such as CEDA, LFDA and Yield, have been used for a number of years and feedback provided by users over this time has been incorporated in updates of the software and software guides and shaped the development of help files and tutorials for the packages. The CEDA and LFDA packages were initially developed in 1992 (by project R4517). They were improved and re-programmed in Windows formats in 2000 (R5050CB).

The new versions of CEDA and LFDA include a number of very powerful new options. The CEDA (Catch Effort Data Analysis) package provides estimates of stock sizes, maximum sustainable yields and replacement yields. LFDA (Length Frequency Data Analysis) allows users to estimate growth curves from length frequency data. Further analysis using outputs from these packages allows estimation of total mortality rates and age frequency distributions. Uptake of the software packages has been quite successful with more than 150 copies of the software packages are in use in developing countries worldwide. There are also examples of courses being set up locally, for example in India, to train scientists in the use and application of the software and consultancies (e.g. NEFISCO) offering support and training in their use.

Application of the software packages has informed management in a number of cases and in one case analysis indicated that the Mexican Pacific shrimp fishery (the most important export earner and a livelihoods component for an estimated 288,000 fishers) was overfished. This was acknowledged as extremely important and the results formed the basis for the design of management measures to allow stock recovery and to improve the status of the fishery. The packages have also been used to assist management of Costa Rica prawn fishery (Tabash and Palacios 1995), Turks and Caicos lobster and conch fisheries (considered stable fisheries by Thiele 2001), Lake Tanganyika kapenta fishery (a fishery involving some 20,000 fishers), Mexican lobster and spiny lobster around Tristan de Cunha. The packages are

routinely used by the Namibian and Keralan fisheries departments amonst others. The software has also been of use in developed country fisheries including Falkland Island ray (Wakeford et al. 2004), Scottish squid (Pierce 1995), Mediterranean anchovy (Santojanni *et al.* 2003) and Hong Kong inshore fishery (Pitcher *et al.* 1998).

When it comes to applying the precautionary approach to management of capture fisheries, increasingly a requirement under international obligations, implementation of precautionary management plans can present considerable difficulties for fishery officers and scientists in developing countries. This is because it requires the identification of both targets and limits for a fishery and the calculations involved require a greater degree of analytical and programming sophistication than is often available. Recognising this, the 'Yield' model and software were developed (R7041[11]). This software was designed to estimate target and limit reference points while allowing for uncertainty, as required for precautionary management approaches. Like CEDA and LFDA, the software has a standard Windows user interface includes a help file and a useful step-by-step analysis of an Indian Ocean snapper data set and a very extensive on-line.

The software allows users to specify levels of uncertainty in each of the input parameters. Results are presented in terms of frequency distributions and stochastic forward projections allow the user to explore further the likely result of different management options. This software package has proved valuable in a number of important fisheries. Under R4778G[12] workshops were held in the target locations of East Africa and Southeast Asia to promote the software and to train trainers in the application of the stock assessment software. A total of 59 people attended the three courses (17 Kenya, 20 Vietnam and 22 India) from 10 different countries (Kenya, Tanzania, Mauritius, Seychelles, Maldives, Vietnam, Cambodia, Lao PDR, India and Bangladesh). Some onward training and dissemination has already taken place in 50% of the organisations. This has resulted in further uptake of the software packages and their incorporation in a number of training materials.

Within project R4778G, questionnaires were distributed amongst all 59 course participants. Responses indicated that the people who had participated in the training had already arranged training sessions themselves or had put in place plans to organise training on a formal or informal basis with staff or students. Two key organisations, the University of Nairobi in Kenya and the Can Tho University in Vietnam, have already indicated that the use of the three software packages in particular LFDA and CEDA will be incorporated into the teaching of fisheries science students on BSc university courses, and has been highlighted for use by MSc and PhD students. The participant from CORDIO, East Africa has also indicated that the stock assessment packages will now be used in the BSc course in the Fisheries Department of Moi University, Kenya. Further training of larger numbers of individuals is planned. The design of data collection systems has been modified in a number of cases.

Four of the projects commissioned by the FMSP have conducted research relating to different aspects of fish growth and their importance for management. These projects were focussed on the assessment of tropical marine fish stocks. There is a difficulty applying stock assessment tools in tropical fisheries because the less distinct seasonality in tropical countries means that it can be difficult to establish age and

[11] R7041 also cross-cuts to cluster 6 (Bayesian stock assessment and management with limited data)

[12] R4778G also cross-cuts to cluster 6 (Bayesian stock assessment and management with limited data)

growth of fish. The first of the four projects, R6465, was able to confirm that age based methods (from otolith (ear bones) readings) could be used to estimate growth rates for slow growing tropical fish (snappers and emperors), species for which there are some 2100 fishers involved in the fishery in Seychelles alone. It was shown that these age-based methods were able to give better results than length based methods. Based on the results, management strategy simulations and cost benefit analysis was able to further confirm that age-based methods could also be more cost effective under certain circumstances. In order to facilitate the uptake of age-based methods, a number of scientists were trained in applying the methodologies at workshops held at the collaborating institutions in Indian Ocean countries. This included disseminating techniques for the preparation of otoliths for validation and ageing, as well as those used to achieve validation, and in the routine ageing of individuals through otoliths.

The potential shown by the age-based methods that had been explored in R6465 led to the commission of follow-on projects (R7521 and R7522). These projects were able to show that assessments based on fully age based methods, i.e. where both growth and mortality are calculated directly from age readings, performed better than either length-based or semi age-based approaches. However, further management simulations indicated that the higher costs involved in undertaking fully age-based assessments could not be justified by the benefits observed in the study fishery. Having established that age-based methods had some potential for slow growing tropical species, project R7835 went on to explore the sort of circumstances in which age and length based methods could be used for in stock assessments for slow growing and fast growing species.

Together, this series of age and length based assessment projects have resulted in guidelines for data collection, stock assessment, and fishery management that have been applied in fisheries in Indian Ocean countries. The Seychelles Fishing Authority now routinely section otoliths for a variety of tropical species in order to age them. And the guidelines have been adopted by them for the management of the inshore fisheries. They have also begun to expand this to examine other important species in the demersal artisanal fishery around the Seychelles islands, important to around 74,000 artisanal fishermen in the region. This demersal fishery is an important one, not just to the fishers, as it provides a cheap source of protein and employment and also represents a significant source of national foreign exchange through the fish export market. Recently the contribution of fisheries and related activities to Seychelles GDP has been described as essential as it generates close to 20% of the GDP and is still expected to increase in the future.

In Mauritius, fisheries staff who have been trained in the application of age-based methods have indicated that age-based methods could be employed for a number of other species, including those caught in the local lagoon fishery and in the banks fishery. The banks fishery is again important for employment and foreign exchange earnings and an estimated 2000 fishers are involved in this fishery. Mauritian management ensures catches in the bank fishery have been sustainable and below MSY. The guidelines for management developed through this study have also been applied in relation to the British Indian Ocean Territory (BIOT) fishery.

Yield, and the use of models to estimate target levels of yield have also been of interest to the Programme. This began with project R4823 that developed an already widely used approximation for the yield to provide more realistic estimators. In 2000, a later project, R7040, was able to publish new simplified formulations of yield models. This project suggested that when drafting management plans it is necessary to explicitly account for the socioeconomic factors associated with the fishery, as well

as the biological and technical. The project also developed methods that could support the biological aspects of the fishery through the development of simple and robust methods for the assessment of fisheries that can provide both an estimate of sustainable yields from the fishery (the production potential) and the current status of the fishery (i.e. whether it is under or over exploited). In developing the simple and robust methods, two approaches were taken. In the first case, methods were developed that were based on simple empirical relationships between the life history parameters of a species were used to develop the yield models. In the second, optimal life history theory was used to develop a model that would allow potential yield and the level of fishing effort that would provide the maximum sustainable yield (MSY), to be estimated directly from the growth parameters. This is useful in the setting of catch rates in line with the precautionary approach.

Further guidance on the conditions required for precautionary management is available from project R7336[13]. The project described the livelihood strategies of small-scale fishers dependent upon highly fluctuating resources in both Indonesia and Malawi and determined methods for categorising fluctuating fisheries. The project not only considered the livelihood aspects but also developed bio-economic models that could inform decisions on management actions for fisheries with uncertain dynamics. The project confirmed that the use of equilibrium MSY based indicators as target reference points might be risky in many fisheries.

Opportunities for uptake were enhanced during the project through training and awareness-building. Capacity of the project partners in both Malawi and Indonesia was increased and the people trained went on to train other practitioners in the livelihoods research methodologies. The project also built awareness among the wider community of the utility of using a livelihoods approach for fisheries policy-making.

Outputs developed by this project have been used by policy research centres in Malawi, Kenya, and Uganda, and the DFID-funded Integrated Lake Management project in Uganda is building on work originally initiated in this project. The outputs have influenced policy and the design of co-management institutions in Malawi, and have generated requests for implementation from Indonesia. During the project there was data sharing with both EU and GTZ projects in Malawi and lesson learning between the projects. Outputs have also been used in the DFID-funded ODG project 'Livelihood Diversification Directions Explored by Research'. The Malawi National Economic Council have also made use of data on fisherfolk's incomes (not previously available) supplied by the project in helping to advise on prioritisation of development activities in lakeshore regions).

The fish stock assessment tools, such as the CEDA and Yield models discussed above, all make use of data that is routinely collected from fisheries in order to estimate management parameters. However, in new or lightly exploited fisheries there is likely to be a paucity of data and in other cases there may be fisheries where historical data have not been collected (e.g. due to a lack of resources). A series of projects have been commissioned in order to address the problem of how to manage and set management targets and limits where there is a lack of fishery data. The first of these, Project R6437[14], developed methods for stock assessment that were based on a Bayesian rather than frequentist stock assessment and decision analysis to allow for the uncertainties that exist where there is little data. Applying this in

[13] R7336 also cross-cuts to cluster 2 (Livelihoods appraisals)
[14] R6437 also cross-cuts to cluster 6 (Bayesian stock assessment and management with limited data)

developing fisheries, a Bayesian model to assist in the assessment of the Namibian orange roughy was produced (see Annex 7 for more details of this aspect of the project). The orange roughy model has been further developed as a software package by Wildlife Conservation Society and is now being used for ICCAT swordfish assessments. A second (non-Bayesian) model was also developed for the lightly exploited and data limited Tonga seamount fishery. This model was able to demonstrate the economic tradeoffs for artisanal and commercial fleets exploiting nearby and remote seamounts and has generic lessons for such geographically dispersed fisheries.

The new Bayesian methods for stock assessment developed in project R6437 (Management of lightly exploited fisheries) have very wide applicability. In practice , they have had a major impact on the approaches adopted during a recently completed EC-funded project carried out jointly by MRAG and Italian and Icelandic research institutes (FAIR-CT95-0561 "Innovative integrated bioeconomic models for the management of multi-species multi-gear fisheries"). Material from review papers has been incorporated into several publications from the project. In June 1999, the Namibian Government agreed to fund a one year research contract to continue the research and educational work with regards to orange roughy and other important marine species. Namibia currently has precautionary orange roughy management.

During 1998/9 MRAG Ltd, who manage a number of UK overseas territory fisheries on behalf of the UK Foreign and Commonwealth Office, were involved in fisheries negotiations and licence agreements on behalf of St Helena and associated dependencies. Projects R4775 and R6437 (Management of lightly exploited fisheries) were of direct relevance in these negotiations and further extended linkages to these projects.

Much of the stock assessment work that has been done has been of a single species nature, or applicable in fisheries where species can be aggregated for the purpose of management. However many tropical marine fisheries consist of catches composed of species that have varied life histories. Project R5484 was therefore commissioned to assess the effects of fishing on this type of multi-species fish stocks and was able to derive a set of useful management guidelines and minimum data requirements for management for such fisheries. The guidelines for management included an assessment of the adequacy of length-based methods and a comparison of single and multi-species models. Methods for setting overall effort in multi-species fisheries were described. The guidelines also provided recommendations on suitable management interventions and on assessment methods and the related data requirements.

Applying the guidelines in the project, the case studies selected, Tongan snapper, were based on a relatively simple multi-species example, but one which was believed to have widespread applicability. Within the case study, a multi-species and age-structured dynamic pool model (MIDAS) was produced. Results from this simple example showed that single, and aggregate single species models were adequate to derive management advice, at least for a fishery such as the single-gear fishery examined. Guidelines for management derived using this model were disseminated and describe ways of selecting the most important and vulnerable species for analysis and give a method for setting overall effort limits for a multispecies fishery.

Currently Tongan snapper catches are estimated to have settled to around 250-350 tonnes per year. The fishery concentrates on the higher-value species from deeper water and stocks appear to have stabilised after the declining trend of the early 1990s. The estimates of sustainable yield, while acknowledged to be imprecise, are

in the region of 400-550 tonnes per year. The Tongan deepwater snapper fishery is probably operating at present within margins of sustainability, both economic and biological (SPC 2000). Preliminary results from the research have already been used in the assessment of the British Indian Ocean Territory Inshore Fisheries Management Strategy.

Tools to support stock assessment in data limited small-scale fisheries have been produced by R7947[15]. This project provides multivariate analysis tools and software that can incorporate inputs from participatory analysis with fishers and that may accelerate the learning process for adaptive management. This project, together with projects R8397 and RR8464 are described more fully in Cluster 6 and in Annexes 5 and 6.

All the stock assessment tools have been the subject of uptake promotion under projects R8360[16] and R8468. These projects have sought to synthesise the main messages from the stock assessment related projects and provide users with the means to decide on the stock assessment tools that best suit their fishery based on the type of management approach that they are seeking to take, the type and quality of data available, the objectives of management and the constraints (such as a lack of financial resources) that are faced by managers. R8360 has produced the synthesis and this will be promoted worldwide through the respected FAO Fisheries Technical Paper series. The project also worked in the DFID target country of India where the project also trained 20 stock assessment scientists from India in the use of FMSP tools and software.

Project R8468 has just been commissioned with the objective of testing and promoting the stock assessment synthesis. It was felt that a more accessible entry point to the guidelines is needed that can be used to raise awareness of what is in the synthesis and to show what tools are available to support the management of fisheries in developing countries. This project will involve the training of stock assessment scientists and through such activities, together with awareness raising, will increase the potential for uptake of the FMSP stock assessment tools.

While the FMSP projects have produced a range of applicable research products that have been appreciated by stock assessment scientists in both developed and developing countries, the enabling nature of the products has made it extremely difficult to assess the impact of the projects in terms of the effect on the livelihoods of the poor in developing countries. The efforts that have been made by the FMSP to raise awareness of the tools on offer, to provide training in the use of the tools and also the efforts to develop communications materials that illustrate how the tools fit into the management process and can be applied, including the data needs and outputs, are likely to increase the uptake and application of the tools. However there remain two fundamental problems in assessing impact from these tools as outlined on page 6. That said, the modelling that has been conducted within the projects supported by the FMSP have indicated that there can be benefits arising from using the stock assessment tools that have been made available and, while the resulting outcomes may not be directly attributable to the projects and will, because of the response times of fisheries, take some years to become apparent, improved fisheries that provide a more resilient resource system on which the poor can depend are welcomed. The efforts of the FMSP in the past few years to make the potentially

[15] R7947 also cross-cuts to clusters 4 (Information requirements for fisheries management) and 6 (Bayesian stock assessment and management with limited data)
[16] R8360 also cross-cuts to cluster 6 (Bayesian stock assessment and management with limited data)

useful tools available, train stock assessment scientists in their use and support their application and raise awareness of their availability should lead to increased use over the next few years.

Cluster 6: Bayesian stock assessment approaches and methods for management with limited information.

R6437: Management strategies for new or lightly exploited fisheries in developing countries
R7834: Interdisciplinary multivariate analysis (IMA) for adaptive co-management
R7947: Integrated fisheries management using Baysian multi-criterion decision making
R8285: Fisheries data collection and sharing mechanisms for (co-) management.
R8360: Synthesis and uptake promotion of FMSP stock assessment tools and guidelines
R4778G: Software training courses
R8397: Uptake of Participatory Fisheries Stock Assessment (PFSA) Tool Kit
R8462: Evaluation and uptake promotion of data collection guidelines for co-managed fisheries
R8464: Application and promotion of FMSP Participatory Fish Stock Assessment (ParFish)
R8468: Capacity building in the use of FMSP stock assessment tools and management guide

The methods developed in this cluster concentrate on the application of Bayesian statistical methodology to fish stock assessment. Bayesian statistical methodologies differ from the more widely applied frequentist statistical methods in that they allow the formulation and incorporation of prior probability distributions for key parameters of interest (e.g. initial stock sizes, current stock size etc). This means that stock assessments that use such methods are able to incorporate other information that reflects current knowledge about these parameters. For example, in a tropical reef fishery the growth rate of a particular species may not be known but the Bayesian statistical methods could allow, for instance, the use of a prior probability distribution based on the growth rates known from other, similar, fisheries. This distribution is then updated as more data become available from the actual fishery in question. In addition, the prior distribution is very flexible and can be based on direct information about the fish stock (from test fishing) and fishery (including from fishers themselves) being assessed or information about similar stocks and fisheries elsewhere. The ability therefore of Bayesian methods to make use of other sources of information to construct the priors make them highly relevant for small-scale fisheries and for new or developing fisheries where there may be very little, or indeed no, time series of fisheries data such as catch and effort, or where the biology and dynamics of the fish stock may be uncertain. For all of the Bayesian stock assessment products, as with the products developed in Cluster 5, the ultimate beneficiaries will be fishers in developing countries, fish processors and people who rely on fish products who will benefit from more sustainable management and a more resilient resource system. The immediate beneficiaries however will be sub-national, national and regional fisheries managers, policy makers and fisheries institutions who will be able to better manage fisheries resources, even in cases where there is only limited scientific data available.

The Yield model that was developed in project R7041[17] uses Bayesian statistical methods to estimate target and limit reference points while allowing for uncertainty, as required for precautionary management approaches (see Cluster 5 for more details on this project). The resulting software has proved valuable in a number of important fisheries. Project R6437[15] developed a Bayesian model for the assessment of the Namibian orange roughy fishery and a second (non-Bayesian) model for the lightly exploited and data limited Tonga seamount fishery (see Cluster 5 for more details).

Project R7947[18] developed and tested an innovative multi-criterion management decision-making methodology, based on Bayesian techniques and participatory processes. One of the ideas behind this project was that the provision of management advice in data-poor, artisanal fisheries in developing countries could be enhanced if the prior probability distributions used in the assessment models could incorporate the knowledge of resource users. The ParFish stock assessment methodology/software allows the identification of information required, involves fishers in the assessment process through an interview process and enables managers to rapidly apply assessment procedures to artisanal fisheries where there is little data.

Participation in the process during the project led to prior distributions being determined for key population parameters and the identification of targets for the fishery and management controls based on fisher preferences identified through a ranking procedure. Involvement of fishers in the assessment procedure was aimed at making the management actions decided upon based more on fisher preferences and based on their knowledge as well as information generated from any fishery data that existed.

The software component was shown to work well in the Turks and Caicos conch fishery (see also Annex 5) and as a result has been further developed under project R8397[19]. This development recognised that while the assessment process appeared to be effective, this was not situated in a framework that ensured that fishers were fully engaged or that the outputs of the ParFish software and their implications were both understood by resource users and then incorporated into management plans and implemented so that the potential benefits from the management advice could be realised.

In order to develop the necessary co-management framework in which to situate the ParFish stock assessment, project R8397 looked to use the framework for adaptive co-management that had been developed in project R7335. Project R8397 has conducted activities based on this framework and implemented revised and simplified versions of the software developed in R7947. The project also developed and tested tools and methods for communicating stock assessment concepts to extension workers and fisher groups. The process has involved fishers in the target area in Zanzibar, East Africa, a location where there are 23,000 fishers and 2300 traders directly dependent on fisheries and where fisher families form part of the poorest and most disadvantaged communities on the island. The project has also provided training to scientists from a local fisheries agency in the use of the methods. A set of

[17] R7041, R4778G, R6437 and R8360 also cross-cut to cluster 5 (Stock assessment guidelines)
[18] R7947 also cross-cuts to clusters 4 (Information requirements for fisheries management) and 5 (Stock assessment guidelines)
[19] R8397 also cross-cuts to clusters 4 (Information requirements for fisheries management) and 6 (Bayesian stock assessment and management with limited data)

guidelines for implementing the ParFish assessment methodology was developed that includes the tools developed during the project, the software and a software help manual. The project has worked hard in promoting the methodology widely through a range of media.

While it has not been possible within the timeframe of the existing projects to both develop and implement management plans, modelling of resource systems and the potential benefits (see Annex 5) suggests that there could be benefits to those dependent on the resource systems if management plans are based on assessments and incorporate information from those familiar with the systems and also reflect their objectives.

The process outlined in project R8397[20] is now being implemented in part and tested in a number of fisheries systems in the DFID target regions of Africa and South Asia, bringing direct benefits to the fishers involved as well as providing evidence of how well the approach can work in small-scale fisheries in locations outside East Africa. The testing process should enable the revision of existing materials and make the methodologies more widely applicable. In addition the project will raise awareness of the methodologies and software that has been developed and its' potential and also train scientists in the target regions in the use of ParFish software and tools. However, again because of the limited time available it is unlikely that management plans will be developed from the assessment outcomes and implemented. It will therefore not be possible to assess the impact of the project beyond the increased capacity of the intermediary organisation and perhaps the increased knowledge of the ultimate beneficiaries. Capacity building of potential users of the ParFish methodology has been supported through project R4778G[15]. As described under Cluster 5, a workshop was held in India to promote the software and to train trainers.

While the proceeding projects have been focussed on providing research outputs that support stock assessment, and in the case of the ParFish projects, of putting stock assessment outputs into management plans, the performance of co-management arrangements, and the information needed to monitor performance was the focus of R7834[21]. The project undertook a review of existing approaches to evaluating management performance and considered the merits of alternative potentially appropriate methodological approaches. It was concluded that General Linear Models (GLM) and Bayesian Network (BN) Models offered the most scope for constructing models of co-management performance given the data structures and types of variables typically encountered. The project was able to identify simple multi-disciplinary measures and indicators of co-management strategies, arrangements and outcomes that could enable those involved in management of the resources to bring about improvements to resource management that might ultimately be reflected in reduced poverty and improved livelihoods. Project staff report that some of the methods have already been put into practice by various organisations worldwide.

As a follow-on to the investigation into information types and information requirements in co-management undertaken in project R7834, project R8285[22] has consulted with key stakeholders and target institutions from Philippines, Bangladesh, Mozambique and Uganda as well as the five Mekong Basin Countries. This has led to the production of guidelines for designing and implementing locally-appropriate

[20] R8397 also cross-cuts to clusters 4 (Information requirements for fisheries management) and 7 (Generic management guidelines)
[21] R7834 also cross-cuts to cluster 4 (Information requirements for fisheries management)
[22] R8285 also cross-cuts to clusters 4 (Information requirements for fisheries management) and 7 (Generic management guidelines)

data collection and sharing systems to support co-management that also incorporate aspects of projects R7335, R7834 and R7947. In order to ensure the greatest possible application of the guidelines (which have been produces as and influential FAO Fisheries Technical Paper), handy field guides that provide an entry point to the more technically detailed FAO paper have been produced in a range of languages including Khmer, Bangla, Vietnamese and Lao. These guides have been developed to enable extension workers to make use of and apply the methods in order to support co-management initiatives. The guides have been applied through the Mekong River Commission (MRC) Management of Reservoir and River Fisheries component and in Thai reservoir fisheries it has been reported that there has been a change in attitude towards data collection and information sharing amongst both the researchers and fisheries agency staff involved in the co-management process but also amongst the user representatives in the reservoir management committee (Deeburee pers. comm.).

An uptake promotions project (R8462) has also been commissioned that will apply, test and further promote the field guides and data collection guidelines. This project has also initiated a range of communications activities that are designed to raise awareness of the methods that have been developed and illustrate their applicability. Through this it is hoped that the potential for uptake can be increased.

Further uptake is likely to be stimulated through the activities and products associated with project R8360[15]. This project has sought to promote many of the Bayesian stock assessment approaches and those developed for fisheries with limited data together with the other stock assessment tools and methods developed within Cluster 5. Promotion has included the high profile FAO Fisheries Technical Paper series. In addition to the promotion through R8360, a further stock assessment methods promotions project (R8468) has been commissioned with the aim of raising awareness of the products that have been developed and also train a number of scientists in their use. It has been recognised that using a variety of media and communications products a range of intermediary beneficiaries can be made more aware of the FMSP outputs and demand for them can be increased.

Uptake of these methods can be expected to lead to improvements in fisheries resource management. The outputs also have greater potential for impact as many of them (e.g. R4778G, R8285, R8397, R8462 and R8464) are working at a more inclusive and focussed level and include a strong capacity building element. However these projects have only recently finished and/or have not included the implementation of management plans that incorporate research outputs so it has not been possible to determine directly the outcomes and impacts of these management plans on the resources and the livelihoods of those dependent upon them. The only impact that has been detected thus far is an increased awareness and capacity in the intermediary beneficiary organisations and some evidence of increased knowledge and access to information about the resource system amongst the target beneficiaries. It is still too soon to be able to provide an assessment of the impact of many of the projects within this cluster. However, that said, it is highly likely, given the recent emphasis on testing, capacity building and awareness raising, that there will be increased uptake over the next few years resulting in beneficial impacts on the livelihoods of those dependent on fisheries that have to be managed with little existing data..

Cluster 7: Generic management guidelines

R4777: Analysis of Fish Aggregating Devices
R5023: Potential Yield of Small Reservoir Fisheries in South Asia

R5953: Fisheries Dynamics of Modified Floodplains in Southern Asia
R5958: Culture Fisheries Assessment Methodology
R6436: The performance of Customary Marine Tenure (CMT) in the management of community fishery resources in Melanesia
R7042: Information systems for co-management of artisanal fisheries
R7043: Selection criteria and co-management guidelines for harvest reserves in tropical river fisheries
R7334: Management of conflict in tropical fisheries
R7335: Adaptive learning approaches to fisheries management
R7917: Self recruiting species in aquaculture – their role in rural livelihoods.
R8210: The use of sluice gates for stock enhancement and diversification of livelihoods
R8285: Fisheries data collection and sharing mechanisms for (co-) management.
R8292: Uptake of adaptive learning approaches for enhancement fisheries.
R8294: Enabling better management of fisheries conflicts
R8397: Uptake of Participatory Fisheries Stock Assessment (PFSA) Tool Kit
R8462: Evaluation and uptake promotion of data collection guidelines for co-managed fisheries
R8464: Application and promotion of FMSP Participatory Fish Stock Assessment (ParFish)
R8468: Capacity building in the use of FMSP stock assessment tools and management guide
R 8470: Synthesis of FMSP experience and lessons learned for fisheries co-management
R8486

In part so that intermediary organisations can access and utilise the products of FMSP research, a large number of projects have produced some guidelines. The projects in this cluster are a diverse range and cut across all the fishery types considered within FMSP research, capture and enhancement, inland and marine fisheries. Because of this diversity, many of the projects in this cluster cross cut to other Clusters. This section will consider these cross-cutting projects only briefly as they, and their identified and potential impact, will be discussed more fully within the other Clusters.

Project R6436[23] focussed on the then target geographical area of the South Pacific. This is a region that has a number of existing community based management regimes that are based on customary practices, including the use of tabu. These management regimes may have a lot to tell us about how community based management regimes function and how initiatives can be made more effective. The project examined coastal fisheries dependent livelihoods and the performance (social equity and ecological sustainability) of a number of customary management regimes in Fiji and Vanuatu. This helped identify the ways in which co-operation with government (co-management) could enhance the current system. The results from the study were used to produce a set of co-management guidelines (see Cluster 2).

Data collection and the use of fisheries information is another thread that crosses all the resource types and is one that is touched on by projects in many of the clusters. Within this Cluster project R7042[24] sought to provide support to managers by exploring the potential for the development of a generic Fisheries Information Management System (FIMS). This was aimed at providing an affordable and widely

[23] R6436 also cross-cuts to cluster 2 (Livelihood appraisals)
[24] R7042 also cross-cuts to cluster 4 (Information requirements for fisheries management)

applicable tool that could improve the co-management and appropriate development of artisanal fisheries. This FIMS had applicability to both marine and inland fisheries and a database and manual were developed. This project formed the basis for projects R8285 and R8462. These projects have been increasingly focussed and have a much higher capacity building and awareness raising components (see Clusters 5 and 6 for further details).

Project R8294 again addresses an issue that is common to all resource types. The broad objective of this project has to identify and promote institutions and practices that will resolve and minimise conflicts that often go against the interest of poor fishers; and to promote conflict assessment and resolution tools and consensus building approaches by targeting key stakeholders. Building on the earlier work that was carried out within a number of projects, particularly R7334, it is expected that, because the project worked closely with agencies and communities in pilot schemes to test the policy options in Bangladesh and Cambodia, the potential for uptake is high. The impact of the project, while only becoming evident over the next few years, should be relatively easy to measure in terms of reduced levels of conflict and the strengthening of existing conflict resolution mechanisms or development of new institutions.

Floodplain fisheries were the focus of projects R7043[23], R7917[25] and R8210[23]. R7043 identified ecological, social and institutional criteria for the selection and beneficial use of harvest reserves in tropical river fisheries and developed guidelines for their management. These guidelines were published in both English and Indonesian by the collaborating Central Research Institute for Fisheries (CRIFI). Project R7917 has identified that small, self-recruiting are an important livelihoods component for the poor in South and Southeast Asia. Recognising the important role that these fish play, the project has sought to develop management strategies and associated guidelines that can potentially lead to increased production, and access to, self-recruiting small fish resources by the poor in Southeast and South Asia.

Project R8210 is another recent floodplain project that is addressing another important issue in the management of floodplain resources. In Bangladesh, At least 75% of the floodplain catch is taken by occasional or part-time fishers as a supplementary activity to rice farming. The use of sluice gates, and the timing of the opening and closing of the gates can have significant effects on the survival of migrating fish species, and their subsequent availability to fishers in the floodplains. This is of great importance in a country where some 40% of the floodplain has been modified and water control systems are widespread. The project has undertaken research to identify the effects of different sluice opening timings. From the results that were obtained, the project was able to develop guidelines for an optimal procedure and protocol for the operation of sluice gates. These guidelines take account of both the need for irrigation water and the requirements for the fisheries and seek to integrate the two. The guidelines are aimed at uptake of the best practice procedures by local communities via the intermediary NGOs and government agencies. The project, together with a follow-on project (R8486), have worked hard to promote the research findings and the guidelines. These efforts have been successful in achieving uptake of the findings and one of the project partners, BCAS, has negotiated a memorandum of understanding with the Bangladesh Water Development Board with a view to applying sluice gate management guidelines throughout Bangladesh. Similar linkages are also being developed with other donor funded projects and programmes (e.g. AUSAID, MACH and DANIDA). Efforts are

[25] R7917 also cross-cuts to clusters 9 (Floodplain fisheries management) and 10 (Enhancement of inland fisheries)

also being made, e.g. through newspaper articles, to target the fishers and farmers, and their representatives, directly in order to raise awareness of the issues and the benefits from appropriate management. Further efforts will be made through R8486 to promote the findings and guidelines more widely in Southeast Asia.

Inland enhancement fisheries have also been the focus of a number of projects commissioned by the FMSP. These projects have included both the theoretical and the applied. More detail on these projects is provided in Cluster 10. Population dynamics modelling (R5023[26]) has shown that in enhanced fisheries, the highest production is achieved at a high stocking density and high fishing mortality. Harvesting strategies were assessed quantitatively using a population model and management guidelines developed. Projects R5953[27] and R5958[22] increased the scope of the system being considered from the purely bio-physical and technical to include social and economic aspects as well. These projects developed a methodology for the technical, bio-economic and socio-economic assessment of culture-based fisheries and tested the methodology in three case studies conducted in India, China and Northeast Thailand.

While the earlier projects have focussed on the assessment of culture-based fisheries, it was recognise that assessment was only part of a management process and that the other parts of this process has to be addressed if the assessment results were to both inform the management and lead to the implementation of management plans based on the assessments. The adaptive learning projects, project R7335[22] together with the follow on uptake project R8292[22], have sought to develop, test, refine and promote a framework for implementing adaptive co-management. These projects sought to provide tools and methods for intermediary beneficiaries to enable them to engage with the target beneficiaries and enable all to participate in a collective research and management process that incorporated the use of assessment procedures and adaptive management experiments. The resulting guidelines have been widely promoted through the uptake promotion projects. Further details regarding the impact of project R7335 are provided in Annexes 8 and 9.

A more formal linkage between the earlier assessment projects and the later learning and co-management projects should be achieved through the recently commissioned project to develop a decision support tool (R8469) that incorporates the assessment methodologies and situates these within a co-management framework provided by the adaptive learning projects. This set of projects have already achieved uptake in India, Thailand, and Lao PDR and there is considerable interest in applying the research products in South and Southeast Asia (including Vietnam, Cambodia, India and Bangladesh) as well as in Africa through initiatives such as the Challenge Programme on water and food (India, Bangladesh, Vietnam, Cambodia and Mali) and the DANIDA funded SUFA project (Vietnam).

Project in this cluster R4777[28] addressed marine enhanced fisheries and sought through research to identify the biological components of successful inshore Fish Aggregating Devices (FAD). The information generated by the field research was used to develop a manual for the deployment and monitoring of inshore FADs. This was produced with the South Pacific Commission (SPC) and has been used for the

[26] R5023, R5958, R7335 and R8292 also cross-cut to cluster 10 (Enhancement of inland fisheries)
[27] R5953, R7043 and R8210 also cross-cut to cluster 9 (Floodplain fisheries management)
[28] R4777 also cross-cuts to cluster 11 (Enhancement of marine fisheries)

deployment of FADs in a number of South Pacific small-island nations (see Cluster 11).

A final cross-cutting thread in FMSP projects has been co-management. A large number of projects have, directly or indirectly included aspects of co-management. For this reason the FMSP has commissioned a project (R8470) to synthesise the information on co-management and make it available to policy makers and development practitioners in an appropriate format. This project will promote some of the key research findings and policy messages from the ten years of research. It is hoped that this will ensure that there is a greater likelihood that the information that has been generated will be utilised to provide more relevant policies and development interventions in the post-RNRRS environment. Overall, projects in this cluster are expected to achieve further impact through the continued uptake of the outputs from individual projects within each cluster as well as the through the synthesis activities and product testing undertaken under other clusters.

Cluster 8: Control of Foreign Fisheries

R4775: Control of Foreign Fisheries
R5049CB: Control of Foreign fisheries - Field development
R8463: Promotion of models generating national economic benefits through the control of foreign fisheries

Demand for fish worldwide is very high and it is accepted that wordwide there are large numbers of vessels that undertake illegal, unreported and unregulated fishing (IUU). This is an issue not only on the high seas but also within exclusive economic zones (EEZ) that are not effectively regulated and results in some US$ 4 billion of fish being caught illegally each year (MRAG 2005). It is a particular problem for developing countries as they often have fewer resources with which to effectively control and prevent the incidence of IUU fishing within their national jurisdiction and who also stand to lose disproportionately from the loss of a valuable resource.

The FMSP has commissioned a total of three projects to research aspects relating to the control of foreign fisheries. This is an issue of great importance to developing countries and touches on aspects such as the conflict between national artisanal fishers and international fleets, the securement of resource rent for national development and control of IUU fishing.

A methodology for evaluating the benefits from the licensing of foreign fishing, particularly within the tuna purse seine and longline vessels operating within the Exclusive Economic Zone (EEZ) of a nation, was the output from the first project on foreign fishing (R4775). This methodology was developed as a means to illustrate to policy makers the issues around licensing of foreign vessels in order to inform policy and legislation around areas associated with licensing such as license fees and monitoring, control and surveillance (MCS). The second project (R5049CB), tested the methodology that had been developed in R4775 in order to assess the extent to which they can be applied in practice by governments of developing countries in order to formulate policies for controlling foreign fishing.

The majority of uptake and uptake promotion has so far been achieved through project R5049CB. During project R5049CB, the methodology developed in R4775 was applied in six case studies. These were the offshore fisheries in Seychelles, British Indian Ocean Territory (BIOT), South Georgia and the South Sandwich Islands (SGSSI), the South Pacific (through the Forum Fisheries Agency), Namibia and the British Virgin Islands. The methodology was applied in these cases with

differing degrees of success. Namibia was an unsuccessful case but this was as a result of policy decisions. Namibia had previously been affected by excessive foreign fishing effort and the government of Namibia decided that they would pursue a policy of promoting local rather than foreign fishing in order to build up their indigenous industry (see also Annex 7).

The methodology was promoted, based on the results of the case studies to the agencies responsible for managing foreign fisheries in EEZ waters in each case. In addition to this direct promotion of the methodology, the methodology and the results from its application were also presented to a wide audience of fisheries managers at an FAO/Norway regional workshop on monitoring control and surveillance held in Mauritius in 1996.

A number of the countries that had been selected as the case study sites in R5049CB have subsequently shown great interest in applying the results and findings in developing and improving their strategies controlling of commercial fishing by foreign fishing vessels operating within their EEZ. For example, in 1996 the Seychelles Fishing Authority used funds that had been made available through their fisheries management agreement with the European Union to fund a workshop to present the results of R5049CB to staff members.

The methodology has also subsequently been used in the process of revising legislation for the management of the fisheries of British Overseas Territories. This has resulted in substantial increases to revenue from the fisheries around these territories (e.g. BIOT where annual revenues increased to £1 - £2.5 million), most of which is directly attributable to the introduction of a new management system. In SGSSI, the application of the methodology has helped to reduce instances of IUU infringements. As an example, following application of management strategies based on the methodology, in December 1995 a longliner was arrested in the South Georgia Zone and prosecuted for illegal fishing. The owners pleaded guilty to two counts of illegal fishing and were fined £900,000 for each offence. This represented a huge increase in the level of fine, which previously had not exceeded £100,000 and provides a significant disincentive for other vessels that might have been tempted to break the regulations.

In Seychelles uptake is demonstrated through revised legislation and improved management has resulted in an increased flow of funds to the consolidated revenues of Government from the sale of foreign fishing licenses. In Seychelles there have been additional benefits from the methodology as there are more vessels landing catches in the country, which has had an additional and significant positive impact on the processing sector.

The methodology that has been developed and tested in the two control of foreign fishing projects is widely applicable. A number of governments around the world, as well as international and regional organisations such as the Food and Agriculture Organisation and the Forum Fisheries Agency in the South Pacific, have sought to utilise aspects of the methods developed. The methodology developed has been revisited by the FMSP following changes in the Programme geographical focus and a needs assessment that indicated that countries in East Africa, where there is considerable potential for increased benefits from foreign fishing licensing, and, due to capacity and financial constraints, MCS capacity is low and the fisheries are currently subject to IUU fishing activity from both national and foreign fleets. The countries of East Africa were therefore interested in applying the methodology in order to capture more of the potential benefits from their resources and at the same time reduce the incidence of IUU.

The recently commissioned project (R8463) will use the bio-economic models developed and tested in the earlier projects as the basis of a tool for controlling of foreign fisheries. In addition, the project will seek to improve local capacity within national agencies and increase national, regional and international awareness of the possibilities for, and benefits from, increasing foreign fishing license fees and developing MCS strategies for the control of foreign fisheries. Given the significant results from the earlier projects (the annual value of which already exceeds the entire annual cost of the FMSP), application of the methodology in East Africa should lead to increased government revenues and sustainable exploitation of offshore marine resources as well as potential benefits for national on-shore processing facilities.

Given the clear benefits that have resulted, at least at the national level, the potential for uptake is considered to be high. The potential benefits, both in terms of increased national revenues and decreased IUU incidences have recognized by DFID, with support from NORAD, who convened an international meeting in June 2005 to discuss the problem of IUU fishing in developing countries and presented and discussed potential solutions and strategies for combating it. The project leader on the control of foreign fishing was invited to present the research findings as a contribution to the solutions to IUU fishing.

Given the current high profile of IUU fishing internationally and the success of the methodologies in many of the cases where they have been applied, the potential for uptake is considered to be high, especially if adoption continues to be supported at the national level through DFID. While it is possible to show that there have been significant benefits at the national level, and in the case of Seychelles there were benefits to those who were working in the processing sector, it has not been possible at this stage to assess how the benefits that have accrued at the national level have been transformed into benefits to the poorest of the poor.

Cluster 9: Floodplain fisheries management.

R5030: Synthesis of simple predictive models for river fish yields in major tropical rivers
R5485: River and Floodplain Fisheries in the Ganges
R5953: Fisheries Dynamics of Modified Floodplains in Southern Asia
R6494: Evaluation of the biological and socioeconomic benefits of enhancement of floodplain fisheries
R7043: Selection criteria and co-management guidelines for harvest reserves in tropical river fisheries
R7917: Self recruiting species in aquaculture – their role in rural livelihoods.
R8210: The use of sluice gates for stock enhancement and diversification of livelihoods
R8486: Promotion of FMSP guidelines for floodplain fisheries management and sluice gate control

This cluster of projects has produced a considerable amount of new knowledge concerning floodplain fisheries. Floodplains fisheries are highly productive and form a crucial livelihood component, particularly as a source of animal protein, for many millions of farmer-fishers in South and Southeast Asia. In Bangladesh alone, more than 13 million people depend upon the floodplains to some extent. Because of the importance of floodplains fisheries, research messages have got a great deal of potential for uptake and impact. The need for information that can inform management policies and actions and the timeliness of research outputs has meant

that many of the research outputs has been taken up by FAO and incorporated into the Fisheries Technical Report series and FAO databases. This has ensured that the information generated remains easily accessible to a wide range of intermediary organisations where it can have the greatest potential impact.

Projects within this cluster have sought to generate this new information and to develop management strategies and guidelines for the management of fisheries and aquatic resources. Because of the enabling nature of many of the projects in this cluster, particularly those projects that were commissioned early in the life of the programme, the immediate beneficiaries are recognised as being national and regional fisheries and water managers, policy makers and fisheries and irrigation agencies who will be able to provide advice that can support better management of these resources. The target beneficiaries will be mainly small-scale subsistence and artisanal fishers in South and Southeast Asia, fish processors and those relying upon fish products. Additionally, through improved water management, poor rural communities reliant on rice farming will also potentially stand to benefit.

The first of the floodplain fisheries projects, project R5030[29] sought to develop and test a number of relationships for predicting yields of fish from floodplain fisheries from parameters representing the biophysical characteristics of floodplains. This included biophysical characteristics such as the basin drainage area, floodplain area, and river discharge rates. The modelling exercise was performed for floodplains in both South American and Asian areas and a number of useful relationships that could inform policy and management were derived. Building on this type of approach and the information from R5030, project R5485[25] sought to develop management strategies for fisheries resources within the entire Ganges major river basin. Models and data from this project were influential in developing and sustaining cross-border cooperation in managing whole basin as well as proving to be useful within national sectors.

Moving beyond issues solely around production, project R5953[30] attempted to address the need to understanding the implications of river fish biology and migration for the management of inland capture fisheries and the impacts of flood control measures on the fish production potential, particularly in the modified floodplains in Bangladesh. The information generated by this project led to recommendations for the sustainable management of floodplain resources for fish production. This information, together with the increased capacity of key staff resulting from the project, have led to significant advances the use of riverine reserves and waterbody licensing as well as advances in the understanding of the links between property rights and fish behaviour patterns.

The project provided important baseline information on the biology and population dynamics of important fish species in Indonesia and Bangladesh that were relied upon by large numbers of subsistence and artisanal fishers. The project also provided an initial assessment of the impacts of hydraulic engineering on fish production and diversity in Bangladesh that was made available to scientists and policy makers in country. A great deal of the floodplain in Bangladesh has been compartmentalised and is subject to water control schemes. It is estimated that within the compartmentalised floodplain in Bangladesh there are over 1,700,000 poor fishers. Floodplain fisheries models devised under the FMSP projects proved invaluable in planning the impact of fish refuges and other enhancement methods of the Fourth Fisheries Project in Bangladesh. This assessment provided a basis for

[29] R5030 and R5485 cross-cut to cluster 1 (Databases of information)
[30] R5953, R7043 and R8210 cross-cut to cluster 7 (Generic management guidelines)

later projects within this cluster that looked to develop, test and promote strategies and guidelines for incorporating fisheries considerations into water management policies an inform the development of mitigation measures.

Within Indonesia, to assist CRIFI with project planning and research methodologies, a training workshop was held attended by many CRIFI staff. Further capacity building efforts included students in Bangladesh being recruited to research the movement of fish to the floodplain via flood control sluice gates, and the capture and survival of fish in waterbodies over the crucial dry season. To facilitate the exchange of information between the study sites in Bangladesh and Indonesia, two project staff from each site made exchange visits to their counterparts in the other countries. This helped them to develop awareness of regional resource issues in each case.

R7043[26] also focussed on tropical river fisheries, including in Indonesia, and the project identified ecological, social and institutional criteria that should be considered in the selection and management of harvest reserves. In order to enhance the effectiveness of the research messages, a set of guidelines were developed that were published in both English and Indonesian language by CRIFI. The models developed in this project were invaluable in the planning of management interventions in Indonesia and the information generated was synthesised and promoted through an FAO Fisheries Technical Paper.

Floodplains are dynamic environments that are also subject to enhancement initiatives. Results from projects in this cluster have been useful in informing important large scale stocking initiatives. For example, the results of project R5953 were important in the development of the Fourth Fisheries Programme in Bangladesh. Also in South Asia, research in project R6494 led to the compiling of detailed strategies and guidelines for stock enhancement for the South Asia region. These were again useful in Bangladesh where an important contribution was made to the overall evaluation of fish production under the Third Fisheries Programme for the Bangladesh Department of Fisheries and the FAO Expert Consultation on International Stock Enhancement Procedures. This again informed activities planned by the Department of Fisheries under the Fourth Fisheries Programme.

Enhancement initiatives often lead to the establishment of culture-based fisheries that provide catches of fish that include both the stocked and wild fish. There are issues associated with stocking including the distribution of benefits from stocking initiatives and the effect of stocking (particularly of exotics) on the naturally occurring wild fish species (see also Cluster 10). Project R7917[31] was commissioned to examine the role of wild fish in culture-based fisheries in South and Southeast Asia. The project focussed on the role of small, self-recruiting wild fish in enhancement fisheries and their contribution to overall production from the fishery systems. These are a resource that has been identified as being important to the rural poor in these regions as they provide a cheap and relatively accessible source of animal protein.

The project has sought to develop management strategies and a set of guidelines that will enable production increases and improved access to self-recruiting small fish resources by the poor in these geographical target areas. The methodologies developed in this project have now been adopted by the Thai Department of Fisheries. The results of this project are also going to be the subject of an uptake promotion project funded through the Aquaculture and Fish Genetics Research Programme (AFGRP).

[31] R7917 cross-cuts to clusters 7 (Generic management guidelines) and 10 (Enhancement of inland fisheries)

R8210[26] has been developing an optimal procedure and protocol for the operation of sluice gates to promote best integration of fish immigration and water management that will be promoted for uptake by local communities via NGOs and government extension services (see Cluster 7). A further project (R8486) has been commissioned by the FMSP to synthesise the key messages regarding floodplain fisheries and promote these widely to both policy makers and implementing agencies. Again, the Programme has sought to develop tools, methods and management strategies that will benefit those dependent on floodplain fisheries resources and more rational water control management. More recently the emphasis has been on developing the tools and making the research messages more available to the intermediary beneficiaries in the target geographical areas and beyond. These efforts should help to ensure that the opportunities for uptake are maximised. Already there seems to be some success in this respect (with R8210 and R7917 for example) and it is likely that positive impacts on the livelihoods of people dependent on floodplain fisheries will be seen over the next few years.

Cluster 10: Enhancement of inland fisheries.

R5023: Potential Yield of Small Reservoir Fisheries in South Asia
R5958: Culture Fisheries Assessment Methodology
R6338CB: Reservoir Fisheries Management in Savannakhet Province, Lao PDR
R7335: Adaptive learning approaches to fisheries management
R7917: Self recruiting species in aquaculture – their role in rural livelihoods.
R8292: Uptake of adaptive learning approaches for enhancement fisheries.
R8469: Fisheries enhancement Decision Support Tool and Toolkit

Enhancement fisheries are important in the livelihoods of many people worldwide. Most enhancement activities take place in inland waters (see also Cluster 11) and these activities contribute to the 15% of world production that inland waters account for (FAO 2002). This cluster of projects has produced some influential research on the topic of inland enhanced fisheries and there has been increasing interest in the products developed from development practitioners, donors and in-country organisations.

By far the most common enhancement measure is the creation of culture-based fisheries, which are fisheries that are mostly or entirely supported through regular stocking for recruitment and that rely entirely on the natural productivity of the waterbody for growth (Lorenzen 1995). As such culture-based fisheries fall somewhere between the more commonly considered capture fishery and aquaculture systems. Culture-based fisheries, consisting of both a wild fish and an often more important cultured fish component are important as they are usually less intensive than aquaculture systems. This makes culture-based fisheries a relatively simple and generally low risk way to increase production.

Stocking as an enhancement activity has become an increasingly popular intervention in rural fisheries development and has been a high priority on development agendas over the past two decades (Warren 2000, De Silva 2003). Worldwide, many thousands of stocking events involving the stocking of several million fish take place annually (Hickley, 1993). Throughout Southeast Asia, such interventions are often seen as a simple, effective and quick way to increase food production from aquatic systems (Welcomme and Vidthayanon 2000). As an example of the popularity and magnitude of government sponsored stocking programmes in the region, Welcomme and Vidthayanon (2000) describe how in

Thailand in 1998 an estimated 720 million common carp, tilapia, silver barb, and Indian carps were stocked across the country.

Despite worldwide application of stocking initiatives, Welcomme and Bartley (1998) consider the amount of literature related to enhancements to be surprisingly small. The FMSP has commissioned a number of projects on enhanced fisheries that have contributed greatly to knowledge in this area. Projects in this cluster have followed a similar pattern to other clusters in that there is a progression, starting with developing technical solutions and testing these. This testing phase led to the identification of a need for multidisciplinary approaches and increased emphasis on developing, testing and, more lately, promoting multidisciplinary approaches.

The earliest of the projects commissioned focussed on the more technical aspects around enhancement fisheries. Projects R5023[32] and R5958[28] developed methods for the assessment of management options. While these were technically focussed projects, they did include bio-economic and socio-economic analysis and did develop an integrated framework for appraising enhancement development options. The projects investigated reservoir stocking and harvesting strategies and this led to the identification of optimal strategies that could potentially raise fish yields by several hundred percent. The management recommendations were developed as a set of guidelines. These guidelines were then widely promoted to over 20,000 households in Asia. The uptake of the recommendations cannot be accurately assessed but it is reported that for R5958, for example, there has been significant uptake of project results in India, Thailand, and Lao PDR. The new assessment methodology that the project has developed has reportedly been applied through a number of development projects. In India, quantitative assessment tools developed under the project are used by the Indo-German Reservoir Fisheries Project in Kerala and models have been incorporated into CIFRI guidelines. The Royal Thai Department of Fisheries uses project methodology in its work on both village fishponds and larger reservoirs. Two training workshops have been held in the Department, and participants in these workshops prepared a Thai language manual for culture fisheries assessment that was based on course material. There has been strong interest in project outputs from many other institutions and individuals.

Following these more technical projects came the projects that increased the interdisciplinary nature of approaches to enhancements research. Projects R6338CB and R7335[28] were both focussed on ‘community fisheries’ systems in waterbodies managed by villages in southern Lao PDR. These are small (1 to 40 hectare), communally managed waterbodies that are managed by one or two nearby villages and where the benefits obtained from the fishery are shared by the village as a whole. The benefits from the systems have included the tangible, such as village development funds raised from fish sales that are available for addressing community development priorities (such as improving the local school, road, temple or health centre). They also include less tangible benefits such as increased village solidarity (from being involved in a communal activity) and increased managerial capacity.

Project R6338CB examined the management of community fisheries in a number of villages an considered the impacts of the establishment of a community fishery and the conditions needed for management sustainability. The research indicated that the production potential of the community fisheries was increased through stocking. Attention was also explicitly paid to the impacts of community fisheries on the poorest

[32] R5023, R5958, R7335 and R8292 also cross-cut to cluster 7 (Generic management guidelines)

members of village communities, including women. It was found that, like others in the village, these groups benefited from the increased community income. However, being more vulnerable than other groups, they benefited more, relatively, at times of household emergency (e.g. by getting free fish for funerals) and from the reduced need to provide income or food when guests came, or village work needed to be done. This interdisciplinary research was able to provide recommendations on the development of management strategies that could increase community income while not overexploiting the fisheries. These recommendations were used by the government of Lao PDR to develop a Province-wide strategy for community fishery promotion that led to wider uptake of the system of community fisheries.

As interest in community fisheries in southern Lao PDR spread, partly due to the uptake following R6338CB and partly due to the activities of the Asian Institute of Technology outreach programme, waterbody management was becoming increasingly common and the number of community fisheries in the area increased from 21 to over 40. Many of these villages were not adopting the recommendations wholesale but, it was noticed, adapted them and experimented with management. However, because each village was doing so in isolation, their learning was slow. Recognising this, Project R7335 was commissioned to develop and test an approach that could improve management, and the benefits from management, of the community fisheries that would provide a structured process-based approach for village learning. The approach developed in R7335 together with the impacts and potential impacts of the research findings are discussed more fully in Annexes 8 and 9.

Project R7335 was successful in developing and testing the adaptive learning approach. However, the focus had been very much on this development and testing so that while there was evidence of uptake and impact within the target country, there was very little awareness of the approach and uptake elsewhere. The programme country visits indicated that there was demand in a number of countries in South and Southeast Asia for the products of R7335 and so a further project (R8292[28]) was commissioned in order to raise awareness and promote the outputs from R7335. Part of this promotion would include the testing of the guidelines in alternative locations and resource systems in order to make them more widely applicable. Another component of the project has focussed on refining, translating and promoting the guidelines and the approach through a variety of means. The testing part of the project has provided direct benefits to target beneficiaries including increased skills and knowledge and also the development of technical solutions that will enable farmers to increase their production without increasing their inputs, an important contribution in these low input, low risk systems.

Interest in the approach has come from donors including GTZ, NORAD, CIDA, SIDA and DANIDA, Universities, CGIAR centres and development projects, e.g. the DFID funded Sustainable Fisheries Livelihoods Project (SFLP) and the WorldFish managed component of the Challenge Program for Water and Food. Because the project has only recently been promoting the approach it is likely that uptake and subsequent impact will only be seen over the next few years.

Another recent project within this cluster has been R7917[33]. This project looked at the role of small, self-recruiting wild fish resources in enhancement fisheries, an oft overlooked resource that is of importance to the rural poor throughout South and Southeast Asia (see Cluster (for more details). The methods developed have

[33] R7917 cross-cuts to clusters 7 (Generic management guidelines) and 9 (Floodplain fisheries management)

already been taken up by the Thai Department of Fisheries and increased uptake of the recommendations can be expected following a recently commissioned AFGRP project that will promote the research messages from R7917. The uptake in the years following this project should then lead to increased benefits to the rural poor.

As well as follow-up by the AFGRP, The FMSP has also commissioned a project that will provide a more formal linkage of the earlier assessment method development projects and the later learning process projects in this cluster. This will be achieved through project R8469. The project will develop a decision support tool for use by the intermediary beneficiaries involved in supporting enhanced fishery co-management, such as fishery departments and development projects with a fisheries remit. The project will situate the new knowledge from the earlier technical projects within a co-management framework such as that developed and tested within R7335 and R8292.

By creating an accessible software package that contains the assessment models and situating this within a broader framework, the assessment methodologies should be more accessible to the intermediary beneficiaries and the outputs should be more available to the target beneficiaries. The project will develop teaching and communications materials and promote this package. It is expected that this project will lead to increased uptake and application of research outputs and recommendations that are more relevant to the needs and objectives of those managing culture-based fisheries. However, the impact from the application of the tools and methods developed will not be seen until several years after the end of the project.

Cluster 11: Enhancement of marine fisheries – FADs

R4777: Analysis of Fish Aggregating Devices
R8196: Understanding Fisheries Associated Livelihoods and the constraints to their development in Kenya and Tanzania.
R8249: Livelihood assets required for an East Africa FADs Programme.
R8331: Promoting Livelihood Benefits from Fish Aggregation Devices

While the geographical focus of the inland enhancement fisheries research (Cluster 10) was South and Southeast Asia, the marine fisheries enhancement research started in the South Pacific and, following a shift in DFIDs geographical focus, has recently been concentrated on the countries of East Africa. The research conducted under this Cluster has contrasted on technologies for small-scale nearshore fisheries to attract and aggregate fish in a particular location so that they are more available to fishing gear.

As with the other clusters, the initial projects sought to look solely at the technical aspects and. The first project (R4777[34]) was commissioned to identify the biological components of a successful Fish Aggregating Device (FAD). The project would also provide an assessment of the socio-economic effects from inshore FAD deployment as a means of demonstrating the benefits of the technology. The project resulted in a manual for intermediary beneficiaries that could assist them in the deployment and of inshore FADs. This manual was produced together with the South Pacific Commission (SPC), an important regional organisation.

The uptake of the research outputs and use of the manual has resulted in the successful deployment of FADs in a number of South Pacific small-island nations for

[34] R4777 also cross-cuts to cluster 7 (Generic management guidelines)

whom fishing is a vital source of income, both household and national (accounting for up to 12% of GDP), and food security. As an example, Chapman (pers. comm.) has described how Nauru, one of the smaller countries in the Pacific, has benefited. Following the exhaustion of revenues from its phosphate resources, Nauru is in serious economic difficulty and the government is currently almost bankrupt. Government wages in the country were suspended for a while and are currently being paid at a much lower rate. The SPC has helped Nauru to deploy two FADs to assist local small-scale fishermen as food security has become a major issue/concern. The reason for this is that the islanders are heavily dependent on marine resources yet the reef flat has been over gleaned and little remains for the local fishers. This overfishing is exacerbated because fishing effort has been increasing through the use of spearfishing and SCUBA spearfishing as well as the use of gillnets as people try to feed their families.

It is hoped that with inshore fish getting harder to come by the FADs will help to alleviate the current situation. While the FADs were only recently deployed (2005), there are already reports that they are working and that fish are starting to show up with several good catches by local fishers being recorded. While the FADs are only a recent introduction, the SPC believe that the FADs were the only real option for Nauru for food security given the lack of other marine resources for the local people to harvest.

In addition to the direct benefits to the people of the Pacific countries from FAD deployment, the SPC believe that this initial work on inshore FADs conducted with FMSP funding has led to more work being done on this area. The SPC have used the manual, together with information generated by their own FAD research, as the basis for a revised FAD manual that is now being finalised (Chapman, pers. comm.). The SPC are confident that inshore FADs for small scale fisheries will be used more in the future, especially as countries and territories in the Pacific look to conserve inshore resources (lagoons and reef flats). Over fishing of inshore resources is common in the Pacific, and the tuna resource is the only other resource for people to focus on.

It was some time after this research before more work on FADs was commissioned by the FMSP. The geographic focus had changed and opportunities had been identified for potentially extending FAD technology to East Africa, a region where the Programme had identified that there was demand for technologies that could support small-scale fishers. In order to explore the potential, and to provide policy-makers with a better understanding of the importance of fisheries and the needs of coastal fishing communities, Project R8196[35] sought to develop an understanding of fisheries associated livelihoods in Kenya and Tanzania and identify some of the constraints to their development. The project examined fisheries dependent livelihoods in a number of villages in both countries. The information from the study was fed back to the communities involved leading to changes in institutional structures in the villages. The results were also presented to national level stakeholders including policymakers and have been adopted for the Zanzibar Institute of Marine Science (IMS) National oceanographic Data Base. This project confirmed that FADs were a technology that could potentially benefit the livelihoods of poor fishers in the region.

Given the conformation by project R8196, Project R8249[31] examined further the role of FADs in fisher livelihoods and the potential benefits that could accrue from FAD deployment. The project was able to produce a number of clear recommendations that were presented to policymakers in the form of a policy brief. Development

[35] R8196 and R8249 cross cut to cluster 2 (Livelihood appraisals)

projects that were already working with fishers were targeted to promote the application of FAD technology alongside the existing activities of the projects. There has been some effect of this in that the Mafia Island Marine Park in Tanzania has started to encourage FAD trials to examine how FAD deployment could actually benefit local fishers.

Because the earlier research had showed that FAD technology could be successful and could provide benefits to fishers and that there was demand for the technology, the FMSP commissioned project R8331. This project, currently underway, is trialing FADs in East Africa (Tanzania) to show their potential to improve livelihoods of fishers and to use this in order to promote the technology. Lessons from the trials will be disseminated through training activities with the target beneficiaries as well to a variety of intermediary beneficiaries who will be targeted through a variety of media As has been seen with the example in the Pacific, while it can be expected that there will be tangible benefits to the target beneficiaries who are directly involved in the trials (and who will benefit from the project FAD deployments) that will be apparent in the next year, the importance of FAD technology regionally and the full extent of the impact will only be able to be measured several years after the project. However, overall this cluster of projects is considered to have had a positive impact in a number of countries in the South Pacific and will lead to further benefits to the people of these countries through the uptake and application of the research messages by the SPC and others. The cluster also has the potential to provide significant benefits to coastal communities in East Africa should the trials being undertaken in R8331 prove successful.

Assessment of the impact of the selected projects

The more in depth assessments of the selected projects within clusters 6 and 10 highlighted some particular impacts associated with these projects (See Annexes 5 to 9 for more detail). The assessment did highlight the fact that it was difficult to establish impact beyond the test cases and that, because of the recent nature of the projects, developmental impact was ongoing and likely to occur in each case over the next few years. Projects, and indeed the project clusters examined had successfully produced the desired outputs but the process leading to developmental impact (see Figure 1) had not always been completed so the assessments were left considering to a large extent how effective the stages leading up to this point had been and therefore how likely the projects were likely to be in contributing to future impact.

Within cluster 6 projects R6437 and R7947 had been selected for more detailed study. Two projects were selected from this cluster as there was a more diverse set of projects than in Cluster 10. It was not possible to undertake an assessment of the economic benefits from either of the projects in Cluster 6 because of the lack of available data or uncertainty over the stock status. It was however possible to look at each of these projects in terms of the degree of knowledge transfer (including capacity building). This is a crucial aspect in terms of impact because the process of knowledge generation and impact essentially follows three stages from generating knowledge through the sharing of knowledge to the utilisation of the knowledge to generate the impacts. If the transfer of information (to contribute to knowledge) has been successful then the potential for developmental impact is increased.

Project R6437 developed and tested an assessment methodology for new and lightly exploited fisheries where there is little data. The project tested the methodology in Namibia in the orange roughy fishery. The project was very much an enabling project, providing assessment scientists with a tool to support decision making in the

fishery. The project was successful in transferring knowledge to the intermediary beneficiary (the Namibian Ministry of Fisheries and Marine Resources) and the project trained one scientist there extensively and provided training for assessment scientists on the new methodology within the ministry. The publication of the methodology and the effects of applying it in peer reviewed journal articles has made the methodology available to stock assessment scientists worldwide. The fact that these articles have been cited fairly regularly suggests that the project outputs remain relevant to fisheries assessment and continue to be useful to those conducting assessments and managing fisheries.

Project staff provided input at workshops to develop management strategies for orange roughy. Application of the methods enabled the stock assessment scientists to explore the probable effects of various alternative management options. The findings of this workshop were subsequently used by the Namibian Ministry in support of the development plan for the fishery. On the basis of this, precautionary TACs were set for the fishery. The process was much appreciated by those involved, both industry and scientists.

Precautionary management of the fisheries almost certainly reduced the chance of overexploitation in the initial years of this developing fishery. An important fact as orange roughy is particularly vulnerable to overexploitation because of its aggregating behaviour, slow growth and late maturity. The benefits of the precautionary management early on will be seen in the years to come as more information becomes available about the fishery allowing the setting of catch quotas based on a better understanding of the fish stocks and their abundance. It was not possible with the limited data available and uncertainty over the stock dynamics to calculate what the effect of the precautionary TACs implemented was compared to the scenario under the TACs that might have been adopted if the project results had not been available to managers. Nor was it possible to examine the effect on the livelihoods of fishers involved in the fishery. This is unsurprising as the methodology was developed for the management of just such fisheries. However, the precautionary TACs will have contributed to the maintenance of a sustainable fishery that could provide a level of job security for those involved.

Project R7947 had focused on the development of the technological component of the ParFish assessment methodology while project R8397 attempted to place the assessment software developed within R7947 within a wider management framework and to test this in fisheries in Zanzibar. The assessment therefore covers the case study testing of the framework and software. It was not possible to identify any tangible benefits that had resulted from the projects, either in terms of benefits to the livelihoods of those dependent on the resources or of increased resilience of the biological resource. This is not entirely unexpected as the projects have only been implemented in the last few years and each has not been of sufficient duration to allow the implementation and evaluation of management plans based on the ParFish assessment outputs. The impact assessment has therefore focussed more on the extent to which the project has built management capacity and contributed to likely future impact.

The assessment suggested that there had been some degree of capacity building and sharing of knowledge within the intermediary beneficiary organisation. The organisation gained experience in interviewing, species identification, depletion experiment design and implementation, mark and re-capture studies, underwater visual census (UVC) techniques, monitoring methods and data storage. The intermediary beneficiary organisation was also able to appreciate the benefits from engaging with the target beneficiaries in the assessment process, something that

they had previously only been doing to a limited extent. However, at the same time, they found that the methodology was not straightforward to implement and they felt that the organisation would require further training before they would become fully proficient in its application.

The target beneficiaries on the whole appreciated the participatory nature of the ParFish methodology and the local team who were implementing it were praised. However the process of implementing ParFish was viewed by many of those involved as 'foreign' and many of the activities were considered extractive in nature rather than truly collaborative.

The transfer of information about the stock status and management implications was essentially achieved through a two-day workshop. None of the communities have yet been able to create management plans that integrate information or methodologies from the project, nor is it possible from the information available to indicate what the benefits of doing so might be. However, the assessment based on data from R7947 indicates that there can be benefits from the application of the ParFish methodology. It is unfortunate that the project duration did not allow the development and implementation of a management plan as many of the issues around management that were identified by participants – habitat destruction and conflict between gears were not addressed in the part of the process that the project was able to implement. Even so, iIt was felt by those in the intermediary organisation that the process had provided a platform for future co-management activities although it is unclear whether these activities would be pursued or how they would be funded.

From speaking to individuals involved, the degree to which knowledge has been effectively disseminated to the target beneficiaries is not clear. Respondents were able to indicate that they had gained ideas on what responsible fisheries management entail but they did not necessarily appreciate that the process was one of knowledge transfer with the aim of supporting their decision making. Given the timeframe and objectives of the project it is unrealistic to expect that there should be evidence of impacts on the resources and the livelihoods of those dependent upon them at this stage. However it appears to be the case that without further support from intermediary organisations it is unlikely that there will be significant positive impacts on the livelihoods of the target beneficiaries from the process. However participants in the process do believe that there have been some benefits and they appreciate the fact that the process has got them discussing management issues.

What is encouraging from the assessment is the positive responses that have been received from all the stakeholder groups involved from target beneficiaries, through the intermediary beneficiaries through to those (who were the target of communications efforts during the project) who could be expected to support the application of the ParFish methodology in the future. The collaborating organisation in Zanzibar has been receiving calls from other organisations who are interested in using the assessment methodology indicating that the promotional activities have been effective and that there is potential for further uptake and impact. This uptake will be enhanced by the activities under the follow on project that will be ensuring that the methodology is widely applicable, widely promoted and that a number of potential users are trained in its application.

Within Cluster 10 only one project, R7335, was selected for closer examination. This project, as described in the cluster narrative above, built upon previous projects within the cluster. The project, focussing on the management of small waterbody, village managed 'community fisheries' in southern Lao PDR sought to develop and test an approach to management that would allow researchers and those managing

the resource to learn more about the systems and their dynamics while at the same time managing the system. This would provide an enabling tool that could be used by development practitioners who are working in similar complex and dynamic systems. Within the testing phase more focussed activities were undertaken and the aim of these, and the approach were to increase the knowledge on community fisheries held by all stakeholders. This was achieved through a process that generated new information through planned cross-community experiments based on what those managing the resources wanted to know, sharing of this knowledge, together with existing knowledge, in timely and appropriate ways, and building the skills of key stakeholders involved.

It has been found that all stakeholder groups (villagers, extension staff and researchers) felt that their capacity had increased as a result of participation in the project. Whilst increases in knowledge were due to information gained during the project, skills were improved as a result of the ***way*** it was implemented. Interestingly, in a number of cases it was found that the information generated from project activities did not lead to increased yields and income from community fisheries, as might be expected. Instead, the information allowed those managing the systems to take a more flexible approach to management and to continue to get benefits from the resource of differing types depending upon the circumstances that the community found itself in. The effect was therefore to increase the resilience and adaptability of the management.

Within the government agencies, knowledge about participatory techniques, and the principles behind collaborative learning more broadly, helped to generate a new approach to fisheries promotion amongst government officials and a new perspective on the experiences and skills of those managing the resources. The collaborative learning approach was contrasted positively by government employees with projects funded by other donors, in which objectives were pre-established and villagers were simply involved in the implementation process, possibly resulting in quick returns but with the danger of undermining long-term sustainability through knowledge acquisition.

The project was able to provide a number of tangible and less tangible benefits to target beneficiaries within the participating villages and beyond. The economic assessment indicated that the benefit of adopting the technology promoted by the project was equal to some US$1,113 per village or $250 per hectare. Post project data collection indicated that some 67% of villages that had been involved in the project had adopted the recommendations and some 15 additional villages, not considered during the project, had started a community fishery and were benefiting from the outputs of the project. In terms of financial benefits, income from fisheries to the community development fund is used to support village committee activities and the fishing teams; this implies a reduced household monetary contribution to support these activities. In terms of improved services, money from the community development fund has typically been spent on electrification, the building of schools and/or temples, and road improvement. The capacity of the project to generate income for such community projects should not be underestimated given the limited opportunities that exist for rural income generation.

Interviews with members of the village administrations suggest knowledge sharing and skills development through collaborative learning at project workshops was a positive experience. The knowledge gained led to the development of successful community fisheries and in several instances also had the spin-off of improved learning on the part of individuals with privately owned fish ponds. A less tangible benefit, but one that is highly regarded is the fact that in several of the villages the

project is considered to have contributed to strengthening the village administration and increasing levels of harmony amongst villagers.

While the government of Lao PDR has been involved in the project and have continued to hold workshops to share experiences and information between stakeholder groups and have attempted to disseminate the lessons learned and recommendations more widely to other provinces in southern Lao PDR, their capacity to do so is severely limited. In the case of Lao PDR it is highly unlikely that the process can continue without external assistance because of the lack of human and financial capacity. As such, the process developed, while providing clear benefits to all involved, is currently unsustainable within the country.

Discussion

It is clear from a rapid assessment of the project clusters, together with a more detailed examination of three of the projects funded through the Fisheries Management Science Programme, that the programme has generated significant amounts of new information. Projects commissioned under the FMSP are widely believed to have been scientifically rigorous and successful in producing new knowledge or in applying and testing existing knowledge and methodologies in new ways. The CRE report (CRE 1998) despite difficulties in calculating cost and benefit, still found that FMSP funded projects represented very good value for money and have low costs per beneficiary and per unit output. The results from R7335 would appear to confirm this finding. Furthermore, the uptake and the utilisation of the knowledge generated by institutions outside of those directly funded by the programme has led to a number of instances of positive impacts on the livelihoods of those dependent on the resources or on national income. The returns from the Control of Foreign Fishing cluster alone are already greater than the cost of the programme.

Projects within clusters have followed a fairly common pattern of developing concepts, methods and technologies in the first instance before a period, usually in subsequent projects, of testing and revision and incorporation of new aspects before a final uptake promotion phase, again usually within a further project. Development of the methods and technologies through the series of projects has meant that there is peer review of both plans and outputs at each stage of the research and development process. This pattern has been successful in developing a number of very useful technologies based on high quality scientific research and has packaged them in appropriate formats for use by intermediary organisations. However, as is apparent from the narrative for each cluster, the fact that the uptake promotion has, for the most part, only occurred at the end of the developmental process has meant that may of the products and research messages that are being promoted, while achieving some uptake, have yet to show impact far beyond the testing sites. However the process appears very promising and long-term impact after 2005 is to be expected from these uptake initiatives. The difficulty for a future impact assessment, as was highlighted in the introduction and which the case of FADs in the South Pacific (Cluster 11) illustrates, is that it becomes increasingly difficult to allocate the proportion of any achievement that is due to the FMSP research.

The more detailed assessment of the three projects also highlighted another issue that was raised. This is that it is very difficult to assess the impacts of enabling projects on the livelihoods of those dependent on the resources. This is far easier with more focussed and inclusive projects, as the results fro R7947 and R7335 show. However, despite the difficulties, the assessment has been able to show that each of

the three projects was able to provide some positive impact within the location that they were tested. It can be expected that if there is uptake outside the case study locations then additional impacts will be generated. Identifying where the information has been utilised will, of course, remain problematic.

If progress is measured against the logframe purpose then the assessments have clearly been able to show that the three projects funded under the FMSP have made a contribution to the improved access by poor people to fisheries knowledge generated by the Programme (R7947 and R7335), have contributed to less variable capture fisheries production, and yield stabilised at sustainable level to support sustainable livelihoods (R6437) and increased/improved fisheries productivity for enhanced fisheries leading to increased livelihood benefits (R7335). Given that this is just three of the projects commissioned under the FMSP and that there are now further efforts being made to repackage the existing tested knowledge and promote its uptake, it can be expected that there will be significant contributions made towards achieving the Programme purpose (see also Annex 4).

While the Programme is making considerable efforts in the last years of its existence to ensure that knowledge that has been generated is applied, much of this implementation and application will require support from agencies in the target countries and potential funding agencies to provide both funding and the additional capacity that is so often lacking in developing countries. This support will be a major constraint to the realisation of positive impacts from FMSP knowledge and, at the same time, if available, will make the attribution of impact more problematic.

The need for additional support raises the question of DFIDs own role in relation to the knowledge generated and the potential for maximising impact. Evidence from efforts made in R7335 and the follow-on R8292 have suggested that while there has been interest from other donors there has been very little interest from any of the DFID country offices contacted with regard to the research outputs. This not only limits the potential uptake of such centrally funded research but it also leads to the danger that DFID in-country funding of research may cover ground already covered by the FMSP projects.

It is very difficult to establish the extent to which DFID has adopted research messages from the FMSP. Where there has been an interest, for example in the issue of IUU and the contribution that the Cluster 8 can make towards this, DFID support has been able to raise the profile of the research, for example by hosting international workshops. However for many projects the linkage between research and development initiatives appears less than strong. Increased utilisation of the research messages by DFID would remove a constraint and could significantly increase the potential for impact of the FMSP commissioned research.

It is expected that a good deal of the impact of the knowledge generated under the FMSP will occur beyond the lifetime of the Programme. It will also be difficult to assess this impact fully for a number of reasons Not only is there a problem with identifying where the products of research have been utilised but also, within the FMSP, as illustrated in Figure 1, outside the case studies the process still only extends as far as promoting the project/cluster outputs so the impact in each case is likely to be limited. This is because, in each case, at this stage a) the technology developed has probably only had limited documented application. Many organisations, though they may be using the technologies, do not document the fact or make this known outside their own organisation; b) application has probably only occurred in recent years so any impact will be limited and will be difficult to establish

and c) application will have required additional support so any impact may be difficult to attribute (see narrative for Cluster 11).

This raises the question of what exactly should be expected from the research process. Should research be producing technologies and maximising the potential for uptake and application or should it be following the process all the way through to ensuring maximum impact from the technologies? Based on the available information and the assessments conducted here, the FMSP appears to have been successful in the former but less so in the latter. It is perhaps unrealistic to expect everything from research and it is the responsibility of the intermediary beneficiaries (possibly with external support) to make use of the technologies that are developed.

Lessons learned from the impact assessment.

The Programme has made a useful start to assessing the impact of projects and project clusters with efforts made to make impact reporting effective and useful. The Programme has also tried to ensure, through analysis of existing products and demand assessments that the potential for impact from spending on uptake promotion is maximised. The introduction of a requirement for communications plans as standard in projects and the development of a Programme communications plan should lead to raised awareness of the knowledge that has been generated and the benefits that can result from its application.

At the programme level the means of tracking and illustrating impact and potential impact appear to be useful but it would also, given DFIDs recent interest, be useful to provide an assessment of the project clusters using innovations systems indicators. Having said that much of the impact will occur after the programme has ended, it is important that both the projects and Programme provide some details of the promotional efforts so that that uptake may be traced to some extent in the future as part of any impact assessment.

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The impact assessment highlighted a number of important points that could be considered in the future commissioning, management and assessment of the impact of fisheries management research. In the first place it can be very difficult to plausibly attribute the management outcomes to the research outputs and use of these outputs. This occurs because of the nature of fisheries, which are distinct from other renewable natural resources in a number of important ways. In the first place the scale of management has to match the scale of the resource and fish stocks are often widely dispersed and/or migratory. Thus it is often not possible to subdivide the resource (as can be possible in forestry). This in turn means that management frequently cannot be decided and enforced at local or community levels. As a result there is a need for management capacity within agencies responsible for fisheries at a national and regional level. Thus research often has to be enabling and the impacts on the target beneficiaries are less direct and therefore more difficult to attribute.

Fish are essentially invisible and a fishery system (with the exception of culture-based fisheries) is dependent on natural productivity from a dynamic system. This means that the effects of management can be difficult (and expensive) to detect and to distinguish from natural cycles of change in the resource system. If this was not enough then one must also consider the objectives of management. In subsistence fisheries the users often value the production potential of the resource system (i.e. they like to be able to catch the fish that they need in the shortest time) rather than

valuing the opportunity to maximise yields. The effect of improved management in such cases can be a reduction in yield and production.

In addition to having to be able to apply a variety of measures to measure impact and the care required to ensure that the impacts can be plausibly attributed to the individual research output, there is also an important point to be made regarding the scaling up of research. It is important that those research projects and products that are identified as having promise are capitalised on. This requires that there should be mechanisms in place to take up and promote successful initiatives and also to ensure that the key research messages are incorporated into further research, policy and development initiatives.

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Annex 1: FMSP research product themes and project clusters.

Product theme	Project cluster
1. Information to inform management – research and influence policy.	1: Databases of information (Knowledge management)
	2: Livelihood appraisals (Synthesis)
	3: Impacts of climate change (Uptake promotion [UP])
2. Information requirements for including poor fishers in the assessment and management of their fisheries.	4: Information requirements for fisheries management (UP and synthesis)
3. Fisheries assessment methods to inform management.	5: Stock assessment guidelines (UP)
	6: Bayesian stock assessment and management with limited data (UP/ Synthesis)
4. Pro-poor capture fisheries management strategies.	7: Generic management guidelines (Synthesis)
	8: Control of foreign fisheries (UP)
	9: Floodplain fisheries management (UP)
5. Pro-poor enhancement fisheries management strategies.	10: Enhancement of inland fisheries (UP / Synthesis)
	11: Enhancement of marine fisheries (UP / extension)

Annex 2: Programme impact assessment form 2005.

IMPACT ASSESSMENT QUESTIONNAIRE

DFID RNR RESEARCH PROGRAMME
"WORKING TOWARDS IMPACT ASSESSMENT"
(Questionnaire for completion by Project Leaders)

(Note greyed out details e.g. (AR 4a) are for Programme Management use only)

R Number .....
Project Title .....

About your Project

1. Project Outputs

List the key *products* of your project (e.g. stock assessment software; management guidelines (for…); manuals; strategies (for…); descriptions of…; new research techniques and approaches; etc) (AR 4a)

List here:

List the key *Research messages* of your project (The research result, finding, insight)

List here:

2. Project Clusters

Impact is often achieved by a 'cluster' of projects approaching a problem from different angles or building on the results of previous research efforts. When grouped together and considered as a cluster, such projects achieve outputs whose impact can be described, measured or quantified. The other projects may be those funded from another source.

Do you think your project forms part of such a cluster?

If so, please list the other projects involved.

3. Project Collaborative arrangements and Linkages

3.a. Immediate Project Collaborating / target organisations (AR2a-c)

Indicate the lead organisation and formal collaborators (i.e. named in the project). List target organisations that you have established linkages with (note that a collaborating organization may also be a target). Indicate whether the organization works at an enabling, inclusive or focused level (see Appendix 1).	
Organisation	**Enabling/ focused/ inclusive**
Lead Organisation: *Add text here*:	*Add text*
Formal collaborators: *Add text*	*Add text*
Target Organisations: *Add text*	*Add text*

Based on your assessment of the above, to what extent do collaborating and or target partners represent an entry point to work with the poor. State:

How those relationships have assisted in promoting sustainable livelihoods and benefits to poor people.

Add brief text here

Or, must alternative target organisations be identified? If so how will the project address this?

Add brief text here:

3.b Links with other DFID RNRRS Research Programmes and other DFID Programmes

State and describe any linkages of your project with other DFID research PROGRAMMES e.g. aquaculture programme.

Add text here:

3.c. Links DFID Country projects/Programmes

Comment on any linkages between your project with other DFID country projects/ programmes.

Add text here:

3.d. Links with IARCs of the CGIAR and other international (non CG) institutes

Comment on any linkages between your project with other IARC/CGIAR projects/ programmes.

Add text here:

3.e. Links with other donor funded research and or development projects / programmes

Comment on any linkages between your project with other donor funded projects *Add text here:*

3.f. Links with private sector funded research and or development projects / programmes.

Comment on any linkages between your project with private sector funded projects. *Add text here:*

Project Beneficiaries

4. Likely Project Beneficiaries

Please list the likely beneficiaries of your project-add additional rows as needed. The DFID categorisation of beneficiaries is given below (A-L). Describe your beneficiaries and include in parentheses the category letter.

Beneficiaries	Location	Numbers affected now	Likely numbers affected in future, when and where

DFID categorisation of likely direct beneficiaries (A-L)[36].

Target beneficiaries – the poor
Poor fishers (J), and other directly dependent stakeholders (processors and traders (K), consumers (L))

National
DoF fisheries management and extension staff (H)
NGO fisheries management and extension staff (I)
National fisheries research agencies
- Strategic researchers in developed countries (B)
- Applied Researchers in NARS (E)

Training Institutions (F)
National Policy makers / planners (G)

International:
Donor community (A)
Research community
- Strategic researchers in IARCs (C)
- Applied researchers in IARCs (D)

International policy makers / planners (G)

[36] Note that we have retained the DFID categorisation A-L for consistency of reporting with other Programmes, but have re-ordered them in order to classify target beneficiaries as the target group of poor people, then relevant national or international agencies. Please structure your table accordingly.

Uptake Promotion

5. Progress along the Uptake Pathway

Please indicate how far on the Uptake Pathway you think your project is. Refer to the scale in Appendix 2 below. You may find that not all steps are required or that your work may be currently taken up at several different levels. Please describe your current situation (MoV) and what you expect, or hope will be achieved in the future (AR 4d).

Indicate where the project is ***currently,*** and how far your project is ***expected*** to reach on the scale A-H, and state the means of verification (see Appendix 2).	
Current position A-H (Expected position @ project end)	**Means of verification (for current status only) / describe expected situation**
Current: *Insert letter*	*Add text here*:
Expected: *Insert letter*	*Add text here*:

6. Evidence of Changing of Attitudes, Uptake of Messages

*For many projects, particularly dissemination projects, impact is in the form of uptake of messages or of involvement in a dissemination initiative. If your project, or parts of it, fall into this category, please briefly list what the main messages and dissemination & uptake promotion approaches are, and quantify them**. (Add additional rows within each stakeholder category as necessary for additional products / messages) (AR 4b)*

Within the following broad categories of stakeholder (where relevant), outline how project findings (research messages) and products ***have been promoted***, and, how the project ***plans to promote*** its messages / products within the remaining life and budget of the project, i.e.

- **Describe** the format in which promotion has/will occurred (e.g. participatory workshops, manuals/ guidelines disseminated; field guides; policy brief; training programmes (e.g. for extension officers); seminars and workshops; radio/TV broadcasts; software distribution; websites, scientific publications; collaborative links with other projects etc) – add brief explanatory text as appropriate.
- **Quantify*** where possible (i.e. number of briefs or manuals disseminated; numbers attending workshops or training courses; reprints requested; number of hits on a project website, numbers of fishers in target community, numbers of fishers potentially affected in wider community, etc)

Beneficiaries	**Research Message or product promoted**	**Mechanism for communicating project findings (Research messages) / products**	
		Describe	**Quantify (For each promotion mechanism described left, quantify and indicate where evidence may be found detail studies or evaluations undertaken)**
Poor fishers, and other directly dependent stakeholders (consumers, processors and traders)		Existing promotion: *Describe here:*	*Quantify promotion to who / detail internal / external studies (Provide citations):*
		Future Plans within the remaining life and budget of the project: *Describe here?*	*Indicate how their uptake could be measured*
DoF/NGO fisheries management and extension staff / training institutions		Existing promotion: *Describe here:*	*Quantify promotion to who / detail internal / external studies (Provide citations):*
		Future Plans within the remaining life and budget of the project: *Describe here?*	*Indicate how their uptake could be measured*

Beneficiaries	Research Message or product promoted	Mechanism for communicating project findings (Research messages) / products	
		Describe	**Quantify (For each promotion mechanism described left, quantify and indicate where evidence may be found detail studies or evaluations undertaken)**
National fisheries research agencies		Existing promotion: *Describe here:*	*Quantify promotion to who / detail internal / external studies (Provide citations):*
		Future Plans within the remaining life and budget of the project: *Describe here?*	*Indicate how their uptake could be measured*
National Policy makers / planners		Existing promotion: *Describe here:*	*Quantify promotion to who / detail internal / external studies (Provide citations):*
		Future Plans within the remaining life and budget of the project: *Describe here?*	*Indicate how their uptake could be measured*
International policy makers, research community, and donor community		Existing promotion: *Describe here:*	*Quantify promotion to who / detail internal / external studies (Provide citations):*
		Future Plans within the remaining life and budget of the project: *Describe here?*	*Indicate how their uptake could be measured*

***** Separately **please provide** lists of the organisations / Individuals attending any workshops, training courses etc. Provide summary lists of the recipients of any materials distributed.

Adoption

7. Adoption

7a. Examples of Uptake / Adoption

Q6 describes the mechanisms for achieving uptake promotion during a project. Here we require a few paragraphs of text to highlight good examples of uptake and adoption – either outside the project, or continued adoption by project target organisations.

Where relevant, highlight where project findings and products have been taken up (adopted) and by whom, and indicate the potential for continued adoption beyond the life of the project (for completed projects – indicate if this has occurred). Where possible indicate the impact in quantitative terms (numbers of people, monetary values etc).

Add text here:
- Identify the problem and its relationship to poverty
- Identify how the product of your research can address that problem
- Indicate who (institution / community etc) has adopted the research product or applied the research message and how it has been applied
- Identify actual and potential impacts (Quantify)
- Finally highlight the potential for continued uptake (within and beyond the target audience)

7b Evidence of Adoption

*What evidence do you have of the **adoption** of the products / research messages of your project (Note this differs from 6 where you listed and quantified the dissemination of research products in different media. Here we require evidence that they have been adopted (e.g software now in use in x fishing institutions, management guidelines used by y institutions, training materials developed in the project now taken up in z training institutions etc). Add additional rows as required*.

Beneficiaries adopting the message or product.		**Research Message or product promoted**	**Mechanism for communicating project findings (Research messages) / products**	
Category	List your beneficiaries		**Describe format in which product or message is presented** (e.g. manuals/ guidelines; field guides; policy brief; training programmes (e.g. for extension officers); software; websites, scientific publications; collaborative links with other projects etc), videos, reports	**Quantify the adoption of the product, indicate its use and indicate where supporting evidence may be found.**
Poor fishers, and other directly dependent stakeholders (consumers, processors and traders)			Existing adoption: *Describe here:*	*Quantify adoption to whom:*
DoF/NGO fisheries management and extension staff / training institutions			Existing adoption: *Describe here:*	*Quantify adoption to whom:*
National fisheries research agencies			Existing adoption: *Describe here:*	*Quantify adoption to whom:*

Beneficiaries adopting the message or product.		**Research Message or product promoted**	**Mechanism for communicating project findings (Research messages) / products**	
Category	List your beneficiaries		**Describe format in which product or message is presented** (e.g. manuals/ guidelines; field guides; policy brief; training programmes (e.g. for extension officers); software; websites, scientific publications; collaborative links with other projects etc), videos, reports	**Quantify the adoption of the product, indicate its use and indicate where supporting evidence may be found.**
National Policy makers / planners			Existing adoption: *Describe here:*	*Quantify adoption to whom:*
International policy makers, research community, and donor community			Existing adoption: *Describe here:*	*Quantify adoption to whom:*

Impact

8. Measuring Potential Economic Impact

Has (or will) work you do have a quantifiable economic impact on end-users?

Please describe what you think this might be and, as far as possible, the orders of magnitude involved?

Add text here:

Have any studies or evaluations been undertaken which have estimated what any of these economic impacts might be?

If so, please list them here:

9. Impact on Poverty

What evidence do you have that your project is successfully targeting poor people?

Would it be possible to differentiate between impacts on poorer as against wealthier households?

Have any studies or evaluations been undertaken which have examined the impact of this or similar work on poor people? If so, please list them.

10. Impact on Livelihoods

Can impact be situated in a livelihoods context? Please describe that context.

Are any of these impacts particularly relevant to women?

11. Suggestions for Impact Analysis

Have you any particular suggestions for ways in which your project's impact could be assessed?

More general suggestions which would help FMSP in assessing the impact of its research programme?

Appendix 1. The poverty focus of research

(From DFID Fisheries Management Science Programme (FMSP) Programme Strategy and Funding Application Procedures July 2002)

DFID recognises three categories of action that can promote the overall aim of the elimination of poverty in poorer countries. These are *enabling*, *focused* and *inclusive* actions, and are known as Poverty Aim Markers (PAMs). DFID does not assume a hierarchy of actions, the three are seen as having equal validity.

Inclusive actions are broad-based, and aim to improve opportunities and services generally, and also address issues of equity and barriers to participation of poor people. Inclusive actions are not specifically targeted at the poor, but benefit population groups as a whole, including the poor. Most previous natural resources research has tended to fall into this category.

Research aimed at increasing production through the introduction of new technologies is an example of an inclusive action. Whilst such research has the potential to make a significant impact on poor people, new technologies do not always lead to poverty reduction. This is because the poor often lack the capacity to invest in new technologies, or are less able to access the institutions through which technologies are promoted.

Enabling actions are those that address the wider policy and institutional environment, and include measures in support of the policies and context for poverty reduction. Enabling actions are defined as those that underpin pro-poor economic growth and support policies that lead to increased social, livelihoods and other opportunities for people in poor countries. This includes actions that promote integration into the global community, safeguard the environment, and promote sound economic management, governance and social policies.

Research projects are likely to have the greatest poverty reduction impact in situations where the policy environment is pro-poor, or where the prospects for changing policies in a pro-poor direction are favourable.

Focused actions directly address the rights, interests and needs of poor people. They are defined as those that bring benefits predominantly to poor people, and specifically improve their social, environmental, and/or economic conditions, and remove barriers to their participation. Since the publication of the 1997 White Paper, DFID research programmes have generally included more focused actions in their project portfolios.

However, as noted, there is no implication that one type of action is better than another in terms of achieving progress towards poverty elimination. There are risks, trade-offs, and potential for low (or even negative) impact on the poor in all three. For example, while a focused action has a higher chance of providing benefits directly to the poor, the overall numbers of poor that can be assisted in this way may be low, relative to an inclusive action. Inclusive actions, on the other hand, run the risk that the benefits provided will be captured by the better off at the expense of the poor. The key is to ensure that the choice of action is based on a good understanding of the dynamics of poverty and livelihoods in each circumstance.

Appendix 2. Means of Verification for the steps in achieving developmental impact.

Step	Description	Means of Verification
A	Formal/informal agreement with collaborating and target institutions	Memoranda of Understanding with collaborating and target institutions. Correspondence with institutions.
B	Generation of relevant research results (output delivered)	Published papers, technical reports, databases, reviews. Annual, quarterly & final reports (Completed FMSP projects)
C	Development of appropriate research based products through adaptation/packaging	Software, manuals, guidelines, databases.
D	Promotion of products into target institutions	Workshops, correspondence, dissemination lists (for software, manuals etc).
E	Adoption of products by target institutions	Correspondence (indicating intention to use product and requests for research products). Annual reports and policy papers of target institutions. Institutional arrangements made.
F	Application and replication of results in target institution programmes	Papers, technical reports etc produced by target institutions using products. Legislation adopted. Catch and production statistics improved. Fishery department extension programmes modified.
G	Promotion of technology or behavioural change among end users by target institutions	Legislation adopted. Co-management strategies established. Products applied.
H	Adoption of technology by end users and generation of economic benefits ie, developmental impact (purpose delivered)	Licence revenues. National catch / production statistics and statistical bulletins. National economic indicators.

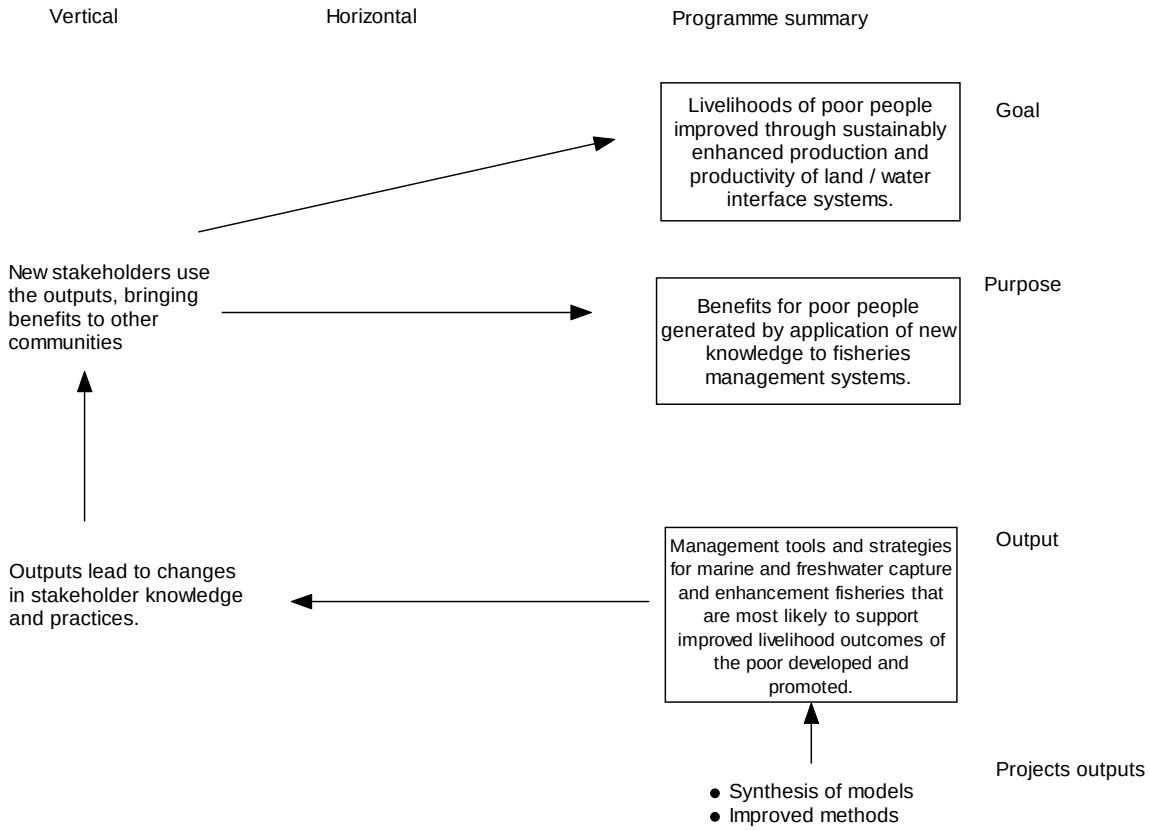
Annex 3: Impact timelines and uptake pathways for project clusters (from FMSP annual report 2005).

For the purpose of describing dissemination, stakeholders have been divided into the following groups:

- Poor fishers and directly dependent stakeholders.
- DoF/NGO fisheries management/ extension staff & training institutions.
- National fisheries research agencies.
- International policy makers, research community & donor community.

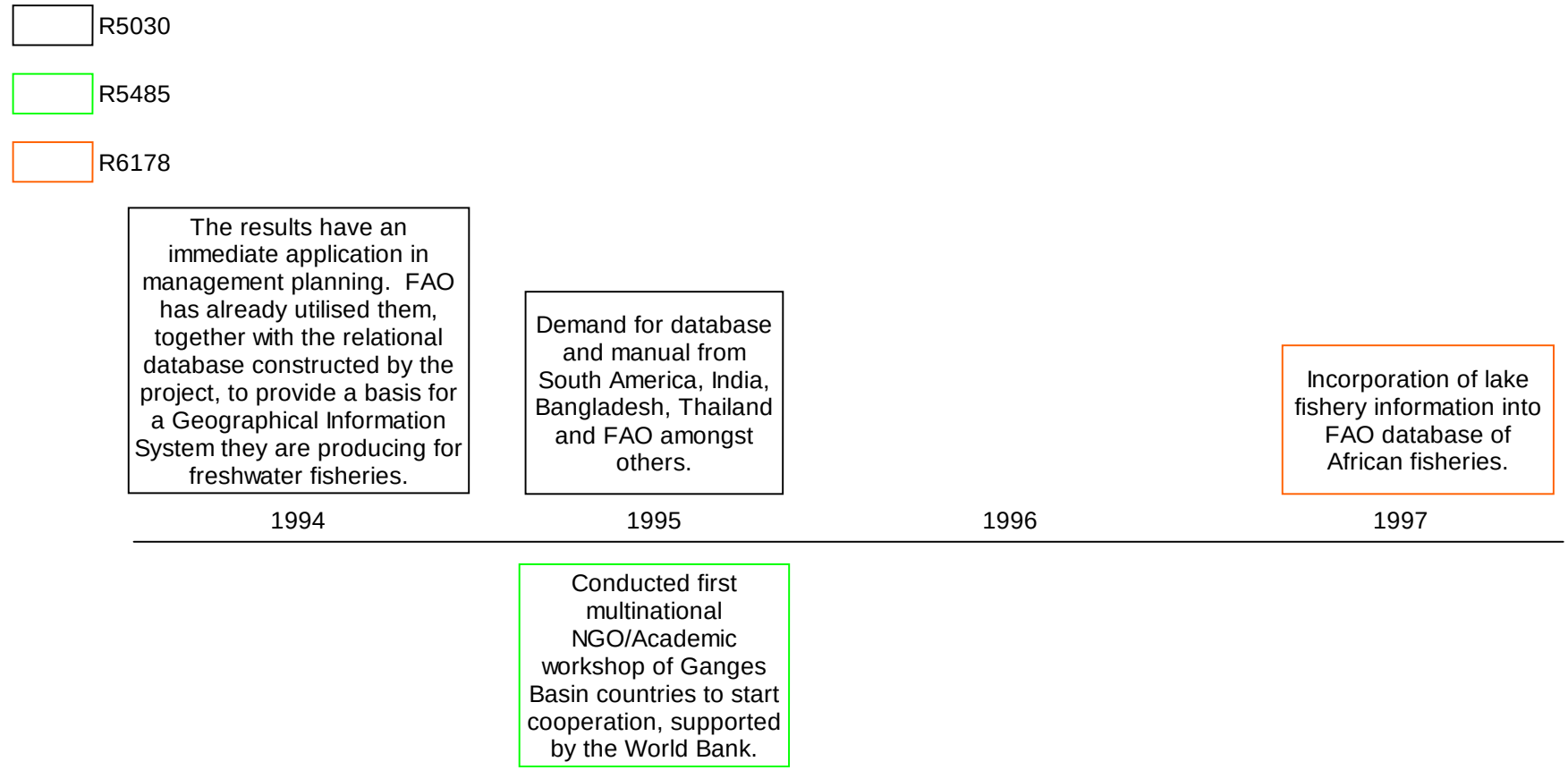
It can be seen in the impact pathways that for many of the clusters (in particular those relating to marine fisheries) there are few methods of disseminating to poor fishers and dependent stakeholders. This reflects the enabling nature of many of the projects the targeting of products at implementing agencies rather than any particular failure to communicate with this group.

The timelines provided for each cluster of projects illustrate some of the main developmental impacts that the cluster has achieved. A number of projects cross-cut project clusters and the impacts are recorded in more than one timeline.

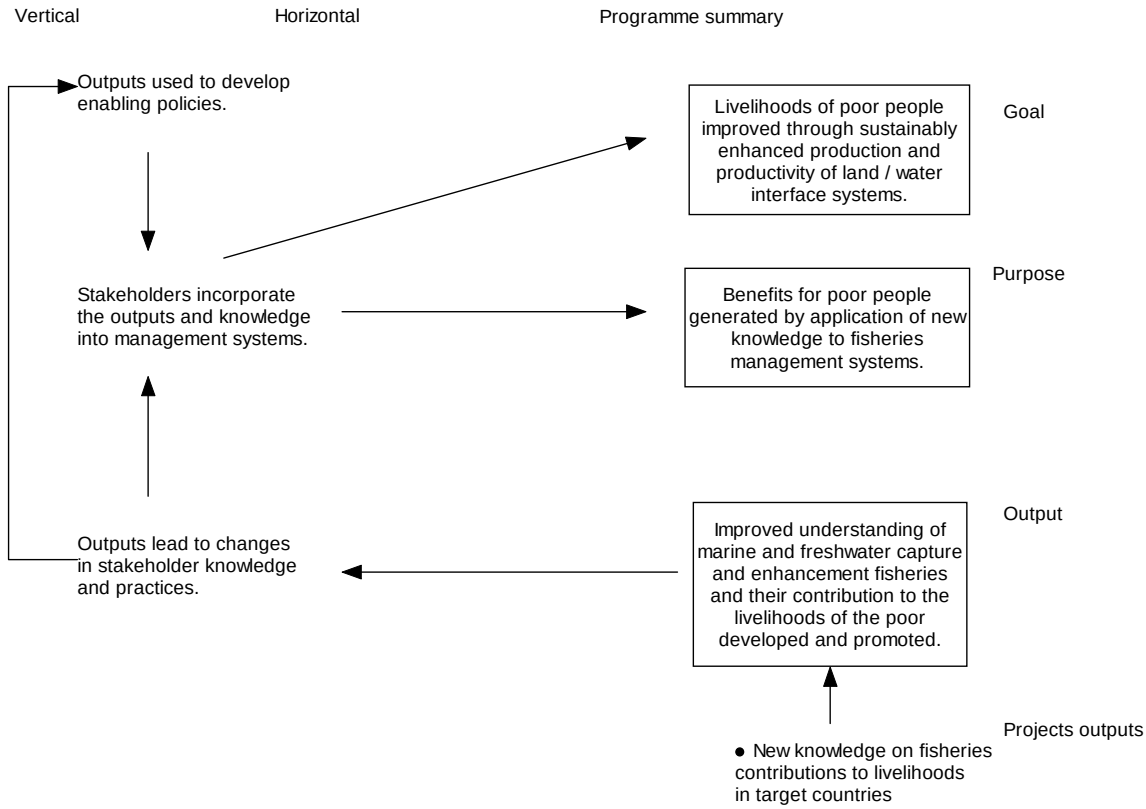


Impact pathways for Cluster 1.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	
DoF/NGO fisheries management/ extension staff & training institutions	Workshops, databases and database manuals, reports
National fisheries research agencies	Workshops, databases and database manuals, reports
International policy makers, research community & donor community	Workshops, databases and database manuals, peer reviewed papers, reports, book chapter.

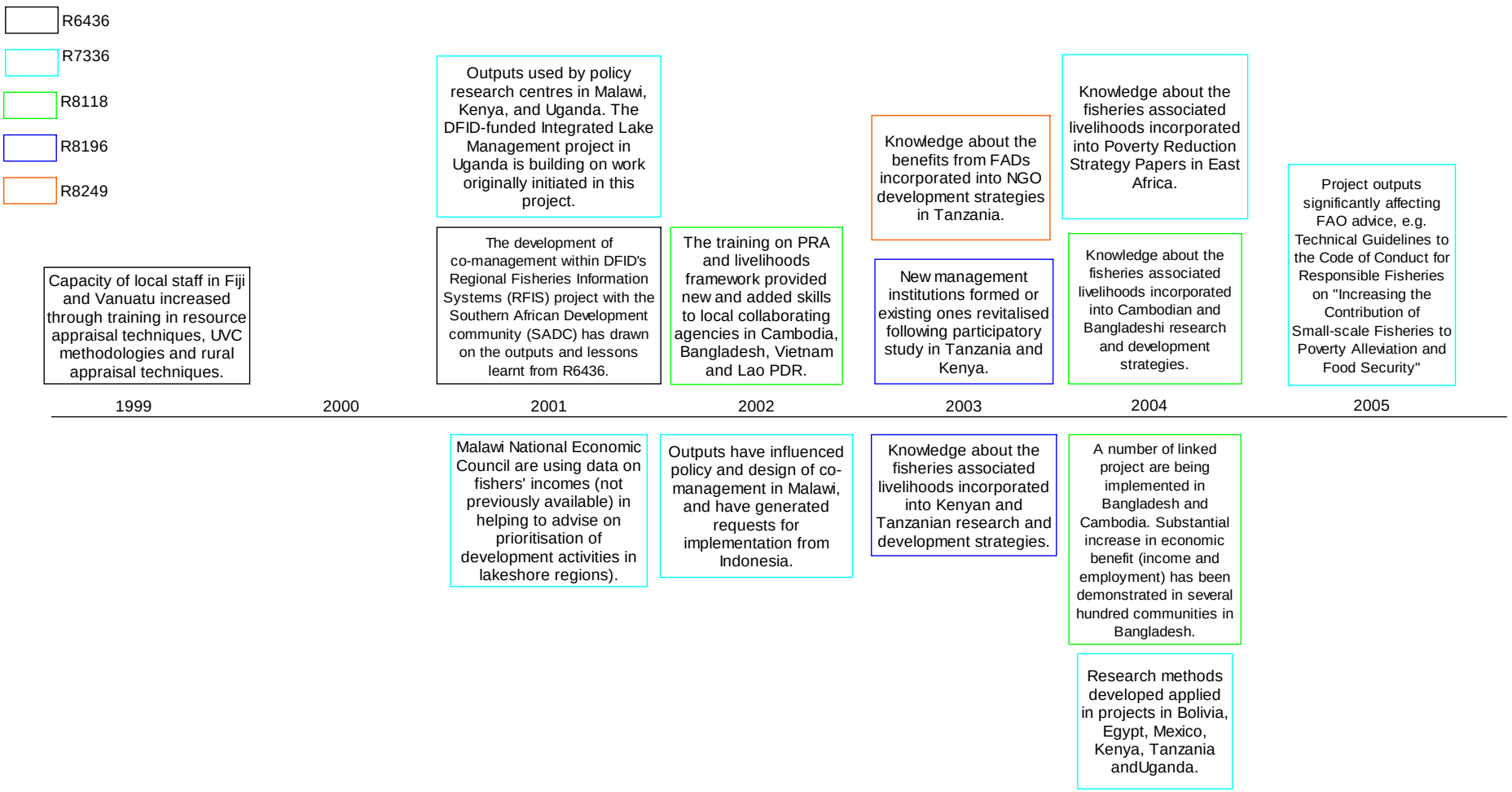


Impact timeline for Cluster 1.

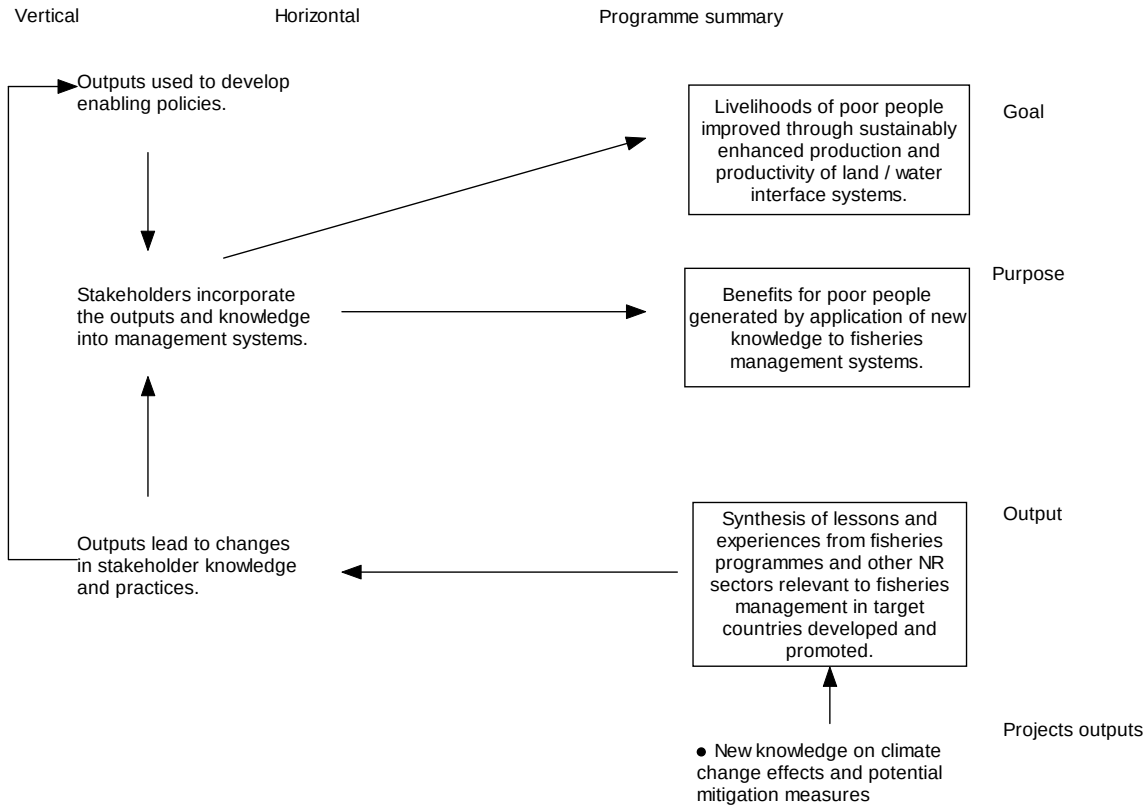


Impact pathways for Cluster 2.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Participatory workshops, meetings with key informants
DoF/NGO fisheries management/ extension staff & training institutions	National and regional workshops, meetings with key stakeholders, reports (English, Khmer and Bangla), management guidelines, FAO Fisheries Technical Paper.
National fisheries research agencies	National and regional workshops, peer reviewed papers, meetings with key stakeholders, reports (English, Khmer and Bangla), management guidelines, Policy Briefs, FAO Fisheries Technical Paper, National Poverty Reduction Strategy Papers.
International policy makers, research community & donor community	National and regional workshops, peer reviewed papers, meetings with key stakeholders, reports (English, Khmer and Bangla), management guidelines, Policy Briefs, FAO Fisheries Technical Paper.

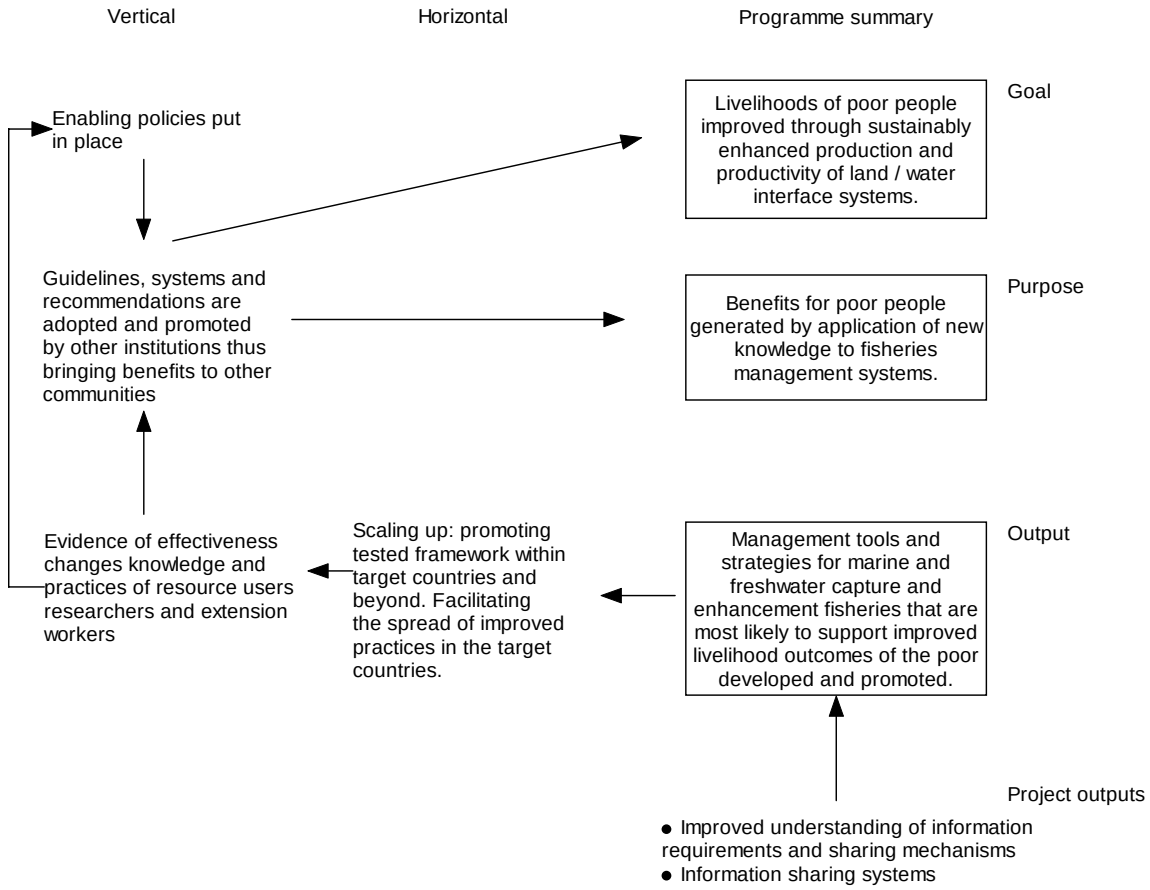


Impact timeline for Cluster 2.



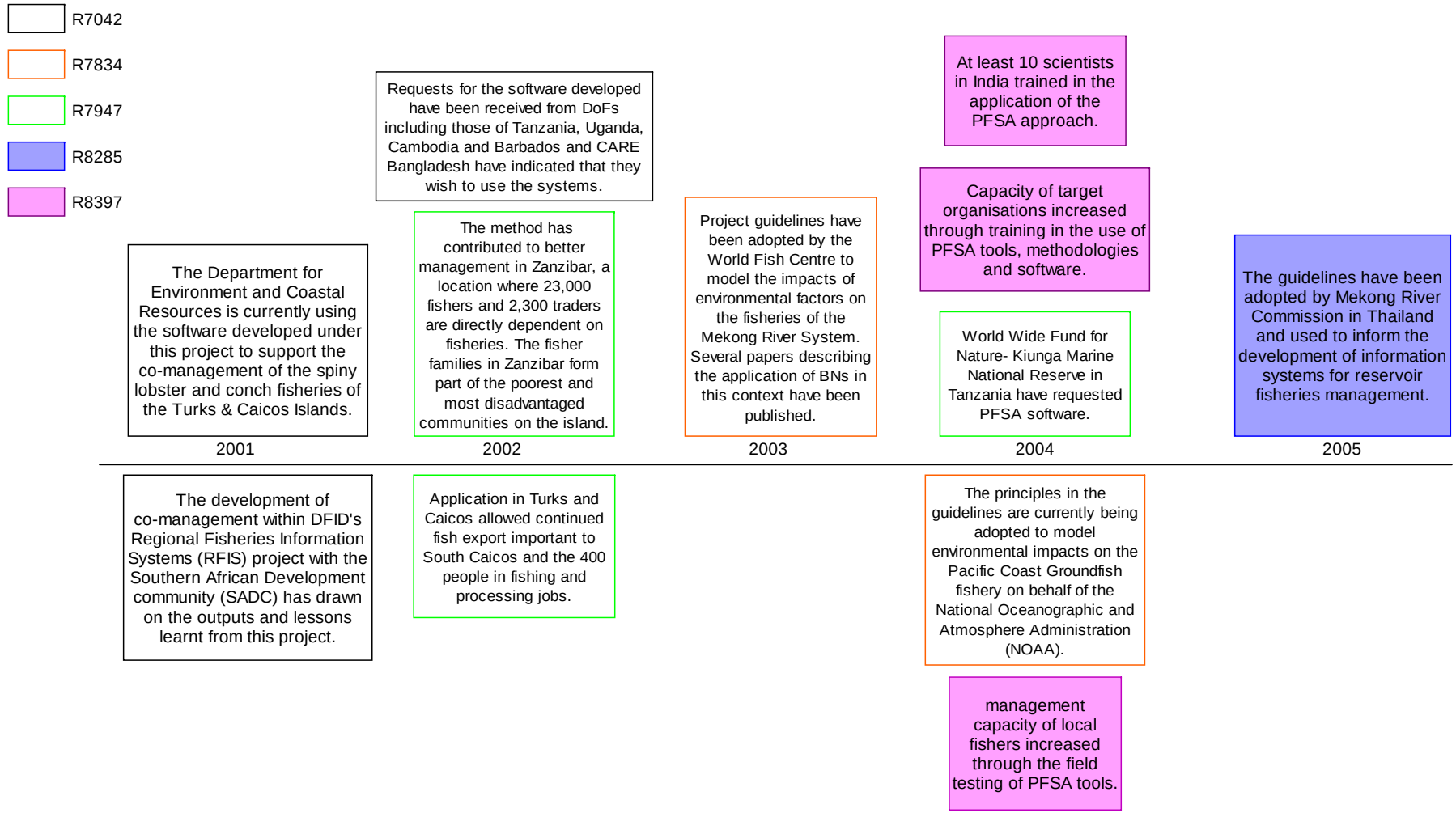
Impact pathways for Cluster 3.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	
DoF/NGO fisheries management/ extension staff & training institutions	
National fisheries research agencies	Peer reviewed papers, meetings with key stakeholders, reports, Policy Briefs, news articles and presentations
International policy makers, research community & donor community	National and regional conferences, peer reviewed papers, meetings with key stakeholders, reports, website, Policy Briefs presentations and news articles.

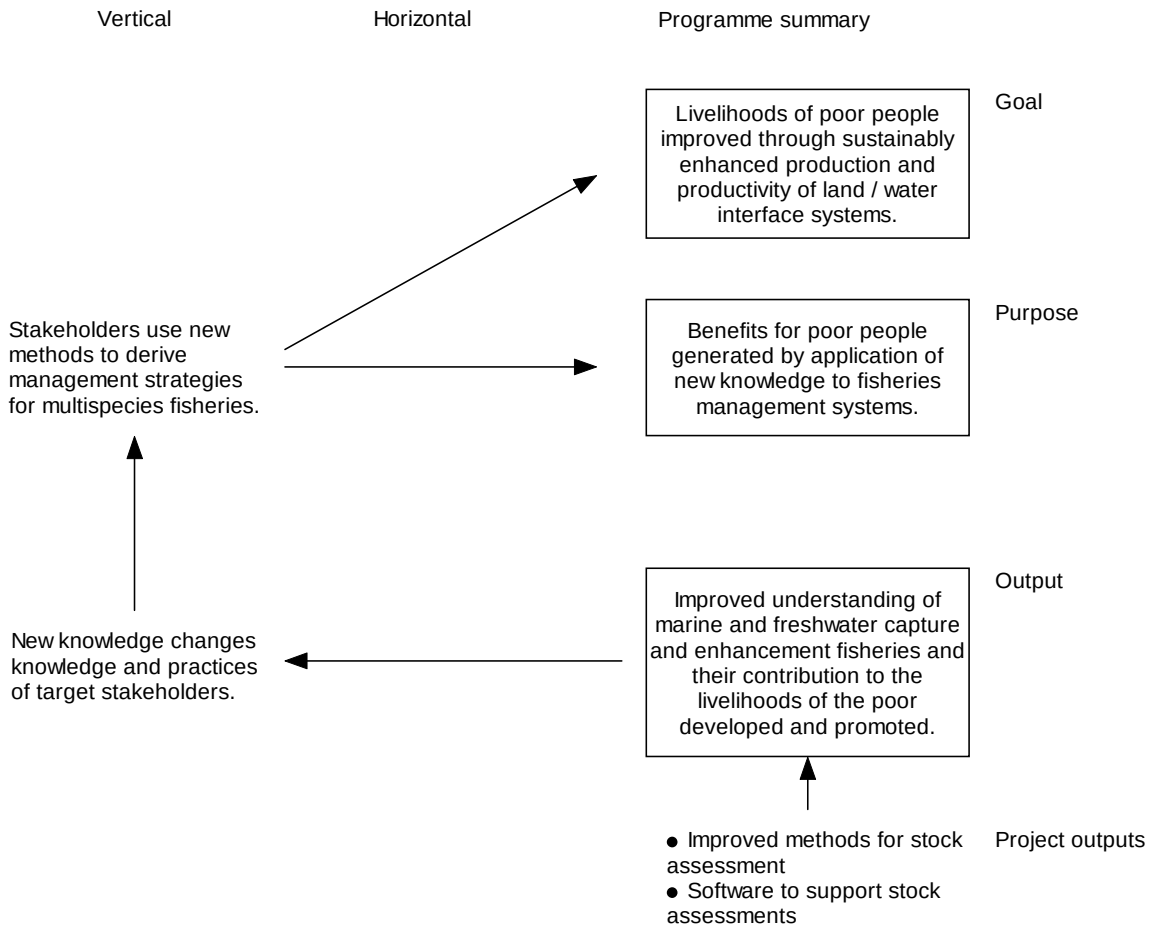


Impact pathways for Cluster 4

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Participatory workshops, presentations, newspaper articles.
DoF/NGO fisheries management/ extension staff & training institutions	National workshops, guidelines, training workshops, articles, websites, software, field guide in local languages (Lao, Khmer, Thai Bangla and Vietnamese).
National fisheries research agencies	National workshops, guidelines, websites, articles, presentations, software, reports, flyers promoting guidelines.
International policy makers, research community & donor community	National workshops, guidelines, websites, articles, presentations, software, reports.

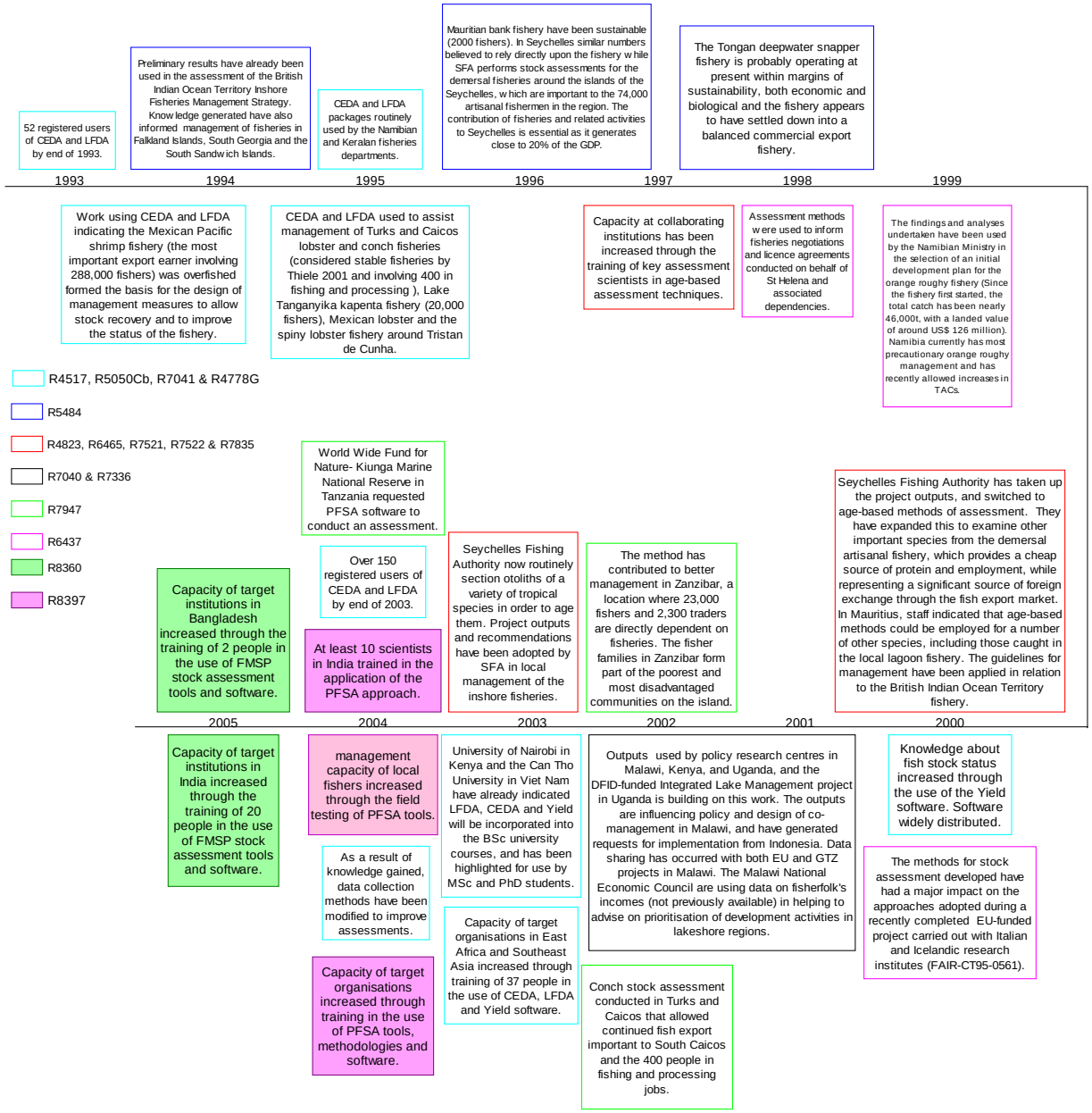


Impact timeline for Cluster 4.

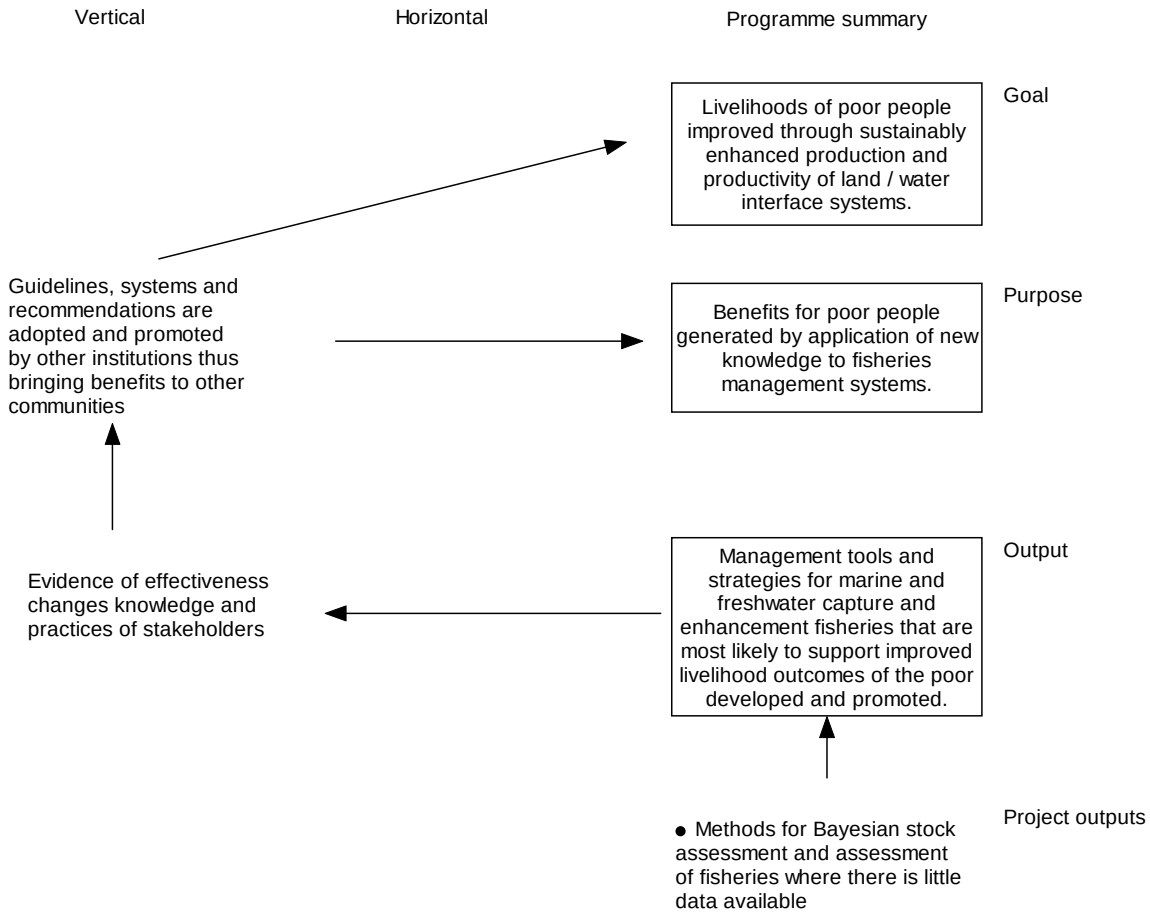


Impact pathways for Cluster 5.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Presentations, workshops, participatory research.
DoF/NGO fisheries management/ extension staff & training institutions	National workshops, participatory research, workshops, management guidelines, meetings with key stakeholders, software, training courses, website, articles, FAO Fisheries Technical Paper, reports.
National fisheries research agencies	National and regional workshops, management guidelines, meetings with key stakeholders, software, training courses, website, articles, reports, FAO Fisheries Technical Paper.
International policy makers, research community & donor community	National and regional workshops, conference presentations, articles, peer-reviewed papers, software, reports, FAO Fisheries Technical Paper.

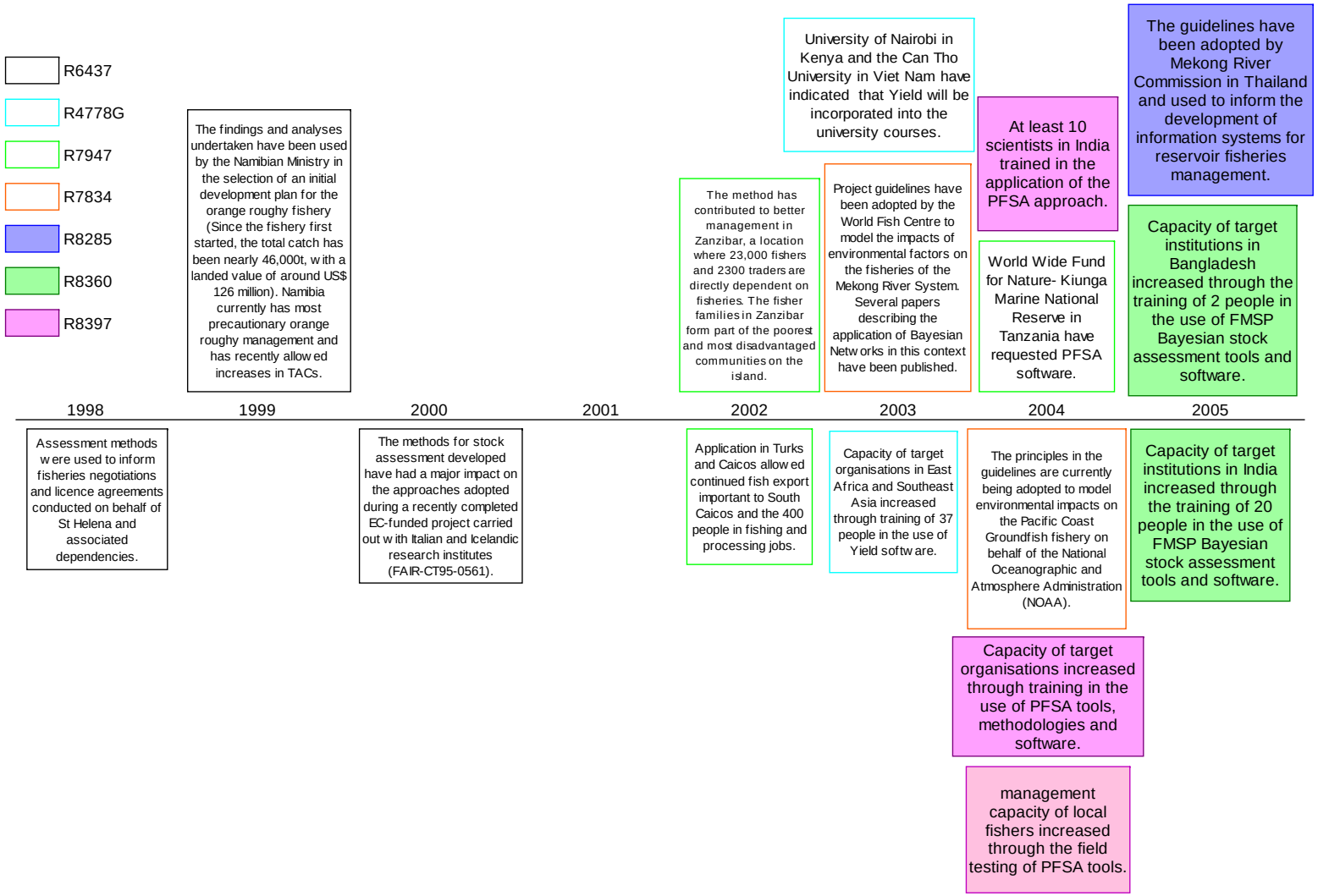


Impact timeline for Cluster 5.

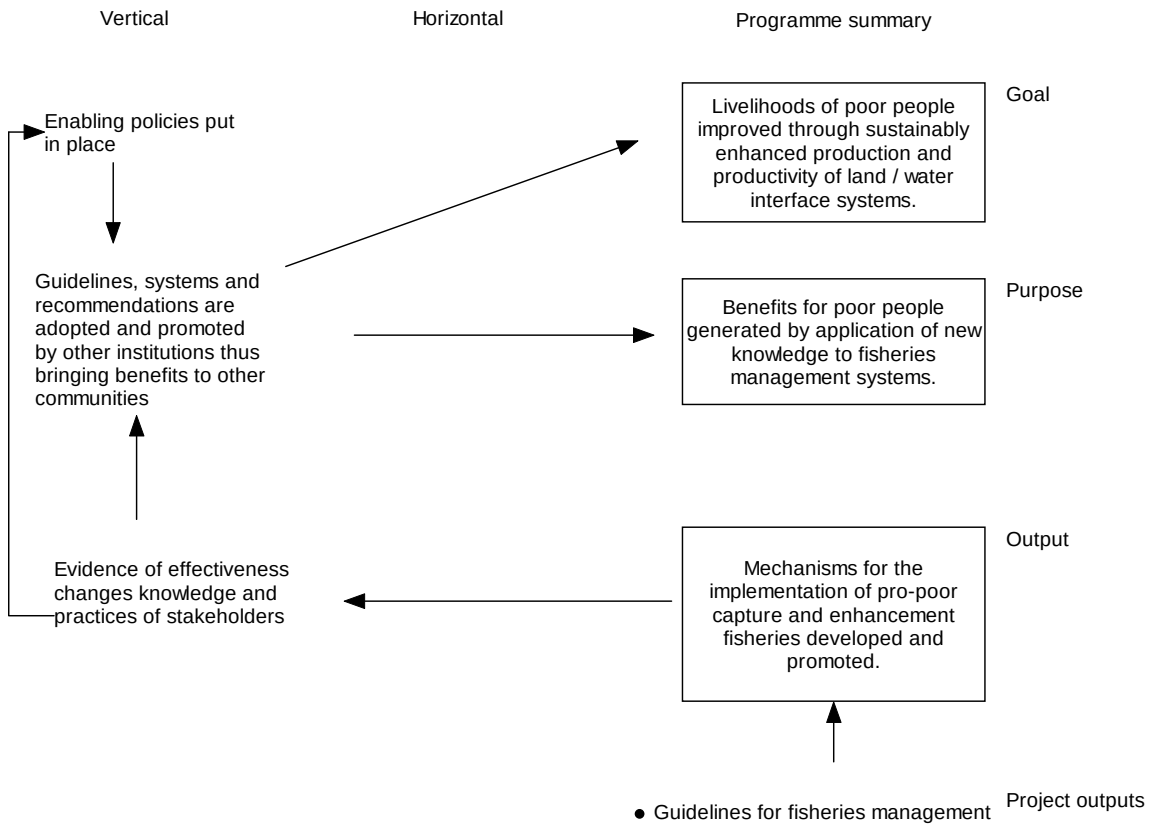


Impact pathways for Cluster 6.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Presentations, workshops, participatory research
DoF/NGO fisheries management/ extension staff & training institutions	National workshops, participatory research, workshops, management guidelines, meetings with key stakeholders, software, training courses, website, reports, FAO Fisheries Technical Papers.
National fisheries research agencies	National and regional workshops, management guidelines, meetings with key stakeholders, software, training courses, website, reports, FAO Fisheries Technical Papers.
International policy makers, research community & donor community	National and regional workshops, conference presentations, peer-reviewed papers, software, reports, FAO Fisheries Technical Papers.

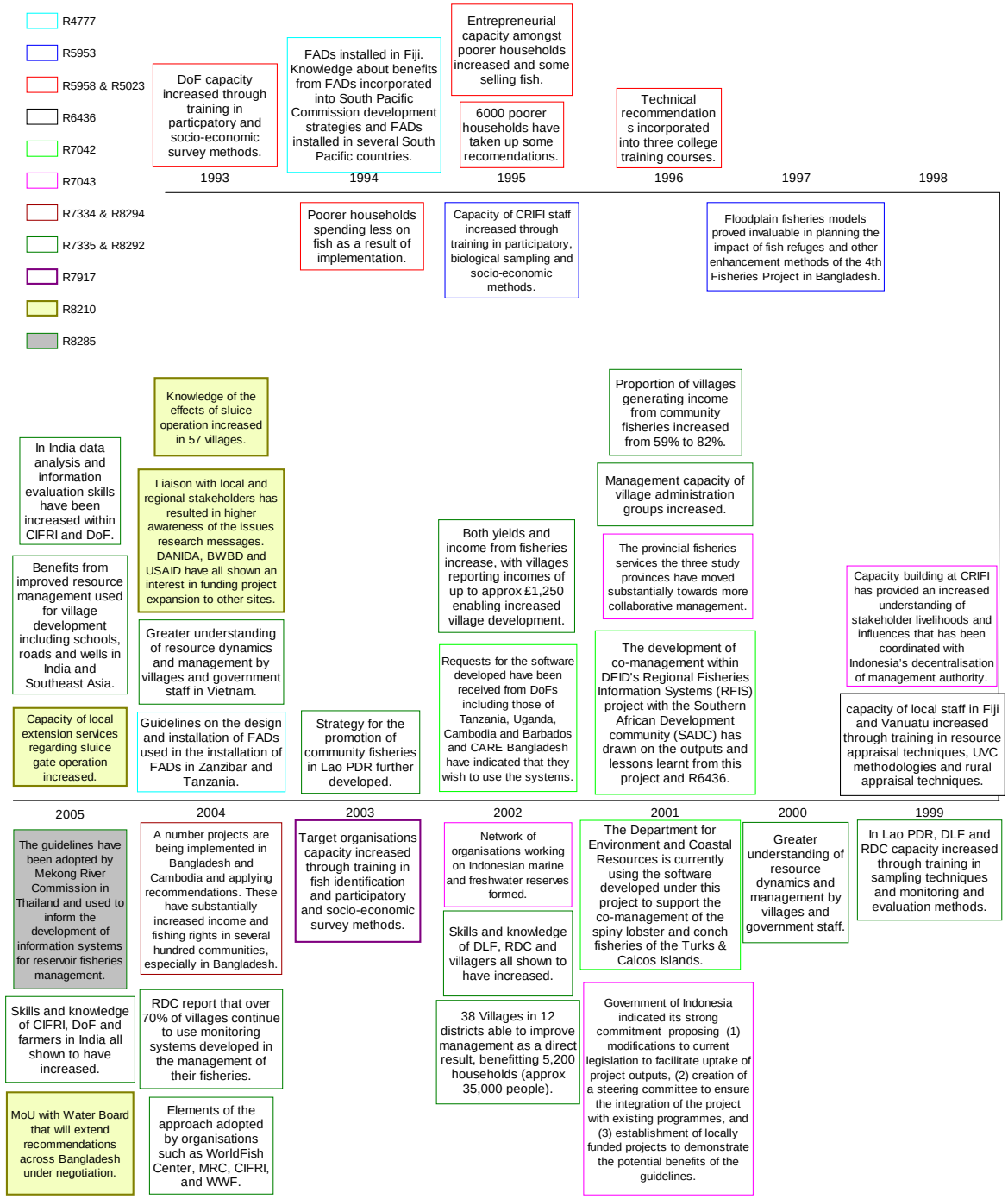


Impact timeline for Cluster 6.

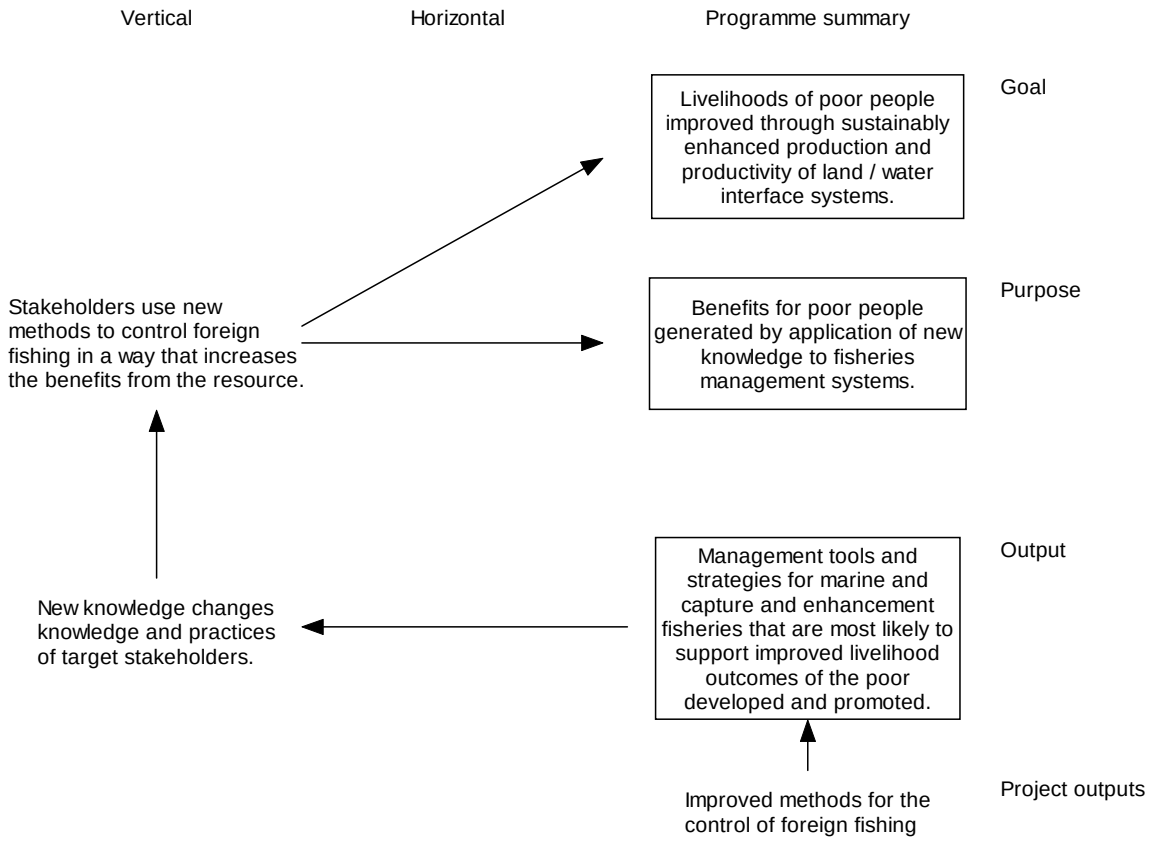


Impact pathways for Cluster 7.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Participatory workshops, presentations, management action plans training workshops, radio, t-shirts, local fairs, study tours, newspaper articles.
DoF/NGO fisheries management/ extension staff & training institutions	Presentations, training workshops, database, management action plans. Guidelines (English and Lao), meetings, national and regional workshops, t-shirts, radio, meetings, articles, FAO Fisheries Technical Papers.
National fisheries research agencies	National and regional workshops, peer-reviewed papers (English and Indonesian), reports (English and local languages), management guidelines (English and Lao), database, conference presentations, FAO Fisheries Technical Papers.
International policy makers, research community & donor community	National and regional workshops, peer-reviewed papers, conference presentations, reports, management guidelines, software, FAO Fisheries Technical Papers.



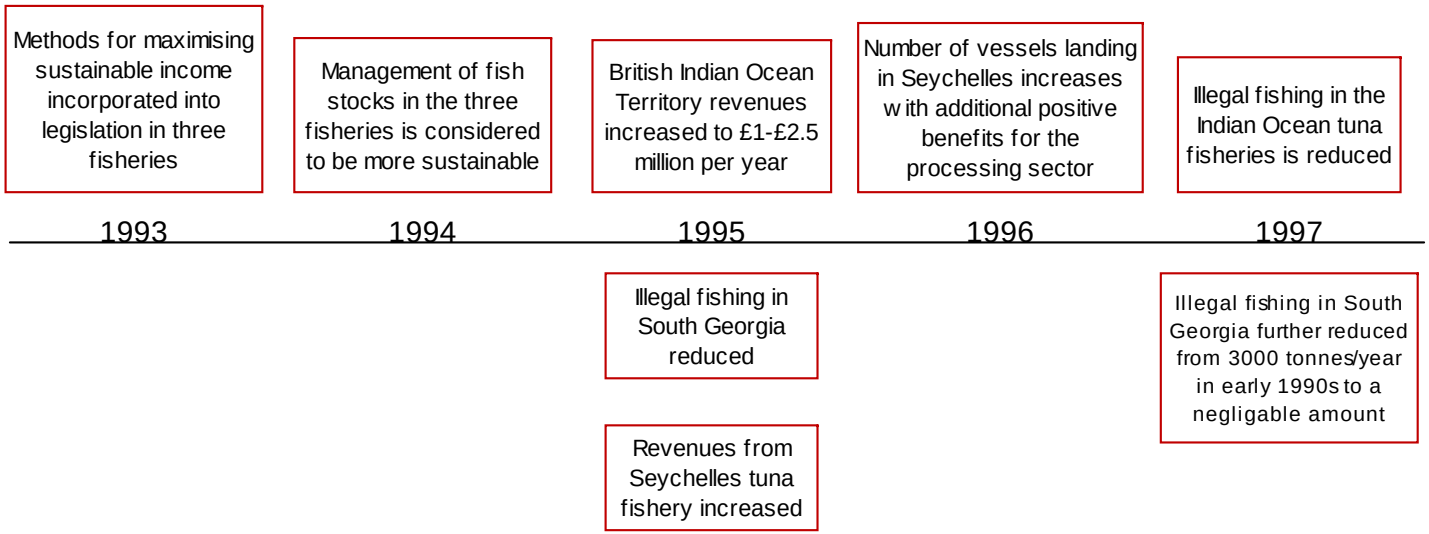
Impact timeline for Cluster 7.



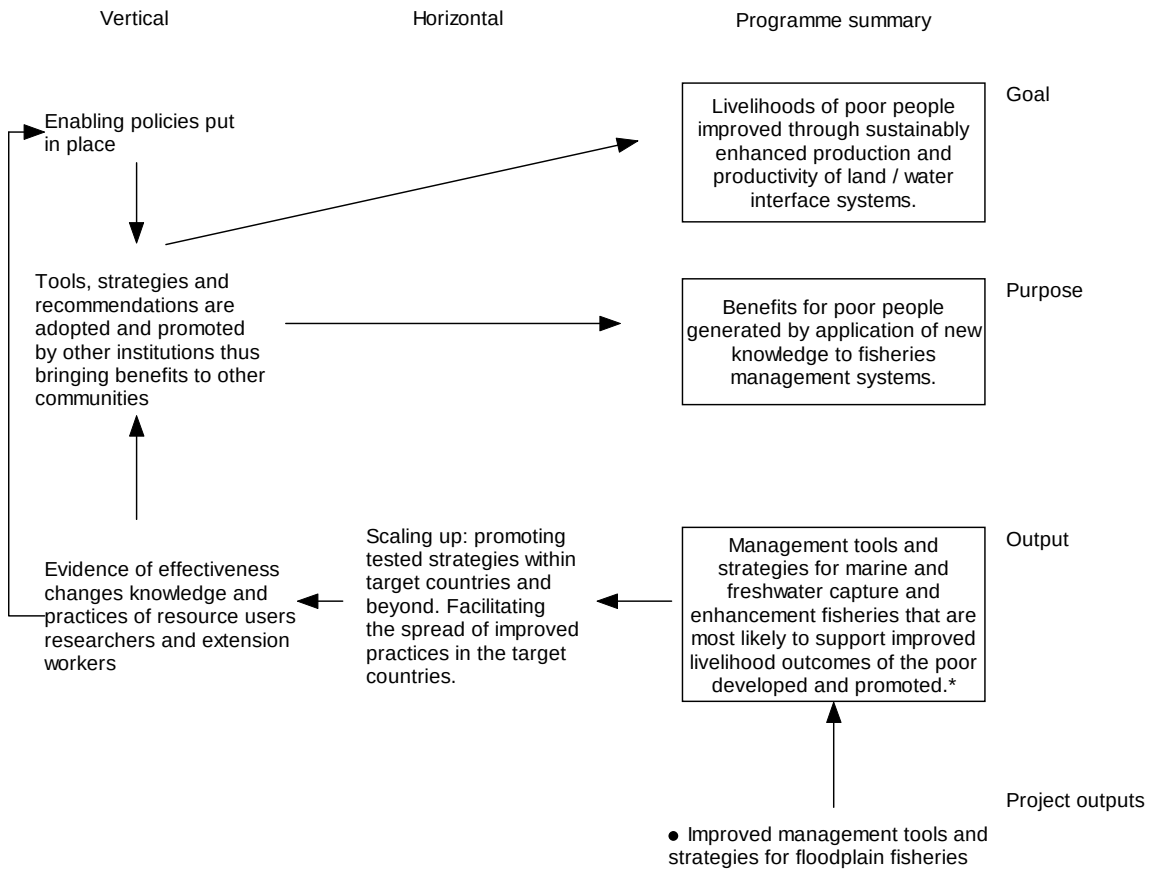
Impact pathways for Cluster 8.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	
DoF/NGO fisheries management/ extension staff & training institutions	Management strategies, reports, articles
National fisheries research agencies	Management strategies, reports, articles
International policy makers, research community & donor community	Management strategies, reports, articles

R4775 & R5049CB

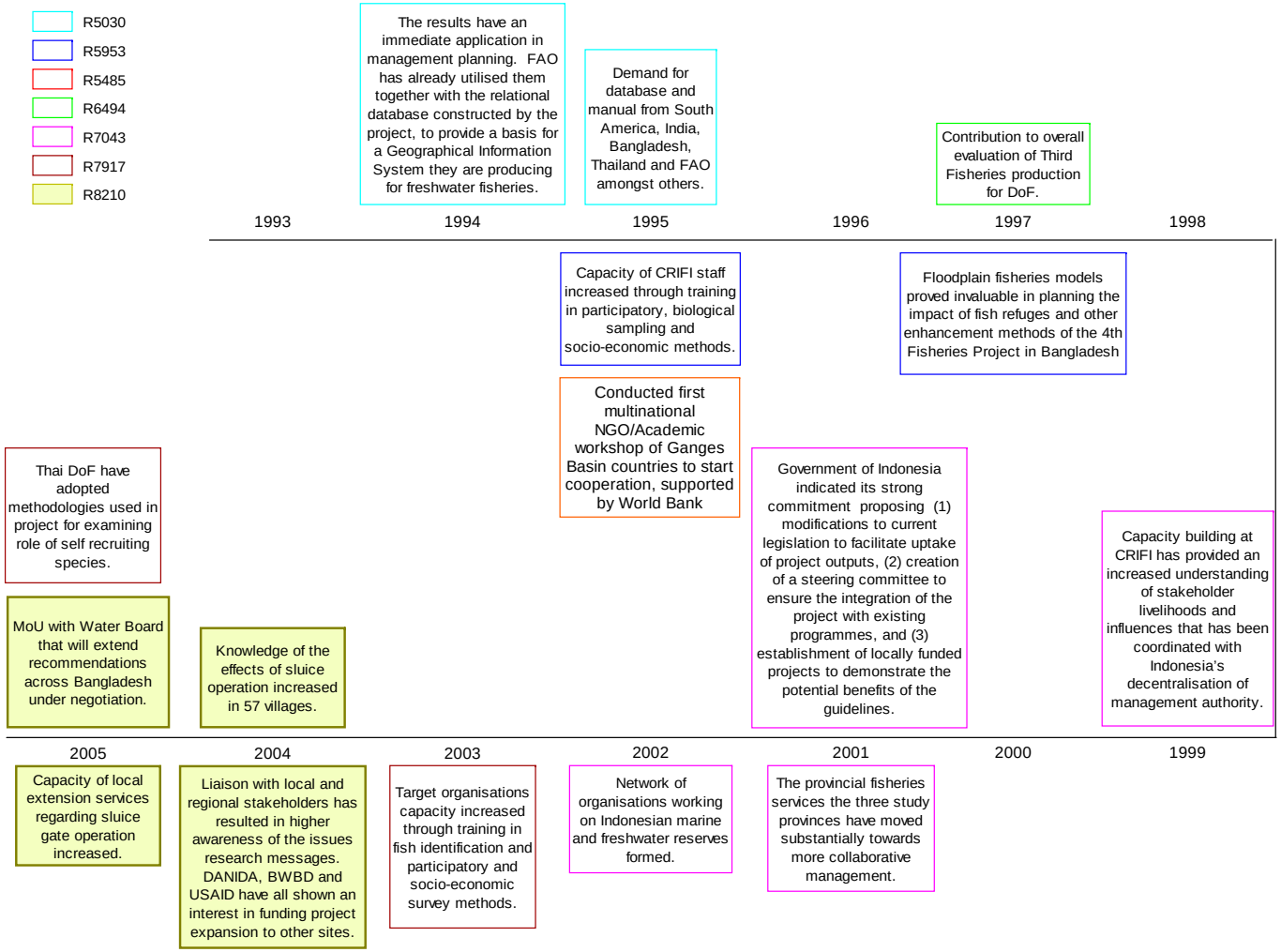


Impact timeline for Cluster 8.

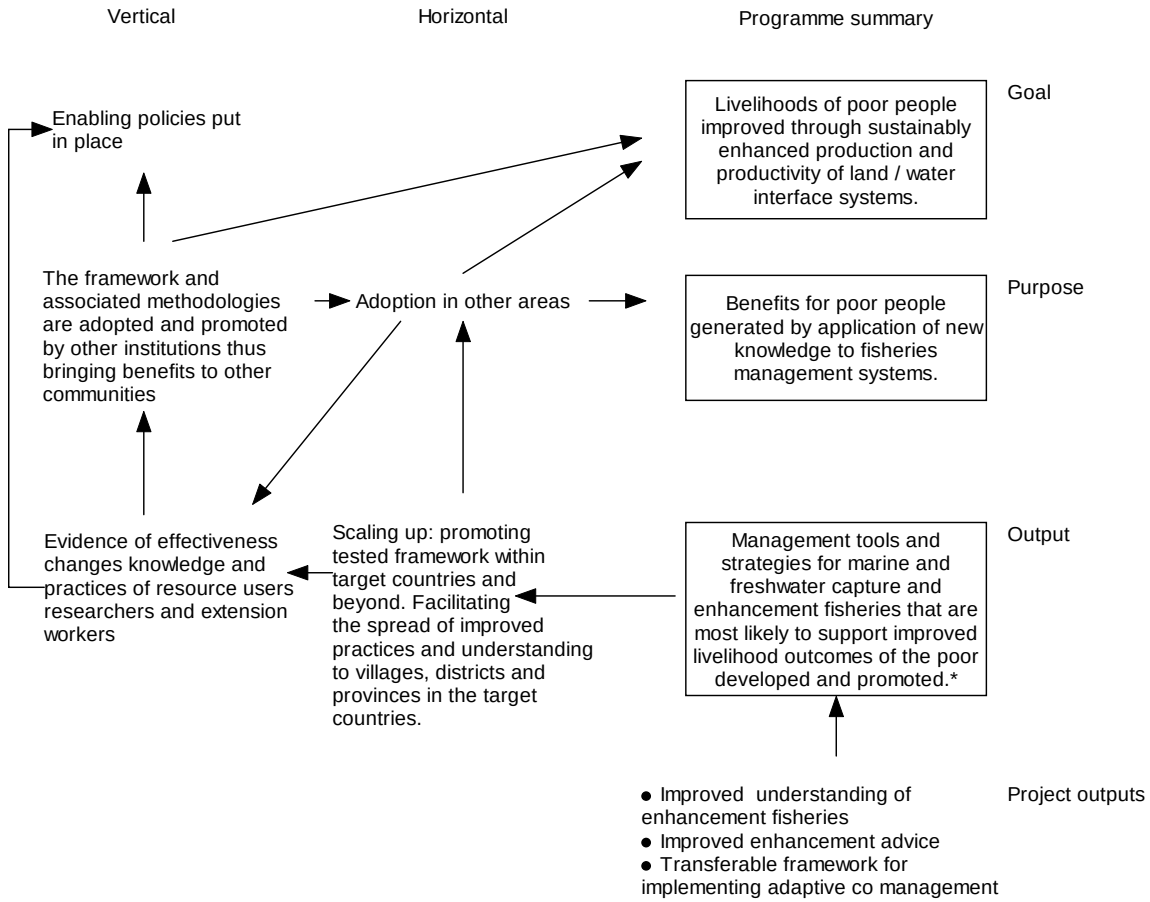


Impact pathways for Cluster 9.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Participatory workshops
DoF/NGO fisheries management/ extension staff & training institutions	Workshops, reports, guidelines (English and Indonesian), training workshops, presentations, FAO Fisheries Technical Report
National fisheries research agencies	Workshops, guidelines (English and Indonesian) reports, peer-reviewed papers, websites, FAO Fisheries Technical Report
International policy makers, research community & donor community	Workshops, reports, conference presentations, peer-reviewed papers, websites, FAO Fisheries Technical Report

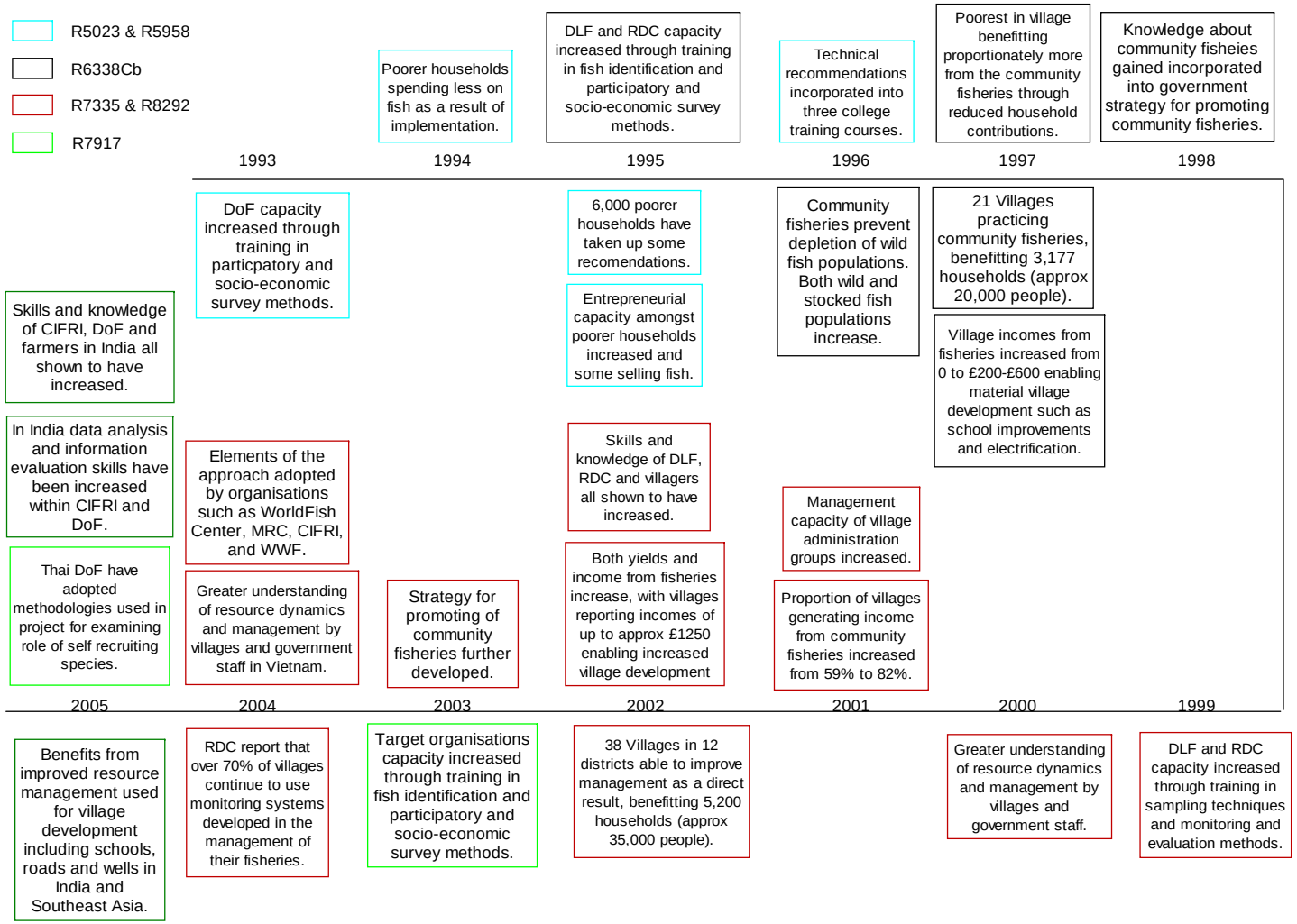


Impact timeline for Cluster 9.

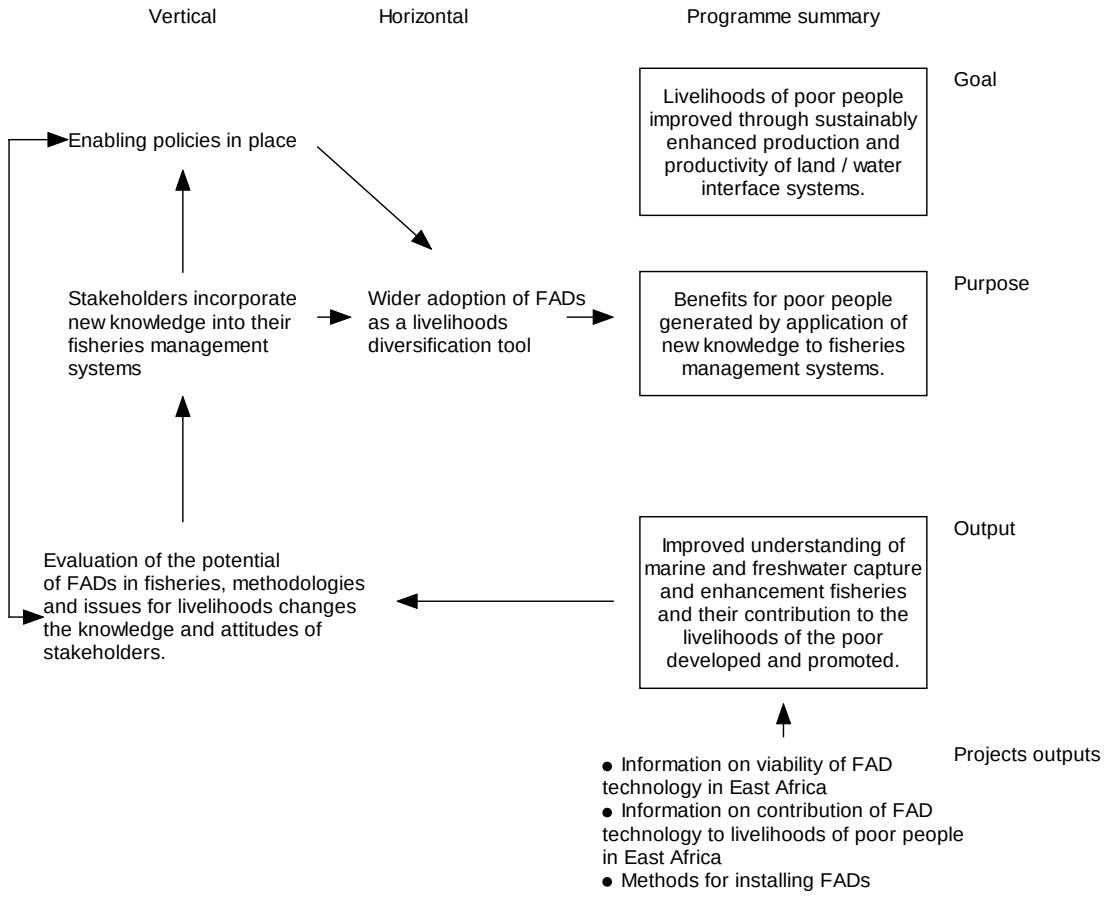


Impact pathways for Cluster 10.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Participatory workshops, training workshops, newspaper articles, radio, t-shirts, local fairs, participatory action plans, study tours.
DoF/NGO fisheries management/ extension staff & training institutions	Guidelines (English, Khmer, Hindi, Vietnamese and Lao), meetings, national and regional workshops, training workshops, website, project briefs, t-shirts, radio, meetings, articles, FAO Fisheries Technical Papers.
National fisheries research agencies	Guidelines (English, Khmer, Hindi, Vietnamese and Lao), Conference presentations, peer-reviewed papers, meetings, national and regional workshops, website, project briefs, meetings, articles, FAO Fisheries Technical Papers.
International policy makers, research community & donor community	Guidelines, Conference presentations, peer-reviewed papers, meetings, national and regional workshops, website, project briefs, meetings, articles, FAO Fisheries Technical Papers.

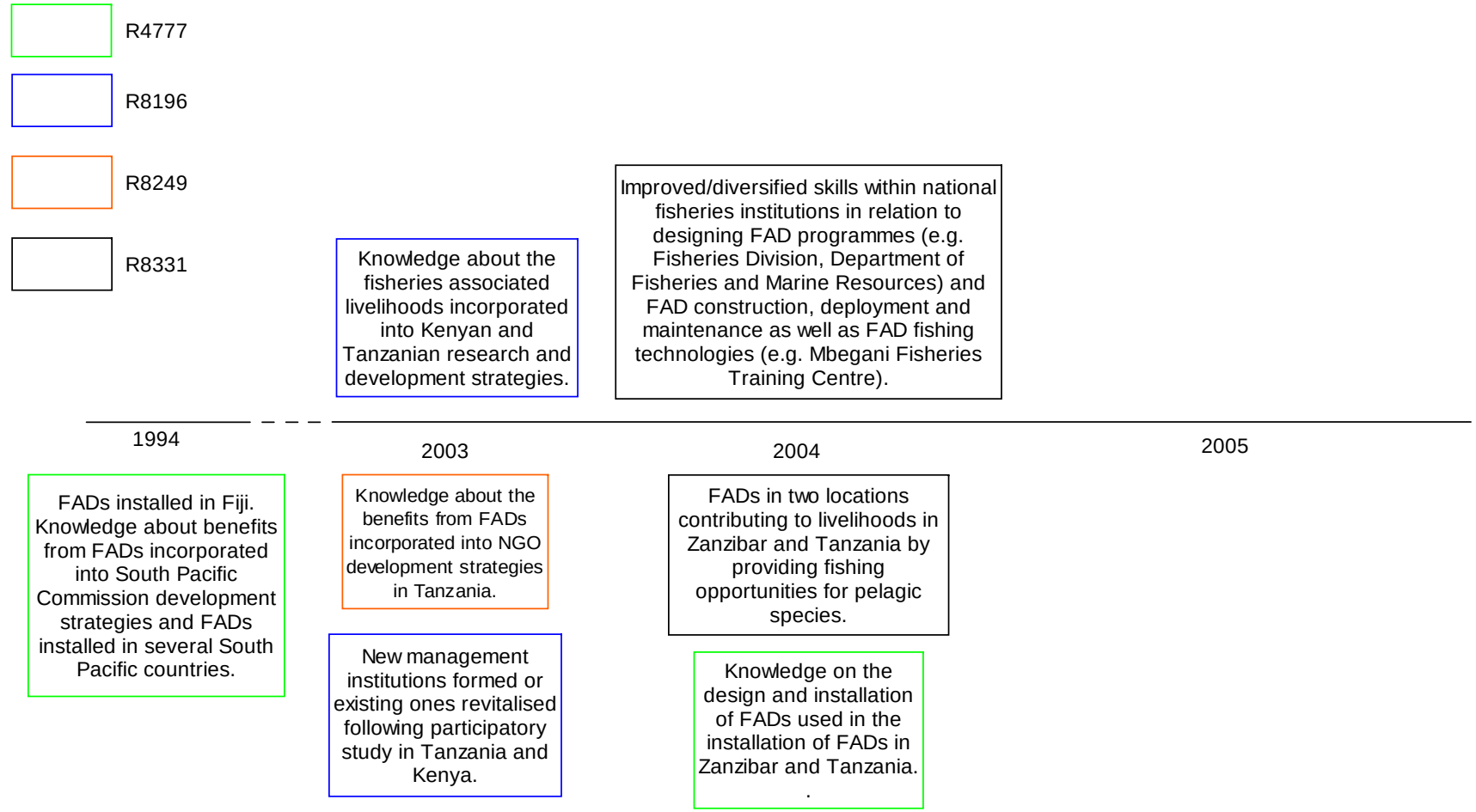


Impact timeline for Cluster 10.



Impact pathways for Cluster 11.

Target	Means of communicating messages
Poor fishers and directly dependent stakeholders	Workshops and meetings.
DoF/NGO fisheries management/ extension staff & training institutions	Policy Brief, FAD guidelines, Livelihood appraisal reports, workshops, meetings, newsletter articles and review documents
National fisheries research agencies	Policy Brief, FAD guidelines, Livelihood appraisal reports, workshops, meetings, newsletter articles and review documents
International policy makers, research community & donor community	Policy Brief, Livelihood appraisal reports, meetings, newsletter articles and review documents



Impact timeline for Cluster 11.

Annex 4: Summary of progress towards achieving Programme level Purpose objectively verifiable indicators (OVIs) since the inception of the RNRRS. From Programme annual report 2005.

Purpose: Benefits for poor people generated by application of new knowledge to fisheries management systems.		
OVI: By 2005, evidence of application of FMSP research products to benefit target communities[1] in target countries[2] by achieving:		
Capture Fisheries: For at least one EFZ, coastal or inland capture fishery, one or more of the following:		
OVI	**Projects addressing OVI**	**Highlighted examples**
Less variable capture fisheries production, and yield stabilised at sustainable level to support sustainable livelihoods	The strategy for achieving the Programme Purpose, which reflects DFID's policy context and demand from target country institutions in south and south-east Asia and east Africa, has been: - Improved understanding of the contribution of fisheries to the livelihoods of the poor; (Projects in Clusters 2 and 3) - Through high quality research, the development of capture and enhancement fisheries management tools and strategies that could benefit the poor, and the means to realise improved management (Projects in clusters 1,4, 5, 6,7,8, and 9 are relevant to this OVI for capture fisheries); and, - Promoting the take-up of research products generated by the Programme (this has been the focus since 2002 for all Product themes and clusters).	Most capture fishery projects were aimed at addressing this Purpose OVI. Note however, there are inherent difficulties in demonstrating less variable production or stabilised yields. Impact timelines (Annex 6) illustrate the contribution of projects within each cluster towards delivering developmental impact. Additionally, during 2004/05 the impact of selected FMSP projects was evaluated. Examples that relate to this Purpose OVI follow: Results from FMSP projects have been used in assessing a number of important fisheries worldwide, for example the inshore fisheries of BIOT and Seychelles, and the Mexican Pacific shrimp fishery, important to approximately 288,000 fishers. While it is difficult to show direct impact, it is likely that improved management of these fisheries resulting from the use of FMSP tools will support sustainable livelihoods. Despite the difficulties, a number of fisheries where project products have been utilised have been assessed as sustainable (e.g. Mauritian bank fisheries and Tongan deepwater snapper). Assessments of conch fisheries in Turks and Caicos (Project R7947) allowed continued fish exports on which 400 people in fishing and processing jobs depended. Project guidelines from R7834 have been adopted by WorldFish Centre for use in modelling the impacts of environmental factors on the capture fisheries of the Mekong River system. This knowledge will assist in the development of management strategies that can ensure sustainability and resilience in these fisheries that are of such importance to the rural poor across a large geographical area.
Improved fisheries employment (numbers,	Cluster 2: R8118; R8196; R8249	This OVI was not the focus of FMSP research. However, one outcome of the delivery of improved fisheries management and the stabilisation of fisheries will be more stable employment, though

income, quality)		not necessarily more fishers (many fisheries are currently overexploited and additional employment would have a deleterious effect). It should also be borne in mind that if fisheries collapse then there can be widespread negative effects on employment (numbers, income and quality). These effects may be direct (on fishers) as well as indirect as employment will also be found in the processing and distribution chain. Certain indicators may be assessed such as the price of fish over time and require a separate study to evaluate them. However, monitoring improvements in employment indicators requires that improvements in production and yield have been demonstrated also, and as indicated, these are subject to inherent difficulties. Research projects (e.g. R8196 and R8249) have been able to identify opportunities such as the deployment of FADs that could have a benefit on fisher incomes and ensure more resilient fisheries related livelihoods.
Improved access by poor people to fisheries knowledge generated by the Programme	Cluster 2: R8118; R8196 Cluster 3: R4778J Cluster 4: R7042; R8285 Cluster 6: R7834; R7947; R8497 Cluster 7: R6436; R7043; R7334; R8294	A number of projects have developed tools and/or knowledge that are relevant to the livelihoods of the poor. A number of methods including presentations, participatory workshops and meetings have been used to present tools, discuss research findings and to develop management strategies and data collection mechanisms. An example is project R7947 that developed and tested a management decision-making methodology that was based on Bayesian techniques and participatory processes. The methodology allows the identification of information required, involves fishers in the assessment process and enables managers to rapidly apply assessment procedures to artisanal fisheries where there is little data. Because of the participatory nature of the process, this can lead to the generation of information that resides with the fishers, improving their knowledge of the resource system and enabling them to participate more meaningfully in the management process. This methodology is currently the focus of dissemination efforts.
Enhanced fisheries: For at least two enhanced fisheries, one or more of the following:		
OVI	**Projects addressing OVI**	**Highlighted examples**
Fisheries productivity increased / improvement for <u>enhanced</u> fisheries leading to increased livelihood benefits	Cluster 2: R8118 Cluster 3: R4778J Cluster 9: R6494; R8210 Cluster 10: R5023; R7917 R5958; R6338CB; R7335; R8292; R8469 Cluster 11: R4777;	Over the duration of project R7335, benefits from fisheries in terms of fish and village income increased enabling the village administration to pursue development aims such as the introduction of electricity to the village. Village income also meant a reduction of household contributions – of particular benefit to poorer households. Quantitative analysis of the benefits from information provided to villagers revealed that if the villages involved in the project utilised the results, leading to changes in their stocking policy,

	R8249; R8331	yields with a value equivalent to the local project costs could potentially be produced within five years. Yields and income were not the only benefits, involvement in the project also provided a number of other valuable benefits such as increases in capacity and capability within the village administrations and increased village solidarity. Learning about enhancement fisheries as a community has also led to individuals having the confidence to build and stock their own private ponds. The focus on collective learning that resulted in a high level of comprehension among Provincial government staff and extension staff has meant that even after the project finished, and faced with lack of resources, staff have continued to utilise the skills and knowledge obtained during the project. Having also seen the value of the learning approach they have also sought to continue to share experiences between stakeholder groups.
Improved fisheries employment (numbers, income, quality)	Cluster 2: R8118 Cluster 9: R8210 Cluster 10: R6338CB R7335; R7917; R8292 Cluster 11: R8249; R8331	It is a little easier to show improved employment benefits resulting from improved management and/or access to enhancement fisheries resources than for capture fisheries. R7335, through improved management strategies promoted to villages and the opportunities that the project afforded to share experiences between managers, led to increased employment opportunities for the rural poor in Lao PDR. Fishers would be employed who would receive payment (either in fish or cash payment) for assisting in the harvesting. Similar operations occur in the enhancement fisheries in India and Bangladesh and, certainly in the former, the fishers employed are more likely to be from the lower scheduled castes. Project R8292 has been working directly with scheduled caste fishers in India to improve the management of enhancement fisheries in marginal brackish water areas of West Bengal. In addition, project R8118 has resulted in a number of linked projects being implemented in both Bangladesh and Cambodia. The projects in Bangladesh have already demonstrated substantial increases in economic benefits (income and employment) in several hundred communities.
Improved access by poor people to fisheries knowledge generated by the Programme.	Cluster 9: R8210 Cluster 10: R7917 R7335; R8292; Cluster 11: R8331	Enhancement fisheries are often managed at a local level or with significant participation of local communities. There is therefore a need for these stakeholders to understand the dynamics of their resource systems and the likely outcomes of management actions. A number of projects have addressed the access of poor people to fisheries knowledge including R7335, R8285 and R8292 (the latter of which is ongoing). Evaluations conducted as part of R7335 and R8292 indicated that skills and knowledge of village resource managers and government extension staff (two key stakeholder groups) had increased as a result

		of project activities, and that the knowledge gained could lead to increased benefits from the fisheries when utilised. In addition, researchers and government staff had a much better idea about the opportunities and constraints that are faced by resource managers and so are better equipped to provide more relevant management advice.

Annex 5: Assessment of the benefits from managing a fishery using the ParFish software management recommendations: An assessment based on outputs from projects R7947 and R8397.

Background

The aim of the project was to develop and test a participatory stock assessment methodology and to develop tools to support management of data-poor, artisanal fisheries in developing countries. The project selected two fisheries in Zanzibar, East Africa as case study sites where the methodology could be tested. The two sites were Mtende (a reef fishery) and Dimbani (an offshore fishery). At both of these sites the tools developed for communicating with fisher groups and supporting their decision making as well as the participatory fish stock assessment tools that had been developed in project R7947 were to be tested. The sites were selected because project R7947 had worked in Zanzibar and it was decided that there was an opportunity to build capacity within the organisation that had been involved in R7947 (IMS) at the same time as testing the methodology.

Assessment of the economic impacts of project R8397

The project had recommended to fishers in the Mtende reef fishery that they should try to achieve a reduction in fishing effort of 10-20% and at the same time also attempt to apply a 5% reef closure as this would represent a reasonable management action to try for 2-5 years. In the case of the Dimbani offshore fishery the recommendations were for an effort reduction of 10-20% and a rotational reef closure that would leave reef areas fallow for some time. Given this management advice and assessments of the current state of the fishery and its dynamics, it was hoped that it would be possible, by extending the models of the fishery that the ParFish assessment software had created, to examine the response of the fishery under different management options. This would allow for an assessment of the response of the resource to the management proposals and an assessment and the costs and benefits to fishers and others dependent on the resources of these different management options.

However, on examination of the data from the project in Zanzibar it was clear that the level of uncertainty surrounding each of the assessments meant that it would not be possible to provide any assessment of the biological and economic benefits, or potential benefits from the implementation of the projects' management recommendations. In each case the ParFish assessments indicated that there was a high degree of uncertainty over the state of the stocks. This is evident from the relatively uniform probability distributions for the stock state (Figures 1 and 2).

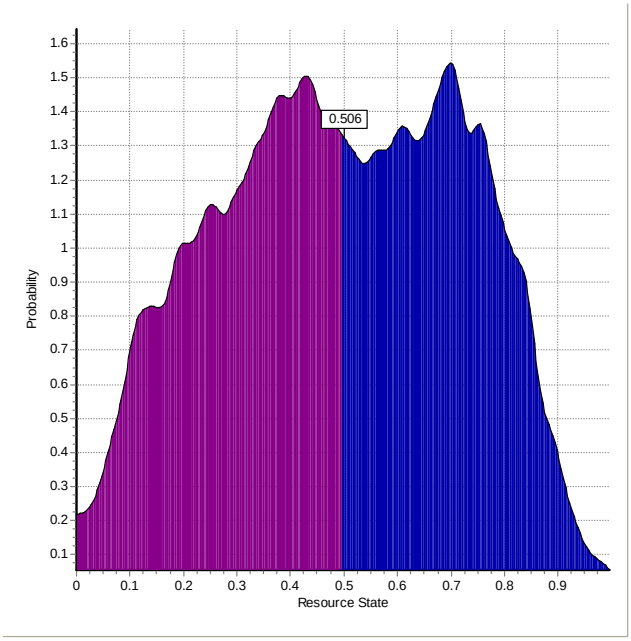


Figure 1. Results from the ParFish assessment of the probable resource state for the Dimbani offshore fishery. The purple area indicates overfishing. The x-axis represents the stock state from unexploited to fully overexploited.

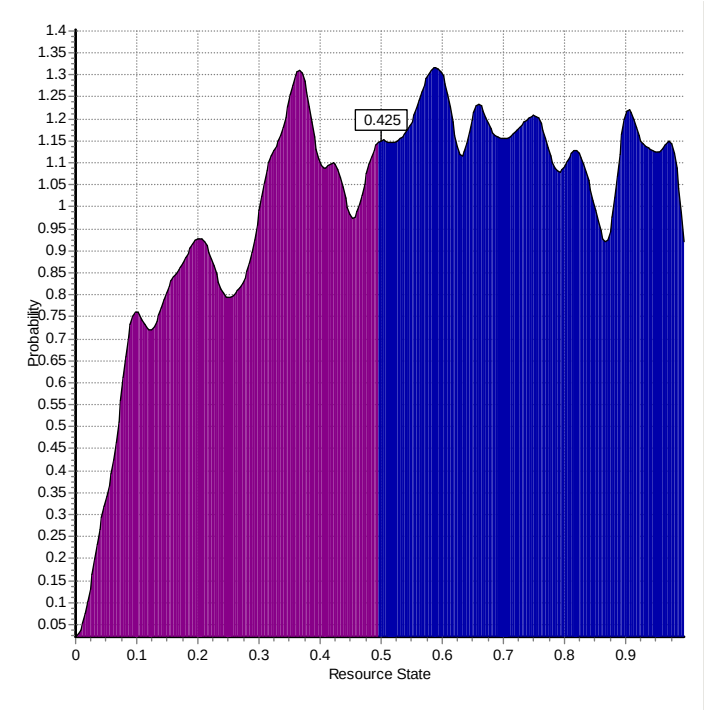


Figure 2. Results from the ParFish assessment of the probable resource state for the Mtende fringing reef fishery. The purple area indicates overfishing. The x-axis represents the stock state from unexploited to fully overexploited.

Given that it was not possible to assess whether the application of the ParFish management advice would result in any change in costs and benefits it was decided that it would be more relevant to examine the earlier application of the ParFish

assessment techniques and management recommendations in the Turks and Caicos Islands Conch Fishery (FMSP Project R7947).

The conch fishery in the Turks and Caicos had originally been selected as a test site because the fishery has a long time series of catch and effort data. During R7947 there had been concerns as to how robust an assessment based only on interview data would be and this fishery therefore provided an ideal opportunity to examine this aspect. It is also useful as it provides us with sufficient data to examine what the effect of implementing ParFish recommendations might be. The analysis was conducted in two ways, in the first case the historical data was used to examine what the effect of the different management options suggested by ParFish would be (assuming that they could be implemented effectively) compared to the actual management over time – a retrospective analysis. This analysis was conducted at the request of this project but was included as an output of project R8397. The second assessment involved projecting the different options into the future using a stochastic bio-economic model and comparing the outcomes of effectively implementing each of the possible management options.

Assessments for the Turks and Caicos Islands Conch Fishery (R7947)

Conch is, together with lobster, one of the principle targets of the commercial fishery in the Turks and Caicos. The fishing industry itself is considered very important in providing local employment and income for local people as well as almost all exports from the islands and resulting export revenue. For both conch and lobster there is a well established processing sector that exports almost exclusively to the US. It is estimated that some 400 people are employed in the fishing and processing sector in Turks and Caicos. The fishery is therefore not a vital one as a source of food and nutrition for the poor but instead the fishery is an important national resource (along with tourism) for income generation.

The conch fishery has operated for almost a century and during this time catches have fluctuated. The current quota for conch is set at 1,675,000lbs, worth over 3.2 million US dollars. The quota system is based on predictions made using a time series of catch and fishing effort data from the fishery. This time series was used in the analysis to compare the effect of different management scenarios.

1) Retrospective analysis

The basis for the assessment was not purely economic but instead was an assessment of the utility of the fishery. Utility was measured in two ways: firstly using the fisher preferences and secondly using price-cost ratio. These fisher preferences were estimated from data obtained from interview. The price cost ratio (PCR) is estimated from economic information (see Parfish software documentation for more details on each of these).

For the Turks and Caicos Islands queen conch fishery we estimate the last years catch was 1.65 million pounds at US$0.60 per pound landed weight. This indicates a

value of the landings of US$990 000. The cost of catching this amount of queen conch was more difficult to obtain. Fuel costs were around US$60 per day in 1992, but there was no information on other costs, such as the labour opportunity costs or the investment and maintenance costs. However there is historical evidence that large numbers of fishers would leave the fishery when catches fall below 200lbs per day. This information was used to generate a conservative estimate the daily cost of fishing (i.e. 200*0.6 = US$120). The last year's effort was estimated to be 4138 boat days, so the total cost was therefore 4138*120 = US$496 560. The price-cost ratio in this case is 990000/496560 = 1.99. If we apply this ratio, we obtain an expected utility maximum equivalent to the expected discounted economic rent optimum. This is clearly going to be an approximation, but can be derived very rapidly and can be used as a check on a realistic range on the controls.

A default 5% discount rate has been applied in all scenarios, which allows them to be compared. In addition a maximum fishing effort limit is applied. Even without management control, there is a limit to the fishing effort which can be applied. This was chosen to be 6000 boat days for all scenarios. Historically fishing effort has responded to economic conditions, but has not been sustained above 5000 boat days for more than a few years, 6000 boat days is therefore considered to be a reasonable upper limit unless conditions in the fishery change.

Results

The management controls that were, based on the ParFish assessments, considered to be optimal are set out in table 1 in terms of target conch quotas for landings. There were two sources of information that were used in the ParFish assessment. Firstly there were the interviews with the fishers which give a prior probability and secondly there was a catch-effort model that was based on 30 years of data from the fishery. The analysis using only the catch effort model represents a classical stock assessment. Using both the catch effort model and interviews gives a Bayesian analysis based on all information making up the “posterior” probability. The interview only model is of interest because for many assessments this might be the only information available. All combinations of the analyses with the PCR and with fisher preferences and using the catch effort model, interviews only and both sources of information gives 6 targets based on the Bayesian action (decision analysis).

Table 1 Target Quotas (in millions of pounds) and % chance of overfishing based on the separate models. The preference model consistently gives a lower target quota control. The interview for the stock assessment model generally has the effect of raising the quota. The interviews assessments of resource productivity are in general optimistic compared to relying on catch-effort data alone.

	Catch-Effort Model	**Interviews Only**	**Interviews and Catch-Effort Model**
Price-Cost Ratio	1.51	2.50	2.00
Risk of over fishing (%)	27	>36	30
Preferences	1.40	1.84	1.59
Risk of over fishing (%)	20	21	18

There is no guarantee any particular answer is right. However we might assume that the more information we add, the better the estimate. Because the fishers' opinion differs from the model, we also might tend to choose the objective information only (i.e. assume a non-informative prior). Therefore the Catch-effort model only represents may be considered as the best estimates for the control. Given this is the case, we can compare how much worse the other advice is compared to this "optimum" (Table 2).

Without effective control, the quota for the fishery seemed to be sustained above 2.0 million pounds between 1976 and 1980 which probably led to an over fished state. While the 2.0 million pound mark was exceeded, it probably represents the minimum uncontrolled quota and therefore the benchmark for management. If the interview only control was applied, a quota of 1.84 million pounds[37] would have been applied. The regret function indicates how well the control does relative to the best option. The 2.00 million pound quota scores relatively badly both for the PCR ratio and preference scores. The 1.84 million pound quota, appropriate for the interview only data, reduces this loss significantly. That is, it would cut the effective utility loss by approximately 50%. In theory, utility measures the true value of income, so the value of action would exceed the simple monetary gain. Avoiding overexploitation would sustain livelihoods while minimising the lost opportunities.

It appears the lower quotas will turn out to be sustainable in the longer term. Previous classical analyses gave similar results, with a tendency to lower the quota.

Table 2 "Regret" values indicating the cost of the various optimums compared to the best option based on all the available data. As more information is added, the results indicate lower quotas are more appropriate target.

Quota (million pounds)	Preference	PCR Ratio
1.40	0.000	-0.099
1.51	-0.099	0.000
1.59	-0.325	-0.079
1.84	-1.749	-1.070
2.00	-3.079	-2.178
2.50	-7.045	-6.198

[37] In fact, the quota would been set closer to 1.7 million pounds if the fisher preferences are used. The default global discount was used to consistency across scenarios.

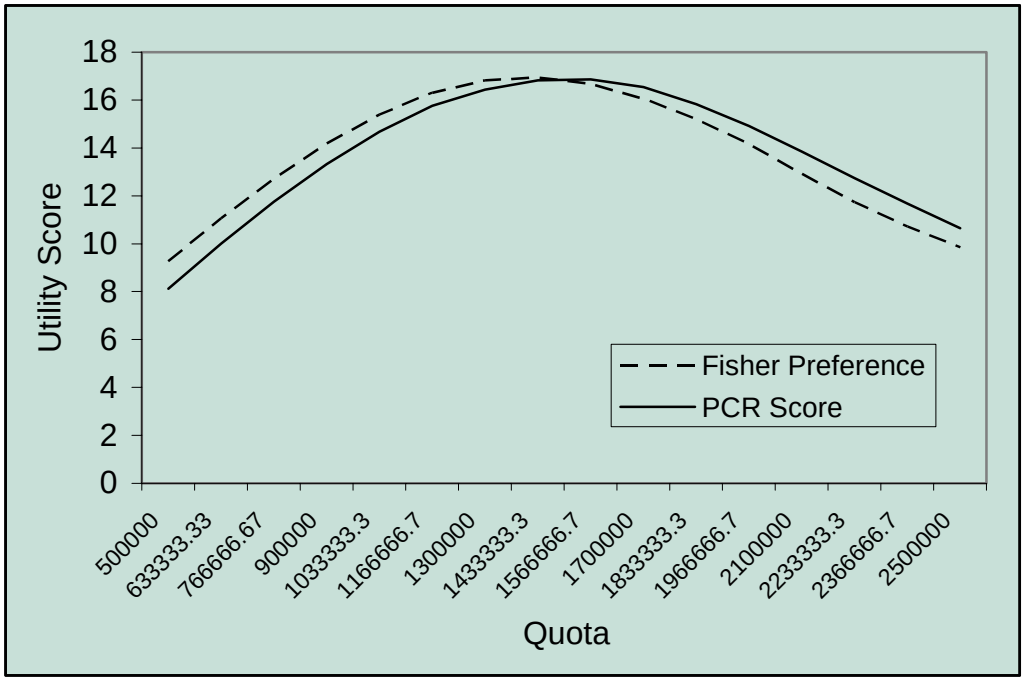


Figure 3 Comparison between the two utility scores across the allowable control range. The preference score shows greater curvature, implying greater sensitivity to risk.

2) Bio-economic analysis through projections

The analysis above shows that the assessment software can provide an assessment and management options that, if implemented, will have a low probability of overfishing and provide outcomes that are more in line with fisher preferences. However the analysis is based on estimating what would have been the case if the management options had been applied since 1974 compared to actual outcomes. This involves assuming that the interview data would have been the same in 1974 as it was when it was collected during the project.

As an alternative, a assessment was conducted that was based on applying management options to the fishery and projecting this into the future to compare the outcomes of implementing alternative options that are implemented with similar effectiveness.

Method

A stochastic bio-economic model of the fishery was created within an Excel spreadsheet. The underlying model of the fishery used was a logistic one based on the historical catch/effort data from the Turks and Caicos conch fishery. The model was fitted using least-squares and the fit of the model to the historical data is shown below in Figure 4.

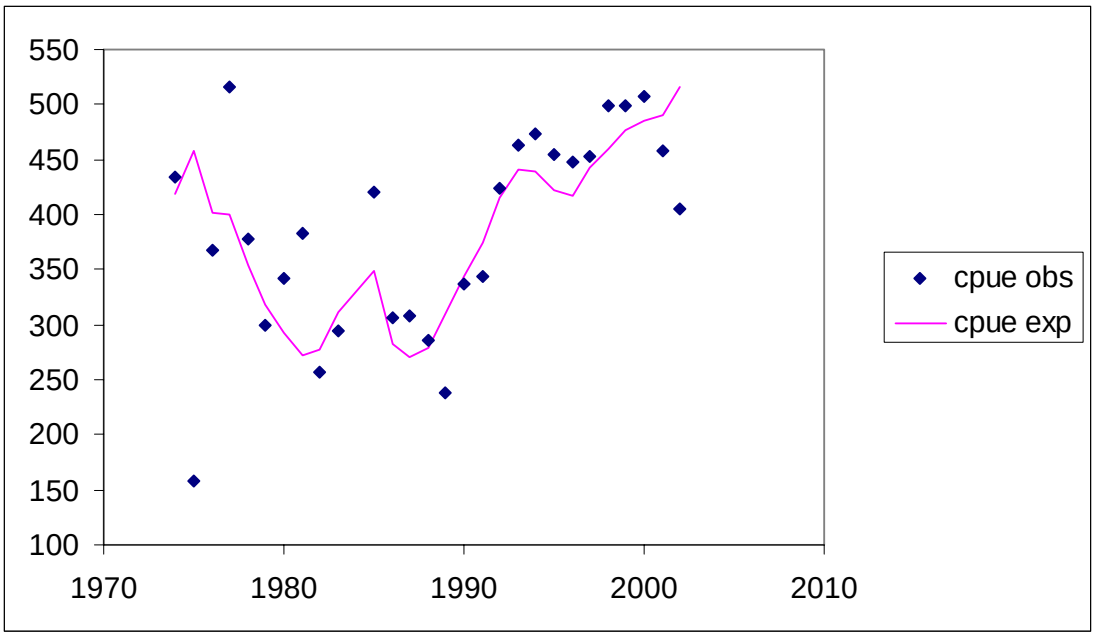


Figure 4. Observed Catch per Unit Effort (cpue) from the historical conch fishery data (cpue obs) and the expected cpue values from the logistic model fitted to the data (cpue exp).

This model was then used as a basis to provide the dynamics of the fishery and its response to different management actions. The model used is not a completely transparent model as the poptools add-in (http://www.cse.csiro.au/poptools/) was used to provide the annual catch figures based on the quotas. The catch estimates were derived using a normally distributed error based on the CV of 4.2% from the historical cpue figures and were generated using the 'random variable' function in poptools). This was then used to calculate the population size using the parameters from the logistic model that had been fitted to the historical catch effort data by least squares. This in turn was used to calculate the effort required to produce the catch given a constant catchability.

This model was used to predict future population size, catches and fishing effort levels under each scenario. Prices for catch and effort in each case were based on the results from R7947 and R8397 as 1.675 million lbs of conch meat was estimated as being was worth in excess of $3.2m, making a price/lb of approx $1.91. While it is to be anticipated that the price of conch will vary with the amount landed, a review of queen conch landings and price statistics for Puerto Rico over a ten year period reported in CFMC (1996) came to the tentative conclusion that price does not respond significantly to changes in landings. It was felt that it would be fair to apply this price over the entire period. The cost per day of running a boat was estimated at $120/day.

The projections were based around four scenarios based on the ParFish management recommendations and the management practice in the fishery at the time that the project was working there (Table 3). All the scenarios are based around the application of catch quotas in the fishery. The difference between the scenarios is the nature of the assessment on which they are based within the ParFish (PFSA) stock assessment. Thus PFSA 1 is the management recommendation from the project experience, PFSA 2 is the optimum bases on the ParFish assessment using interviews only, PFSA 3 is based on interviews and the catch effort data and quota represents the current quota applied to the fishery.

Table 3. Quota sizes represented by each of the four alternative management scenarios considered using the bio-economic model.

Scenario	PFSA 1	PFSA 2	PFSA 3	Quota
Quota (lbs)	1530000	1678103	1384883	1675000

The scenarios were applied and in each case the outcomes of management were compared. The outcomes considered included biological aspects such as the effect of management on stock biomass, the annual catches achieved under the scenario and the total catch achieved. Using the economic information from R7947 and R8397, together with the estimated catches from the biological model, it was then possible to calculate the NPV and PCR for each of the four scenarios being considered. Projections using the model were made up to 2015 (in line with the MDG timeframe). As with the retrospective analysis, a discount rate of 5% was used for the calculation of NPV and PCR. Because of the stochastic nature of the model, for each outcome considered the model was run 50 times and the distributions of the outcomes compared.

Results

Applying the scenarios using the bio-economic model allows us to look at benefits including benefits to the resource status (including increase biological resilience) and production (food production) as well as the economic benefits such as the value of the fishery and the efficiency of production. These will be considered in turn in this section.

As can be seen from Figure 5 below, the different management scenarios had quite different effects on the biomass of conch over time and the recovery rate of the resources. The PFSA 3 scenario, the lowest quota, was able to bring the stock to the level of biomass where it is producing the predicted Maximum Sustainable Yield (MSY) by about 2020. The other options all allowed the fishery to continue the recovery that had been underway since around 1990 but at a slower rate. The PFSA2 and quota scenarios were very similar in performance. The fact that these are similar in both nature and performance could possibly suggest that the fishers had quite a good awareness of both the stock status and the management actions being implemented.

The issue of stock status and the level of biomass is important as stocks held at low levels of biomass are less resilient and there is a greater danger of stock collapse with resulting impacts on those who rely on the fishery for income. It is also the case that the fishery is less efficient when held at lower stock sizes as more fishing effort is required in order to achieve similar yields.

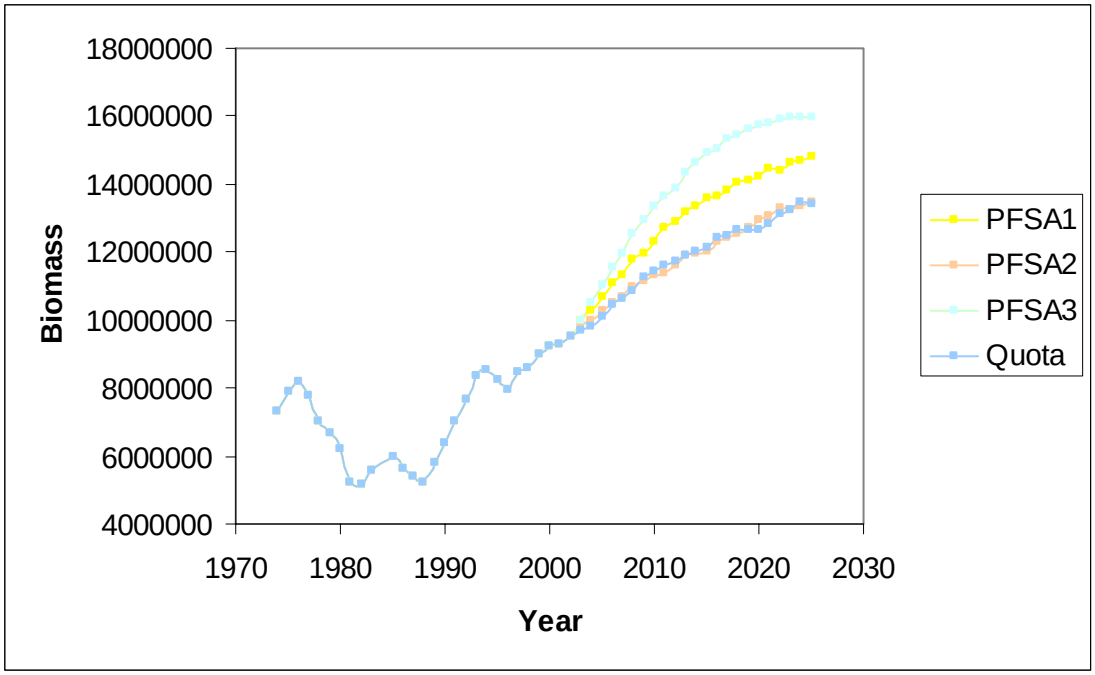


Figure 5. Predicted conch biomass over time under each of the management scenarios being considered.

Figure 6 below shows the predicted conch biomass in tonnes by 2015 for each of the four scenarios. The outcomes for PFSA2 and the current quota level applied annually were similar while the outcome of both PFSA1 and PFSA3 was a significantly higher conch biomass.

In terms of the Millenium development Goals, Goal 7 states that: “The environment provides goods and services that sustain human development so we must ensure that development sustains the environment. Better natural resource management increases the income and nutrition of poor people”. The analysis indicates that if the management recommendations from the ParFish assessment could be successfully implemented then it should be possible to contribute towards this Goal.

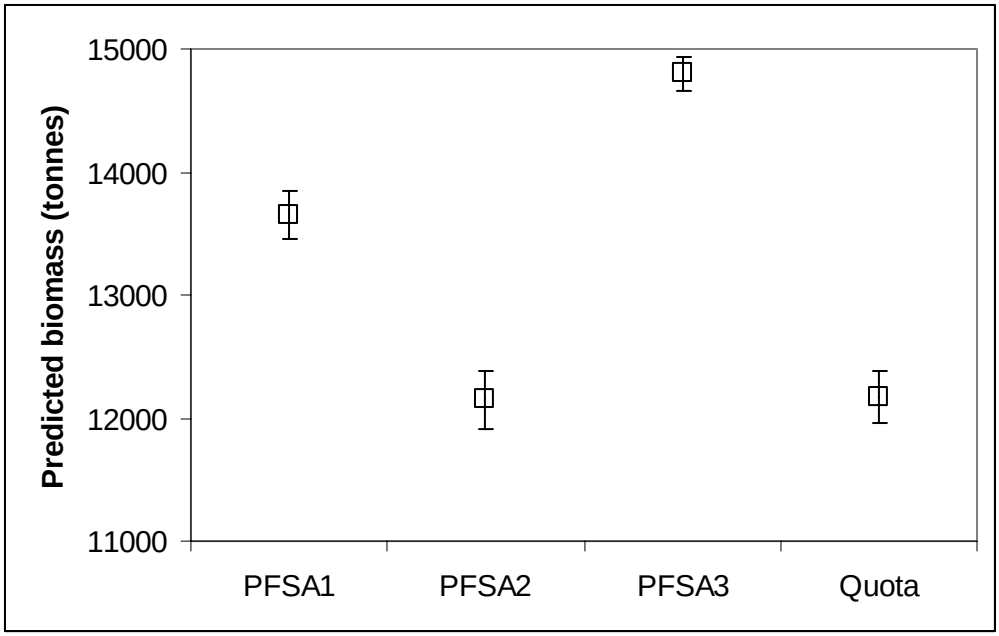


Figure 6 Mean conch biomass in the final year (2015) of the simulation for each management scenario (error bars represent the standard deviation).

Increasing the biomass through quota control involves a trade-off with catches and as can be seen from both Figures 7 and 8, the mean annual catch and the mean catch in the final year (2015) are significantly lower ($P<0.05$) for the two scenarios that suggest applying lower annual quotas (PFSA1 and PFSA3).

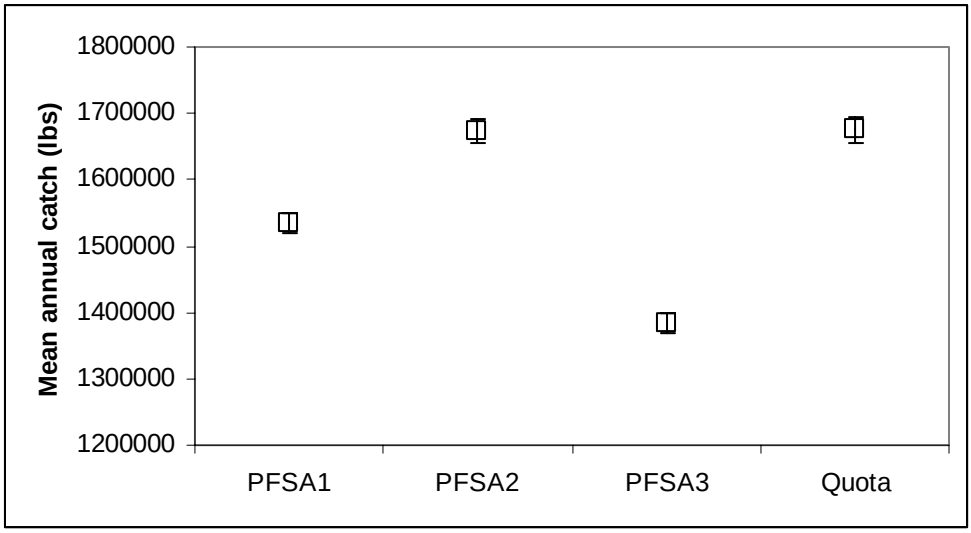


Figure 7 Mean annual conch catch over the thirteen years of the simulation for each management scenario (error bars represent the standard deviation).

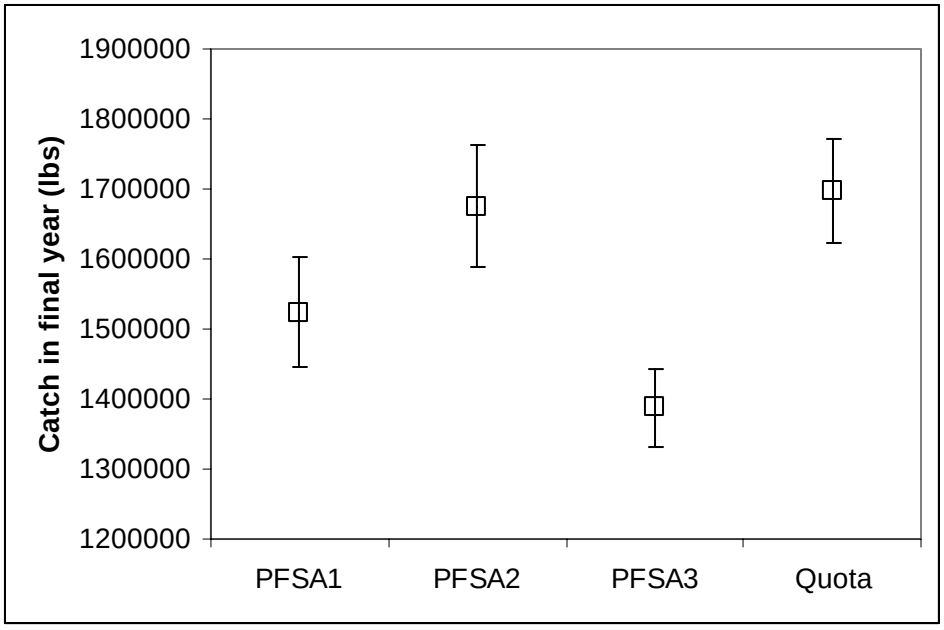


Figure 8. Conch yield in the final year (2015) of the simulation for each management scenario (error bars represent the standard deviation).

The result of the lower quotas and smaller catches required under the PFSA1 and PFSA3 scenarios is that the NPV of the yields from the fishery over the 13 years of the simulation (Figure 9) is significantly lower for these two scenarios ($P<0.05$). Again this illustrates the trade-off that has to be made when rebuilding fish stocks.

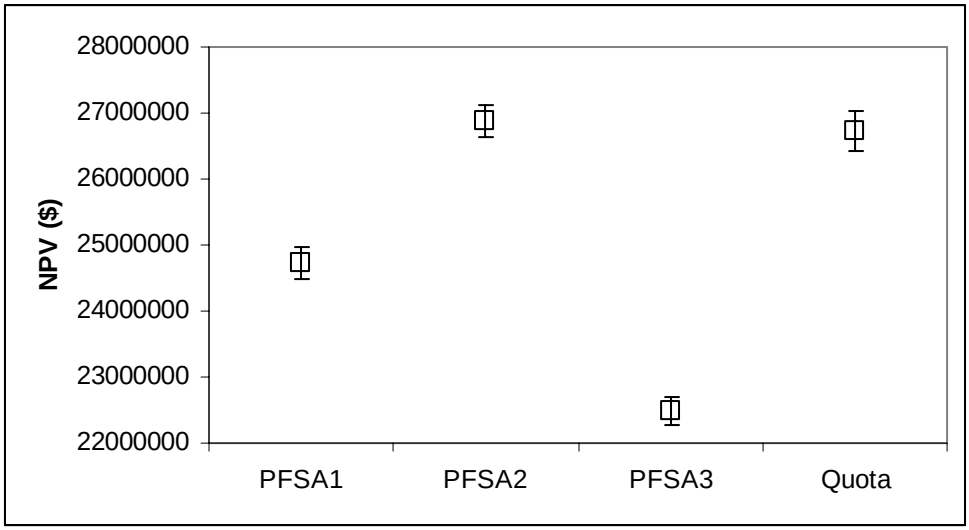


Figure 9 Mean Net Present Value over the thirteen years of the simulation for each management scenario (error bars represent the standard deviation).

While the NPV was higher for the current management quota and PFSA2, as Figure 10 shows, the PCR of the ParFish recommendation is significantly higher than the current management quota. This is because the fishing has become more efficient under the reduced quota and less effort is required to fill the quota.

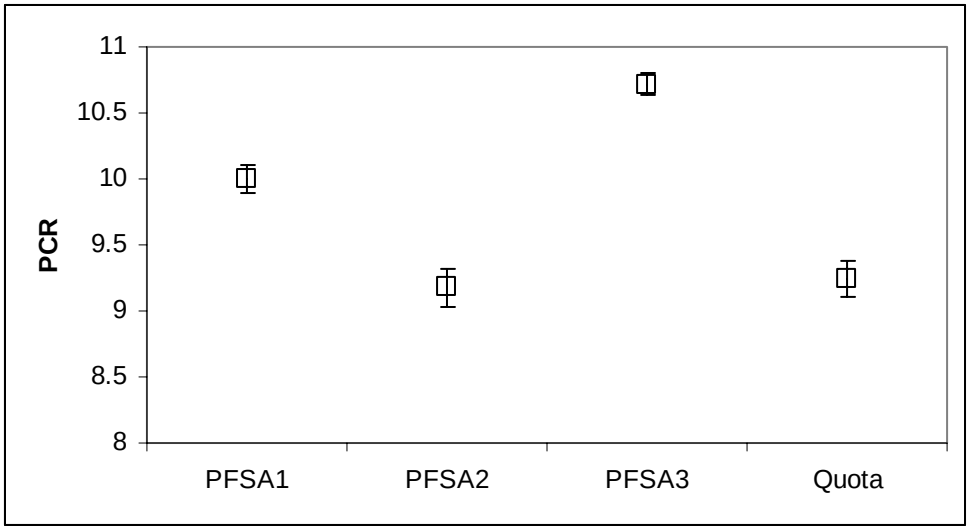


Figure 10 Mean Price Cost Ratio over the thirteen years of the simulation for each management scenario (error bars represent the standard deviation).

Conclusions

Overall the analysis suggests that implementation of the ParFish management recommendations could lead to increases in biomass and in resource use efficiency while meeting the objectives of the fishers. However, while this is the case it must be remembered that to achieve these benefits the management recommendations need to be implemented effectively and implementing and enforcing management recommendations is often not straightforward in small-scale fisheries in developing countries.

The analysis also highlights the need for assessments to be based on fishery data as well as information from the fishers. The example from Turks and Caicos indicates that an assessment based only on information from fishers may not provide a very accurate representation of the fishery.

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Annex 6: Evaluation of the Livelihoods impacts of the Participatory Fisheries Stock Assessment project R7947 (PFSA): Zanzibar.

1. Introduction

This report presents the findings of an evaluation of the Participatory Fisheries Stock Assessment project R7947 (PFSA) that had been developing and testing a participatory fish stock assessment methodology (PARFISH). The evaluation was conducted between 11th February and 20th February, 2005. This project forms part of the Marine Resource Assessment Group's (MRAG) Fisheries Management Science Programme (FMSP) and is funded by the Department for International Development (DFLD).

The objective of the PFSA project was to provide information to fisheries managers in the form of a scientific advisory based on a participatory interview technique, existing/archival data, and data that can be collected rapidly in the field. The method is flexible and enables scientific advisories to be produced for a variety of fisheries. The ultimate goal of the PFSA project is to empower stakeholders in responsible fisheries management. It is based on the conception that informing decision makers through the participation in collection of scientific data would enable them to apply this information through more widespread management practices. The PFSA technique thus provides a method for meeting these information requirements in a wide variety of fisheries and could rapidly increase the potential for applied stakeholder management strategies in the region. The project therefore engaged fishers and other stakeholders in a process of learning, management planning and finally implementation of management actions. The field trials of the methodology were conducted in partnership with the Institute of Marine Science (IMS) and the Department of Fisheries and incorporated local fishermen in most stages.

The Project Area: The area where the PFSA project is located is in the three villages of Dimbani, Mkunguni and Mtende, located in the north of Unguja Island, one of the two islands that make up Zanzibar. The three villages represent the major stakeholders for the fisheries in the region and which this project involved in the field trials. The field sites also fall within the boundaries of the Menai Bay Conservation Area which was listed as a multiple-use management area in 1997, and the Department of Fisheries was keen for the PFSA project to work within the area to facilitate an increase in co-management.

The Local Fisheries: Fisheries in the Kizimkazi region are diverse and typical of those found in Zanzibar. These include reef, small and large pelagic species, as well as a variety of invertebrates. The reef fishery gears include the use of hook and line fishing for species of *Serranidae, Lethrinidae, Lutjanidae* and *Balistidae*, and baited fish traps (locally known as Dema traps) for *Acanthuridae, Siganidae* and *Haemulidae*. Spear-fishing and free diving are also common techniques for catching reef fish and octopus (*Octopus cyaneus*), whilst squid (*Sepioteuthis lessoniana*) are caught using jigs. Some destructive fishing practices do take place in the area, even by some members within these three communities, other areas of Zanzibar and from as far as mainland Tanzania. Seine netting is common, and anchor damage is also readily visible in some areas. Offshore and deep water fisheries use gill nets and long-lines for tuna, shark, deep water snappers (*Lutjanus sebae*), and large serranids (*Epinephelus lanceolatus*). More valuable fish species, and octopus and squid are sold to local buyers and in fish markets in Zanzibar town, whilst less desirable reef species are kept for local consumption.

The people: The communities are typical fisheries-dependent communities, with most of their income coming from fishing or fishing-related activities. A good percentage of their protein intake is also acquired from fish (Estimates for Zanzibar

are approximately 20kg person per year). The fishing industry is predominantly artisanal, using traditional gear whose efficiency is low.

In order to achieve the above, the project had been conducted in two phases involving the following processes

- Information gathering through a participatory interview technique in the participating stakeholder communities of Dimbani, Mkunguni and Mtende;
- Carrying out depletion experiments in the fisheries in two separate locations; (an offshore platform reef; an inshore fringing reef to provide catch and effort based parameters to use in the software trials;
- Collection of mark and re-capture data in conjunction with the fringing reef depletion;
- Monitoring and abundance data were collected using an Underwater Visual Census (UVC) technique
- Identify and collate any archival data which may be available and incorporated as part of the rapid assessment;
- Production of stock assessments in the form of scientific advisories for each trial.
- Evaluate the relevance of data collected and use the data and methodology in development and testing of the PARFISH software;
- The small pelagic fishery was identified for assessment using the PFSA technique, and the assessment is currently being conducted by IMS;
- The octopus fishery was investigated for application of the PFSA method. Data collection techniques were investigated during the course of the project.

Table 1: A summary of the two PFSA trials undertaken in the Kizimkazi region of Zanzibar

Trial 1: Dimbani	Trial 2: Mkunguni and Mtende
1. Introductory meeting 2. PFSA Interviews 3. Site selection surveys 4. Experiment meeting 5. Depletion Experiment 6. Data analysis/advisory preparation 7. Presentation of advisory	1. Introductory meeting 2. PFSA Interviews 3. Site selection surveys 4. Baseline surveys, monitoring sites 5. Initial UVC surveys 6. Fisher meeting 7. Tagging and UVC data collection 8. Depletion study and UVC surveys 9. Post-experiment UVC surveys 10. Data analysis/advisory preparation 11. Presentation of advisory

The majority of the field testing and data collection was undertaken during two separate field trials in the study area. The first was undertaken in-conjunction with the village of Dimbani, and the second with the two neighbouring villages of Mkunguni and Mtende (figure 2). Each of the field trials consisted of the initial village meetings, PFSA interviews, and a depletion experiment. Additional data collection was included in the second field trail including Underwater Visual Census (UVC) and a mark and recapture programme. These methods of population assessment were included to test the value of other data within the framework of the PFSA technique and its applicability to the software that has been developed. The main outputs from the data collection undertaken are the two scientific advisories prepared based on the two trials conducted.

Capacity building for the Scientists Team: Some degree of capacity building and sharing of knowledge from PARFISH has indeed been achieved among the

Scientists. Apart from just being involved in the project, the degree of sharing of knowledge and information dissemination is quite significant. The methodology itself offered a training opportunity to those not conversant with participatory processes and collaborative resource management. Opportunity to practice other techniques such as tagging, were indeed new experiences and quite rewarding to their professions.

The PFSA process has also involved a two-day feedback workshop conducted at Kizimkazi and attended by a range of fishermen (i.e. line & hook, *dema; nyavu* etc). This workshop seems to have been the most effective mechanism (or rather appreciated strategy) in disseminating information on the objectives of the PARFISH project and enabling local people to discuss together on the issues concerning management of the fisheries.

Localising practice: some of the techniques used during the 1st phase, such as, concentrating fishing activities in a particular spot for a specific time, measuring fish with a measuring rod, were quite 'foreign' and therefore qualifying the conclusion that the primary objective for the whole exercise was research for scientific purposes – the same extractive kinds of activities.

Local fishermen and village leaders appreciate the participatory process involved in the whole methodology. In particular, they spoke very highly of Narriman and her team. Narriman's open and cheerful personality was often referred to as an ice-breaker, and hence to my own conclusions, a smooth way to reach out and impress upon people that the tool was introduced to them. Judging from the planning of activities and modalities of entry into the local setting, the process had indeed involved a gradual and participatory strategy in introducing the subject and the tool. It was also strategic since the IMS team took advantage of their earlier contacts through other projects and activities in order to establish a base with the people.

The knowledge generation and transfer

None of the communities have yet been able to outline management plans that integrate information or methodologies from the project. But there is has been significant knowledge generation. These activities allowed the Research Team to assess the PFSA as a method for conducting rapid stock assessments. The process therefore not only allowed the Team to develop the methodology, but also provided skills and training of IMS and Department of Fisheries staff. The Team was exposed to the participatory interview, species identification, depletion experimental design, mark and re-capture studies, UVC monitoring work and data storage mechanisms.

While the degree to which knowledge has been effectively disseminated to grassroots level is not quite clear, there are some impressions that the participating communities have gained ideas on what responsible fisheries management entail. At least most of the interviewees could mention a lesson or two learnt from the experiments on collecting catch data, tagging or through the one-to-one interviews.

However, as could be gathered from the opinions of some of them, it was not immediately perceived that 'knowledge transfer' was the ultimate objective and basis for local empowerment. There was the feeling of the same old 'extractive' processes through which people are made to give information – and not realising any tangible benefits – defined in terms of material gain.

Methodology for the evaluation

The methodology involved discussions using a semi structured interview guide with the following persons.

S/No	Name	Title/Occupation	Institution/Location
1.	Narriman Jidawwi	Research Officer	Institute of Marine Sciences, Zanzibar
2.	Mohamed Nur	Researcher/consultant	State University of Zanzibar
3.	Hamad Khatib	Food Technologist	Department of Fisheries and Marine Products, Zanzibar
4.	Omar Amir	Marine Biologist	Department of Fisheries and Marine Products, Zanzibar
	Faridi Kifani	Fisher	Dimbani
	Abrahman Hamis Omar	Fisher	Dimbani
	Jamhuri Haji	Fisher	Dimbani
	Kassim Fadhili Ramadhani	Ex-Sheha	Dimbani
	Pandu Haji Daudi	Beach Recorder	Dimbani
	Haji Pandu Haji	Fisher	Mtende
	Masour Ameir Haji	Fisher	Mtende
	Mwadini Musa Vuai	Fisher	Mtende
	Bashir Faida	Beach Recorder	Mtende
	Hamisi Juma Hamisi	Sheha	Mtende

Four of them are based with or affiliated to the Institute of Marine Sciences and the rest are local residents of two of the participating communities, Dimbani and Mtende. Each of the local people were in way or the other directly involved in the project, either in the planning and mobilisation strategies or in the experiments. Selection of these people was based on their representation in the different stages of the project, and for some their strategic position in influencing knowledge transfer related to the project.

Owing to the fact that the project had not reached implementation stages, the evaluation was only based on what impacts the process may have had on the people and what possibilities for success do the stakeholders see for the future in terms of development of management plans.

2.0 THE INTERVIEWS

2.1 Narriman Jiddawi 11th February, 2005.

Narriman is a Marine Scientist who has considerable experience and some formal training in participatory methods. In addition to being involved in a number of community-based fisheries projects, she has also attended community development related courses including, community resource management, and, governance for responsible fisheries.

Narriman works as the coordinator of the PARFISH project and her roles include taking the lead in organizing for all aspects of the process. During the 1st phase activities, Narriman was involved in the training of IMS staff and technicians on how to use the par-fish methodology. She was also involved in consultation on the areas where the exercise could be done – and she notes that while IMS selected Kizimkazi division generally, the fishermen selected the particular reefs for the exercise eg

Mwamba Uzzi in Dimbani. The following fieldwork entailed diving exercises, measuring catches at the landing sites and administering the questionnaire.

Narriman believes that their entry and planning for the whole exercise with the people was participatory. The continuous dialogue, the choice of the reef and the 10 day commitment to fish in the chosen reef illustrates this complimentarily between the research team and fishermen. However Narriman also said that, during the planning of the fishing exercise, the fishermen explained that they normally do not concentrate their fishing activities intensively around the reefs but they fish randomly, every fisherman selecting a fishing area daily. In addition, since the fishermen felt that the exercise was at a cost of their daily income, they demanded for and were given a cash compensation (ranging from TShs 2000 to 3000/- a person) plus their catches each day of the exercise.

In the 2nd phase, IMS staff were introduced to the software, that the foreign Consultants (Paul Medley and Suzannah Walmsley) had developed basing on what was gathered from the previous phase. More IMS Team members were also introduced to the questionnaire (these were new members) and they tested their skills at Marumbi village with 14 *madema* fishermen.

Narriman believes that the IMS Team has gained significantly from the ParFish process;

- Capacity building for the IMS team – Yes, in terms of being introduced to modern ways of fish management,

- getting used to the practice of continuous dissemination or dialogue with people on research processes that have been done with them. This wasn't the case before.

- Publicity and wider dissemination on the tool – they have developed leaflets on the PARFISH methods (distributed through the Internet), and have been receiving calls indicating interest to learn about the tool.

On whether the tool was an effective means for information dissemination to the local community: Narriman said, the questionnaire had two key issues. Firstly, it took the IMS technicians time to understand and master the card game used for assessment of the fisheries, and therefore it initially was not smoothly practiced with local fishermen. Secondly she finds it needed patience – it is somehow complicated and quite lengthy and unless one was skilled, it took quite some time to make fishermen grasp the objective of the whole process.

On the impact of the exercises: Although fishermen have traditional ways to detect decline in the fisheries, the exercises enabled them to visualise this decline – arising from intensive fishing in one spot – the intended visual impact was part of the knowledge transferred. The 29th – 30th January workshop pursued the results and was also used to give feedback to local people on the progress of the project, including discussing on missing issues required for the software.

Narriman pointed out that although it is too early to assess the impact of the process on local fishermen in terms of imparting knowledge on responsible resource management, she at least can say that two benefits from the participatory manner in which the tool was introduced could be garnered. These include:

- building trust with local communities on fisheries management and related issues

- capacity building in local communities at least on recognizing the importance of responsible management

There are some snags that need to be overcome, at the Institute level. The IMS have not mastered the software quite well, and therefore are not satisfied with the level of analysis. There is need for more training for the IMS staff. The software also still needs rectification in some areas before it can be publicly disseminated.

2.2 Mohamed Nur Mohamed 15th February, 2005

Mohamed's professional training is in Fish Biology. He works as an independent Consultant in marine science and coastal environmental issues, in addition to his engagement with activities related to the Civic United Front Political Party in Zanzibar.

Mohamed's involvement in the project was when he was studying for an MSc in 2003 and was engaged as a facilitator at the local level, planning activities and working out modalities for collaboration with the participating communities. He therefore visited the three participating communities for mobilization and baseline data collection, and was then later involved in reviewing and localising the tools in accordance to the context in Zanzibar, a deskwork task that involved all Team members. He did not participate in the day-to-day activities of the fieldwork exercises. His participation therefore was more on the design of the tool to suit it to local contexts.

In his opinion, initially, there was some uncertainty among the local population during the introduction of the methodology for scientific monitoring of fish stock. He thinks that this was natural, basing on the fact that people were being introduced to new knowledge, or new ways of dealing with resources. However, "I was impressed by the response and the way local fishermen were eager to learn and to participate in every aspect of the process." All fishermen enlisted in the project illustrated a huge commitment in undertaking all activities, patience in interviews and in other activities.

Now that the PARFISH tool has been scaled down to respond to what was found in the field, Mohamed visualises some success in local communities gradually adopting scientific management of marine resources because according to him, the method can be easily assimilated by local fishers. The opportunity to pursue a direct feedback process between the PARFISH team and local communities on the design of the tool allowed more reflection and to review some parts of the tool.

On the aspect whether local fishermen were sensitized enough to be able to take up some provisions of the tool, Mohamed said, "although their participation was quite impressive, it would be even more so if they were able to apply all parts of the tool independently. So far they do not have the confidence for lack of the needed expertise, such as in proper identification of the species. But we have to acknowledge that the tool is still new to them and it will take time to be fully appreciated and understood by local fishermen for them to have the confidence to use it"

2.3 Hamad Khatib Department of Fisheries 15th Feb 2004

Hamad has been trained as a Food Technologist and works for the Government in the Department of Fisheries. He is currently working on part-time basis with the IMS Team for the PARFISH project.

Hamad's involvement with similar marine resource management projects has included data collection of species at a few landing sites in Northern Zanzibar (Matemwe; Vikokotoni, Nungwi) and Central district (Chwaka); collection of data on small pelagic in Malindi; conducting interviews for socio-economic impact assessments in these areas; mobilization of local coastal people in Paje and, working on the aquaculture project in Zanzibar. In his opinion, his involvement in these projects have given him some grounding in people-related resource management processes and considerable exposure to species identification techniques, a background he has found relevant to his involvement in the PARFISH project.

He has been involved in several activities of the project, including the initial planning activities with the people, and the species identification and measurement steps. In order to illustrate the participatory nature of the project, the Team made consultations with the District Fisheries Officer for Kusini Unguja, and the respective *Shehas* and members of the local council. These officials were also used to introduce and popularise the project.

In addition, Hamad was involved in the data entry and data analysis part for the project.

Capacity building on my part?, Yes, it was my first experience learning how to tag fish, now I am able to participate in such activities. We also used local fishermen to catch the fish we measured.

In addition, being the Statistics Officer with the Zanzibari Department of Fisheries, Hamad claims the data entry and data analysis parts of the project have exposed him to better ways of handling marine fisheries related data.

On the transfer of knowledge to local people:
One of the things that I think the process has managed to impress upon people is the relationship between fishing activities, fishing methods and availability of fish.

And yes, the interview process was too long, approximately 45 minutes long and therefore time-consuming for the fishermen. But it was useful since some of the questions and the card game stimulated more discussions and therefore more information from the people on the local fisheries.

The workshop conducted between 23rd and 24th January was also another for a where people learned more about the PARFISH process and what they needed to do to maintain their fisheries. In this workshop, that was attended by 60-70 people (local leaders, fishermen [using nets, line and hook and fish traps], and very few women who catch octopus, and fish for small shrimp, participants had the opportunity to get feedback from the research, discuss about the methodology and propose what needed to be done next.

Generally, I also feel that the project has made a long-term impression on local people on issues concerning management of resources. Firstly the practice of sitting with local people and planning exercises together, and seeking for solutions together illustrated a long term commitment for cooperation between the scientists and local people.

In addition, the process of telling stories – about historically based conflicts over resources – was a step towards an effective conflict resolution process.

2.4 Omar Amir Department of Fisheries and Marine Products 20/02/05

Omar works for the Department of Fisheries and Marine Resources, Zanzibar as a Research Coordinator. He is a trained Marine Biologist. His involvement in the PARFISH project was as an Assistant to Narriman, and had been engaged in the preparatory activities for the project, selection of the area, and the recording and monitoring of the experiments in all of the project areas.

During the fieldwork of the 1st Phase, Omar's specific activities included the following:

- species identification and tagging, activities that were conducted with Mohamed Nur and Mohamed Suleiman with a few local fishermen, including some not directly involved in the experiments.
- recording the weight and height of fish that involved many of the Team members including the Beach recorders (*Maafisa wa Diko*) of each village i.e. Pandu (Dimbani), Bashir (Mtende)
- interviews with fishermen involved in the experiments

The choice of the areas for the fishing experiments was done by local fishermen. For example for the Dimbani area, Hassan, a local fisherman was highly instrumental in influencing the process, while in Mtende, the selection of the reef area was based on local fishing preferences.

According to Omar, the objective of the interviews was to create baseline information on the local fisheries including information on fishing techniques, incomes, challenges and changes in fishing practices over time. Using several innovative scenarios – using cards - the interview process also enabled fishers to discuss on species preferences and to think about the situation of the fisheries more deeply. Although the information drawn from this technique was of value to our project objectives, it also was of benefit to local people by "enabling fishers realise or be aware of the implication of change in the condition of the fisheries and on their choices or preferences on the kind of fisheries they would have owing to a range of circumstances. For example, what would be their preference in fishing effort and expected incomes"

Using analogies - such as making them estimate the number of oranges in a jug – and the range of mostly wrong estimates brought up – was not only interesting but it encouraged them to think of how inappropriate it was for fishers to continue making guesses on the condition of their fisheries.

"The aspect of making them think of savings was however distant because of fishing communities have a different culture of savings and credit. Many of them do not have the habit of saving money in a Bank" This question thus demands us to localise it in future – and turn it into a discussion on *upatu* savings and credit practices"

Omar also participated in the 29th to 30th January workshop that was attended by about 40 participants. Omar's view on the workshop was that it was offered another participatory forum for sharing what could be done to control destructive fishing – especially when participant disused the implication if fishing pressure or fishing gear. "It was interesting to see how people could relate the experiments with their own traditions in identifying workable solutions – such as – the closing fishing seasons effected during '*kusi*' that also reduced fishing pressure and therefore resulting to improving fish stock".

Since most of the fishing grounds were under the protection or administrative mandate of Menai Bay Conservation Programme, it was also felt that the experiments should be as a step to encourage the Menai programme to step up enforcement measures against destructive fishing practices in the area.

Challenges encountered: The greatest problem that the Team faced was in using some of the methods – such as the cards used in the interview process. It has been quite complicated for some members and therefore those who have mastered it have been assisting and teaching other members how to apply them during their discussions with fishermen. Omar for example trained Hamad and Mohamed Ali Ussi on the card technique. Once able to use it, Omar finds the card technique as an effective tool to get information that was needed on the fisheries and people's preferences.

Capacity building: As Omar, a scientist with the Department of Fisheries, I think have benefited in the following ways;

- learning about techniques in participatory identification of issues related to the fisheries
- participatory planning methods – learning how to avoid the top-down process
- direct involvement in planning for fisheries management and monitoring
- more appreciation on the value of socio-economic issues in fisheries management

"we used to make 'express' visits to local communities to local communities, explain on fisheries management, and leave"

Omar and his DFs Team mates have also shared information on the project with other officials in their Department. For example they organised a workshop whereby in addition to sharing results from the experiments, information on the PARFISH tool was disseminated

Participatory processes – have enabled the Scientists Team to establish what looks like a collaborative venture on management of the fisheries. Through sharing of results from the experiments – through feedback and continuous dialogue – "we have been able to put forward this element of collaboration"

Transfer of knowledge: In Omar's opinion, he believes that although it may be too early at this stage to confirm anything, a firm ground has already been laid down for establishing a knowledge base on responsible resource management in the participating communities.

- Firstly, "many of the participating fishermen understood from the questionnaire sessions the value of discussing about a range of scenarios and what these meant to their fishing incomes.
- Secondly, at least some ideas on the relevance of keeping records on the fisheries were initiated. Omar admits that some of the techniques were much too foreign and complicated for local people – such as tagging or measuring fish – but he said that these were just for the experiments – what was meant was to build a culture for monitoring the local fisheries among local people. Omar also admitted that more localised techniques need to be identified for such purposes.

He mentioned that he had previously been involved in a similar project within the Misali area fisheries where together with Scientists from the Directorate of Fisheries

and IMS had involved fishermen to collect and record statistics on the fisheries, He is not sure whether the fishermen have kept on the practice, but the motive was similar – encouraging them to maintain the culture of monitoring the fisheries.

Other benefits from the project include – the designing e.g. the PARFISH tool. The tool, designed from project activities is now available, although every time it needs to be used it has to be adjusted to fit local environments. "The tool is still under evaluation, but can be used .. it offers a guideline … ground-based approaches to management"

On local management plans: According to Omar, much more needs to be done to enable local communities pick up the practice of planning for responsible fisheries. "I know that local communities expect results or change in a short while, and *mvuvi anataka aone mabadiliko na faida haraka* … so do we as Scientists … but this not the case .. things take time … [in any case] only giving guidelines to people is not enough .. but I think what has been important from the process is enabling them to appreciate issues that will help them in planning for or thinking about responsible fisheries – e.g. record keeping and monitoring"

HOWEVER – Omar believes that making local management plans for responsible fisheries needs more than just initiating local management guidelines because the ultimate mandate and powers to confer areas for such jurisdiction remain on the government. According to him, "the government is supposed to give local communities the mandate to do so, that is, establish by policy the right of villages to have areas were they can enforce such management plans – rather than leaving it fluid .. and therefore everybody saying it is the responsibility of the government" The government is still hesitant on this issue.

The need to have more collaboration with other sections of the government is therefore necessary to enable any local plans to be implemented. According to Omar, through strong linkages between Scientists and government authorities, the PARFISH project can lead to implementable management systems. "IMS started at the bottom [ie grassroots level] but it now needs to go up to those with the powers on approving management capacities"

3.0 LOCAL LEADERS AND FISHERMEN

3.1 Faridi Kifani Fisherman Dimbani 19/02/05

Faridi is a 47 year old fisherman who was born and grew up in Dimbani. He has a family of 7, including his two wives. Faridi has been a fisherman all his adult life, and he has specialised in line and hook fishing. "I use a small boat - this is my own choice, although if I get enough capital I may buy fishing nets, they bring more income". "I have always relied on the fishing seasons influenced by the monsoons. The species I am likely to get and the fishing grounds are all dependent on the type of the prevailing monsoon. Commenting that he wasn't sure of the exact calendar period, he said, "between January and May - I fish for *kolekole* around the reefs near Mtende village, between June and July I fish within Dimbani fishing grounds for *changu, chewa, changu chole*. In April I fish using '*kulambaza* technique' for big fish such as *mbasi, nguru, midani*. In the calm season '*leleji*' I get other kinds of fish.

Knowledge on the fisheries – "I have sufficient knowledge on the local fisheries. I know where to fish in which season. I can also identify most species found in our

area, and I thought if I do not get fish at a particular time it is because of the seasons, or, I will just get it if I use bait. If we get a few fish we just say '*wingu baya'* (implying there is an evil shadow) If we get more fish the following days we say – '*wingu limepita*' (implying: the shadow has passed)"

Faridi does not recall the dates when Narriman and the Researchers from IMS came, but he remembers that they told them they were intending to conduct activities whose ultimate benefits was for the local people. He narrates his encounter and experience when participating in the project.

He said "the researchers came and told us that they want to show us strategies that would help us know whether our fish stock is decreasing or not. I was therefore interested and decided to volunteer for the experiment. A major incentive on my part was to get exposed to strategies that would enable me adopt new fishing techniques (*kubadilisha mavuvi*).

People at the village selected Mwamba Uzi for the experiments. We therefore registered ourselves, about 60 of us [he was not sure of the exact number but he referred to many people]. We were then given a timetable – the time set from 7 am to 11 am everyday for about a whole week. We were asked to fish throughout that period and our movement recorded. We were then given TShs 4000/- each everyday after the fishing exercise, including the catch after the researchers on the landing site did their experiments.

The measurement exercises were a bit strange – using rulers!, but we know about weighing scales. We were told that the reason was to know what sizes and species we currently had so that when we measure later we can tell the difference. We usually measure the sizes of fish by looking at them only – especially when you sell – *samaki mdogo, samaki wa kati, samaki mkubwa* – but normally not often do these assessments entail thinking about the situation of the local fisheries. *Tumejikita katika imani* (lit: we are engrossed in our traditional beliefs) believing that if we do not catch today, we might catch tomorrow.

One of the things we noticed during the fishing exercise was that our catches became smaller and smaller every other fishing day. This showed us that fishing efforts – especially of such concentrated nature - have a relationship to the size of catches. But from what I know, line and hook fishing does not destroy the environment, because by using this method, it is difficult to catch fish in their breeding areas (*samaki aliye katika mazalia anakuwa mgumu kupata*) or juveniles. But the *nyavu* can get any type or size of fish. There are about 50 *kokoro* fishermen in the area. I suggest these should also be targeted for marine degradation exercises.

Even for this exercise, normally we do not have concentrated fishing in one spot as was practiced in the project – going to one area with 15-30 vessels at the same time on the same spot! We usually go 5-6 vessels and often at different fishing spots.

However, from the exercise, we do discuss these days on what to do about our fisheries – and especially from the card game – thinking on what they would be like in future. We have not yet drawn a fisheries management plan.

3.2 Abrahaman Hamis Omari Dimbani 19/2/05

Abrahman is about 42-43 years of age [he is not very sure] and he calls himself a specialist of reef fishing. He is skilled in both the line and hook and the net. He

sometimes uses the fishing traps *madema* during the southerlies. He has been fishing since he was schooling. He said, to be clearer, the use of each fishing gear or technique depends on the season, and therefore my fishing practices also rhyme with the seasons.

About the PARFISH project, he said, I know it very well. The Research Team came here with two *wazungu*. During the initial public gatherings, they asked for somebody who knows the reefs well, and local people selected me as the first guide. Therefore with another fellow from Mkunguni village called Bao, we took the divers to the reefs and waited for them as they dived and made assessments on the conditions of the reefs.

For the following days we were taken, a group of us to fish at the reefs – we were quite a number and we had to take 4 boats (normally larger than a *mashua* and engine powered) that also had a number of small *dau* tailing them. Each of our activities was recorded – i.e. time of the trip to the fishing spot and time of arrival at the spot; the time of our return and time of arrival at the landing site [*bandarini*].The fish was measured-

- per species
- per length
- per weight

These measurements were conducted by the two *wazungu* together with Omar of the DFs and one villager, Pandu who is also the local Beach Recorder (*Mkuu wa Diko*) and also Omar's close associate in fisheries activities. Pandu also served as the local guide.

The major objective of the whole exercise was to make us appreciate why and how fish stock decrease – and we saw it – from the effect of concentrated fishing – we saw how our catches got lower every following day and the lowest towards the end of the experiments. This was a big lesson, and since we normally do keep records, this was a big lesson.

Lessons learnt: "we should not concentrate fishing in one area for a long period, although we usually do not have such fishing practices. It is only practiced in those not so frequent incidences when we learn that one of us has caught a significant catch in a particular area. *Kama mtu ameshehena kolekole mahali Fulani. Kesho wote tunaenda* (lit: if somebody has realised a huge catch of *kolekole* in a particular area, tomorrow all of us go there)"

Abrahaman also said "*kupima, sikuona ndani*", (lit: In the measurement, I did not understand a thing) implying that the tagging, measuring by rod. But he knows about species identification – they usually can name most of the species "but we usually do not associate our species identification with thinking of the conditions of the fisheries. "so this was another lesson … that we could be able to learn about through these strategies"

"Anyway, I believe that the whole exercise was for the benefit of the Researchers, they took data, they come again and take their records but it was for their own use. We have not been able to plan anything in that regard. We were made to participate – actually through a campaign – i.e. we were given money in order to participate … because it is not easy to convince a person to concentrate on the same fishing grounds with many other fishermen, everybody wants to go one's own way"

3.3 Jamhuri Haji Dimbani 19/02/05

Jamhuri calls himself '*mvuvi mroho'* (lit: greedy fisherman) because he can practice almost any fishing technique. He sometimes uses gill nets, sometimes the line and hook and sometimes *kapoti* (a line tied with several large size hooks ideal for catching big fish). As his colleagues explained, Jamhuri also said that he usually changes his fishing practices according to the seasons. He said "*kila pepo na uvuvi wake*" (lit: every wind with its own fishing). "Each season also enables us or provides to us different species of fish – and therefore we also target those kinds of fish – e.g. during ***kaskazi*** we get *kolekole*, and we do night time fishing around the reef for species such as *uzi*, *karage*, *changu*, *chewa*, while during *kusi* we get *panje*, *mbase*, etc." Kaskazi he said, is the most lucrative fishing season, and a fisher can realise up to TSh 20,000/- a day"

On the project, Jamhuri said, "the Research team entered our place gradually, they started by asking us questions about the fisheries, wanted us to reflect on the condition of the fish breeding sites, they also wanted us to explain how do we protect these areas so that they suffice the needs of the villagers. They then wanted us to think of fishing efforts, think of what has changed from the past, such as increased population and to make an assessment on whether we think the fish stocks are enough for us, or in view of the changing circumstances the stock will be enough for all of us."

"With time I became used to their presence and their questioning and later decided to join them. They also told us that we will be paying you per day in compensation of your participation in the project, including your catch for the day".

The 2nd phase involved going to the fish within the reef area. In this phase we did a 7 day fishing experiment, where we witnessed a gradual drop in our catches after each day". Jamhuri said then their fish was then measured, weight and height and separated according to species. He then said, "species identification is not a new thing in the village, although I saw some species that I hadn't seen before and therefore could not identify their names. But we do not have a tradition of measuring the heights of fish. We used to have a place where fish were weighed for purposes of marketing only.

Jamhuri is however confident that being part of the project has made him 'heard'. He said "I have been able to voice my concerns on the fisheries and to discuss with them how to make effective marine protection measures" These are some of the things that we discussed during the workshop that also was used to disseminate results of the experiments"

Jamhuri was of the opinion that some of them use traditional fishing methods that are not harmful, and therefore need no monitoring. "But the problem with our fisheries I think is not concentrated fishing, but rather, extensive use of destructive fishing practices. There are several big fishermen who use engine powered boats. These normally fish in deeper seas, and sometimes collaborate with those using trawling nets who drag from high waters up to the beach area – leaving nothing behind and destroying the marine environment. We are currently in conflict with neighbouring Mkunguni village (also a participating village in the PARFISH project) because they harbour fishermen who use trawling nets (*uvuvi wa kuburura*), although we also have the same in our village. The conflict flares when some of these fishers cross over the agreed fishing grounds to that of the neighbouring community.

3.4 Joint discussion with Dimbani 19/02/05

- Kassim Fadhili Ramadhani - a local leader (in the absence of the current *Sheha*, he was the *Sheha* two years ago when the project was being introduced in the village in 2003)
- Pandu Ahmed Daudi – *Mkuu wa Diko* (The Beach Recorder). By virtue of his position, Pandu seems to be the first contact researchers on coastal and marine issues reach at the village. He has thus been involved in many studies, including marketing of marine products, diving with visitors wanting to enjoy the marine wealth; escorting researchers on environmental destruction and many others. IMS in particular have used him very regularly in many of their studies.

According to Kassim, the project made entry through the *Sheha* and asked for participation of fishermen to conduct experiments. The *Sheha* responded by requesting the fishermen's audience. Only male fishers attended the meeting because "that was what the Research Team needed, people who caught fish – and naturally it was men, therefore women could not attend" In this first meeting the research objectives were tabled. In a second meeting, the agenda for selection of an appropriate reef was discussed where the fishermen were asked to make choices and the final selection landed on Mwamba Uzi. The number of the fishermen to participate in the fishing experiment had been pre-determined by the researchers, but the fishermen were consulted in the timing. The fishermen recognised the whole exercise was for research purposes and were therefore quite compliant with the procedures proposed.

Pandu qualified this statement by saying "the researchers wanted to answer for themselves what were the reasons for the declining stock of fish and it was envisaged that in the daily records they took, they would be able to know the answer"

Among the activities that Pandu participated in included record taking on fish. There do exist certain systems for assessing fish stock and therefore this objective of the research was not very new.

"We are used to have such kinds of researchers here at Dimbani, they come demanding to know different aspects related to the fisheries or different aspects or benefits from fish. One of the researchers that I was involved in [Pandu] was on nutrition – i.e. examining household requirements for nutrition was geared to make people or households be aware of what was required for household consumption so that they maintain appropriate nutrition requirements"

Any benefits? Too early to tell, '*bado mwanzo'* and it is difficult to tell whether there is any change in fishermen's behaviour

Knowledge transfer: The two officials believe that although the research may have had the overall objective of suiting the researchers own needs to know about the local fisheries, local people have learnt a few things, and these include the following;

- effects of concentrated fishing made aware;
- exposure on the importance of record taking;
- challenging traditional assumptions that 'fish will always be there'
- exposure on making at least realistic estimates on fish stocks and fish stock decline

- for divers like Pandu – being exposed and taught on breeding grounds (*mazalia ya samaki*), and how to estimate destruction, overall gaining knowledge on marine life

All of these have made some people [though individually] to think about or have some awareness on how to deal with marine life.

Among the problems that were encountered by the participating fishermen was the use of technology that wasn't common among the people in Dimbani, for example, using the sophisticated diving equipment that local divers are not used to, therefore Pandu and his colleague could not say for long underwater with the researchers.

3.5 Masoud Ameir Haji Mtende 20/2/05

Masoud is about 50 plus in age and said he has been a fisherman for more than 40 years. He works as an employee in one of the *ngalawas* in the village for a daily *posho* of usually about TShs 4-5000/-. As our discussion progressed his '*tajiri wa ngalawa'* came over and gave him TShs 3000/- for that day whose proceeds were not so good. He said he goes to fish every day except on Fridays and if he has an important issue to attend to. Masoud speaks relatively good English (for a villager), proud of his earlier school days. People get good incomes here during *kaskazi* especially where the range can be not less than TShs 7-10,000/- a day per fisherman.

He recalls the *'mradi wa uvuvi na kutia vitobo samaki'* (lit: project of fishing and piercing the fish). He said "they came to the beach area (*pwani*) and explained that they needed to work with some fishermen – about 20 – 30 people. They arranged us in several *ngalawa*. We then fished for about a week around Mwamba Kungwi and Kizimkazi and they would give us TShs 3000/ each day including the fish we caught. We did not demand for it, they gave it to us on their free will" They spent about 5 hours fishing, from 2 pm to 7 pm every day of the experiment.

Amongst some of the benefits he thinks he had gained from participating in the project, Masoud said he thinks he has been able to realise that intensive fishing activities, even for a period like a week has a negative impact on fish stock. He said "we usually know that we are not supposed to concentrate fishing in one area and this is why we usually rotate – '*tunabadili maeneo ya uvuvi kipindi kwa kipindi'* (lit: we change fishing areas from period to period), but I had not witnessed the effects in the manner that we did during the project. He also said that "sometimes we may fish for some time in a particular area, but not in such huge numbers"

If they were to do it again, he said, "they should at least select the best fishing seasons – i.e. during *kaskazi* – since the message will register more effectively in people's minds if they witness declining stock from intensive fishing during *kaskazi* – otherwise the timing for this experiment was not ideal – it was *kusi* – and usually the fisheries were not so good – *mavuvi hayakuwa mazuri*"

Masoud was also impressed by the fish weighing and measuring activities. He does not clearly recall the objective, but he thinks it was for research purposes, not for them to know anything.

The workshop last week, according to Masoud was the most relevant activity because it gave him an opportunity to discuss with colleagues what should be done about destructive fishing practices – how can it be eradicated. He mentioned the use

of *bunduki, kuchokoa pweza and nyavu za kukokota* as the most destructive, and that some of their own youth including fishermen from Makunduchi were habitual offenders in this regard. It has been difficult for the Local leadership to control them since they are their own. [Masoud mentioned this last point in reference to a young man who went right across the village and past us on a bike carrying his *bunduki* openly].

3.6 Mwadini Musa Vuai Mtende 20/02/05

Mwadini has lived in Mtende for 15 years now and he practices a range of fishing methods – line and hook, *nyavu*, and used to dive for octopus and lobster (*kuchokoa pweza*). He said he no longer dives "but a few arrogant fishers still practice it although it has been prohibited".

Mwadini recalls that the Research Team came and sought them through Bwana Diko (the beach Recorder) "and we agreed because there were some benefits – *tija fulani* – which were cash and fish, although we were given without asking for it. The experiment involved going to fish each day for 7 days. There were about 30 of us".

He recalls that the objective for the activities was to make people appreciate the causes of declining stock. "We did not know exactly what was the reason, because fishing successes do not have a pattern, you can fish today and get fish, you may fish the next day and get nothing – sometimes you come back home without even *kitoweo* (lit: relish for the day). This is because of our belief that the sea always has fish '*samaki wamo tu'*

In our evaluation we realised that sometimes fish stocks decline from our own practices. My long experience in fishing has shown me other reasons also responsible for decline in fish catches – for example, that seasonality also affects the amount of fish that people can access – for example the heat chases away fish from shallow waters when it is too hot and therefore most of the fishermen cannot get them.

Mwadini is not sure why the elaborate procedures for measuring were carried out but he thinks the purpose may have been to make them realise how much a fisherman has got (in terms of weight) so that "we can get fair prices for the catch" The measurements also showed us who was better at fishing compared to the rest. Otherwise we thought that this part was for the experiment only.

The workshop was spoken quite highly by Mwadini who said that "during the proceedings we were able to discuss the objectives of the whole exercises – the fishing experiments and we discussed how that experience can stimulate people to think about and make assessments on the condition of the local fisheries".

Mwadini concluded his views by requesting that "if the project will come again, they should come when there is plenty of rain, when the season is good eg *masika* – I think the situation of the fisheries will be different"

In addition, he said, "such experiments should wind up by giving people alternatives on what they should do after the lessons intended to be imparted to the people, rather than leave people without any other options"

3.7 Haji Pandu Haji Mtende 20/02/05

Haji fishes using *madema* (fish traps) and his involvement in the project was only at the level of the workshop. According to Haji, the major objective of the PARFISH project is to raise the standards of living in fishing communities. He learned this during the workshop when participants had to assess whether the whole exercise was of benefit to them.

In the workshop they were also told that the fishing exercises were for research purposes so that fishermen would be able to know the range of species found in the area, which species were more than others, and their weight. They thus discussed what should be done so that the fishery improves.

Some of the things they discussed included:

- the number of visiting fishermen who set camps (*madago*) along the beach should be controlled. This is because they are responsible for destructive fishing practices
- the use of too many fish traps (*dema)* in a location chases away fish because they disturb the marine environment.
- How do we deal with '*uyumba*' a sea plant that is poisonous and therefore harmful to human health
- Too many fishermen compromise the availability of fish

Haji was therefore of the opinion that, although the whole project is for research purposes for the IMS, he is convinced that in the process it can help in increasing the abundance of fish and therefore catches to individual fishermen.

3.8 Bashir Faida Mtende 20/02/05

Bashir is the Beach Recorder for Mtende and an employee of the Department of Fisheries and Marine products. He is also a farmer, keeps livestock and occasionally practices fishing. He has lived in the village for 14 years. His responsibilities include:

- encouraging people to use appropriate fishing methods
- issuing fishing licences
- keeping statistics
- inspecting catches especially to see if the fish are fir for human consumption.
- collecting revenue from the landing sites

He said he has wide knowledge on the local fisheries, that include species identification, assessment of fish sizes, some knowledge on breeding and stages of fish development (*ukuaji wa samaki*). He usually also ponders on the causes of fish decline in the local fisheries and in his opinion, the main cause is the use of many fish traps and other techniques, but particularly destructive is extensive use of *nyavu*, which to him collect large amount of fish and without discrimination.

Bashir's recollection of the year 2003 PARFISH project's experiments was very clear, and according to him he was part of the planning team and did a lot of mobilising for it. He said, the choice that the Research Team made of fishermen who used the line and hook was influenced by the season – it was '*kusi*' and although the Research Team wanted also '*nyavu*' fishermen, the season was not ideal for *nyavu* fishing. As an after thought he said that if the project had been conducted during *kaskazi*, it would have been easier to get a range of fishermen.

His participation was in terms of keeping and recording the time, weighing catches and specie identification. The fishing area was then demarcated by buoys and it was clear that the participating fishermen could see how their catches declined after each fishing day..

Bashir believes that the project has imparted valuable knowledge on fisheries management to the people. These include:

- The fishermen were able to know the different kind of species that are available in their areas – through the specie identification process

The workshop: Mtende participants at the workshop included the *Sheha*, himself and 9 fishermen (including a woman who catches small shrimp). They discussed bad fishing practices and how to control them. One thing that was emphasised was to seek support fro government authorities in controlling them.

"After two years, since the research was conducted, there hasn't been much change", Bashir said. He said "*kumbadilisha mvuvi maskini ni kazi ngumu sana*, (lit: changing a poor fisherman is really hard work). A fisherman can only change fishng practices if he is empowered with alternative fishing equipment – but not by just telling him to change when he needs to live and do so is still deepening on the *ngalawa* and *tanga* (sail). Due to the lack of more efficient gear, he will fish mostly around the same places year after year"

Bashir's expectations are that with the local community they may be able to develop plans for improve management of their fisheries and therefore improve individual catches. They may identify and therefore demarcate areas for fishing according to particular seasons/periods. Bashir also commented that future exercises should involve more fishermen using different gear.

He finally recommended that research results should be disseminated widely but also clearly so that people understand processes that affect their lives.

3.9 Hamisi Juma Hamisi Mtende 20/03/05

Hamisi is a retired Senior Police Officer and is currently Mtende's Sheha. He has been in this position since 2003 and therefore is quite conversant with the project.

He said that as the *Sheha*, he participated during the introduction of the project to the people. He has also participated in the selection of fishermen for the experiments and in the feedback sessions such as attending the dissemination workshop in Kizimkazi. Women were not selected because of the type of fishing that they conducting – catching small shrimp or *dagaa*, while 50% of the men in the village are full time fishermen.

Hamisi thinks that most of the fishermen have been able to relate some of the experiments to what is happening in their lives. The best example he thinks comes from the lessons form tagging fish. He said that local fishermen were advised that in case of one of them fishing one of the tagged fish he was to report or take it to the Beach recorder of the researchers/or District Fisheries officials for their records in order to enable the research to proceed. These experiences have enabled them to appreciate the meaning of conservation of fish. According to Hamisi, some time after the researchers had left, some fishermen caught some of the fish that had been

tagged during the experiment and in their opinion, the fish had grown in size (length and weight).

[During our conversation, a local villager who fishes using *madema* said “the objective of the tagging experiment was for us to see if fish circulate and come back to the original grounds. In this way we can know that if you conserve the fish then the benefits may be accrued later because the fish will grow and you can get it anywhere around your fisheries]

Hamisi was also of the opinion that local people have also been able to appreciate the importance of demarcating areas for conservation of the fisheries such as the areas around the reef – and they agree that concentrated fishing around the reef areas will have a negative implication on their lives. The Kizimkazi workshop was also important in allowing people to discuss the objectives and benefits of conservation of the marine environment, protection of fish stock and its benefits to people’s lives.

There has been thus some implication on knowledge transfer to local people, he believes and he said the knowledge actually built upon some of the common experiences people have on destructive fisheries. For example fishermen realise the destruction caused by the use of dynamite, poison (utupa) or bunduki and the indiscriminate killing of fish.

Local people’s defiant attitude against *uvuvi wa kukokota* especially by [what is claimed] fishermen from other communities is testimony of the demand to guard the fisheries against destruction.

But he admits that protecting the marine environment is a problematic agenda, this is because the area is so wide, and is used by fishermen from many other places – eg the fisheries adjacent to Mtende village is used by fishermen from Kizimkazi, Makunduchi and other areas. “We cannot prevent them from fishing, but at least can institute regulations”. In this regards, he then said that the Makunduchi and Mtende local governments have now agreed to join forces and develop a system of collaborative management to get rid of *uvuvi wa kukokota*

Annex 7: Assessment of the Impact of FMSP Project R6437 on the Namibian Orange Roughy Fishery.

Introduction

This report sets out to assess the impact that project R6437 (Management strategies for new or lightly exploited fisheries in developing countries) had in the Namibian case study location through the application of methods and tools developed within the project. The context within which the project was introduced is explained together with an assessment of the contribution that the project made in the management of orange roughy stocks in Namibia and in the transfer of knowledge about the methods to the Namibian fisheries assessment scientists during the project.

Project purpose

For developing countries new or lightly exploited fish stocks can represent valuable opportunities. However, because of the fishery is new or lightly exploited there is usually a lack of data and knowledge about the fishery and its dynamics that can make the setting of appropriate targets and limits difficult and may make the fishery vulnerable to overexploitation. In order to address such situations FMSP project R6437 sought to develop tools based on Bayesian statistics that would be useful to managers in developing countries faced with new or lightly exploited fisheries and that would provide precautionary advice that would allow the fishery to be developed while at the same time minimising the risk that the fishery would become overexploited. Tools were applied in two fisheries, the first was the newly discovered orange roughy fishery around sea mounts in Namibia and the second was the seamount fishery for snapper in Tonga. In this assessment we will examine the application of the tools that were developed to the Namibian orange roughy fishery.

Namibia background

Namibia is a relatively large country of approximately 825,000 square kilometres situated in south west Africa and bordered by Angola, Botswana, South Africa and Zambia. The hyper-arid Namib desert (approximately 170,000 square kilometres of the country) makes Namibia the most arid country south of the Sahara. Because of spatial and temporal variations in rainfall and lack of perennial rivers, drought is a regular occurrence in the country. In terms of marine resources, the establishment of the EEZs has provided Namibia with a sea area within its EEZ of 564,748 square kilometres (of which some 230,000 is shelf area) and approximately 0.02% of the worlds' seamount area.

Namibia gained independence from government under a South African mandate on March 21, 1990. Namibia is governed as a multi-party democracy with a clear division between executive, legislature and judiciary. The government is considered to be stable and the country is rated one of the best in Africa in terms of good governance and human rights (ECA, 2005).

The Namibian economy is heavily dependent on natural resources, both land based and marine. Mining is the most important sector of the economy with mining (metals and diamonds) contributing an average of 21.5 per cent annually to GDP in 1991-95. Fishing is second in importance to the Namibian economy and to the export sector. Since independence, Namibia has seen its fishery resources as an important source of revenue for the economic development of the country (Sumaila and Steinshamn 2004). Apart from these major sources of income, some two-thirds of the

approximately two million people in the population live in rural areas and are directly dependent upon the soil and living natural resources for their livelihoods (Brown 1997). Most of these are reliant upon subsistence agriculture including dryland cropping and/or livestock farming and receive far less income than those living in urban areas.

Per capita income in Namibia is estimated to be around $2,220 (1997), roughly four times the average for sub-Saharan Africa. However income distribution is considered to be the most unequal in the world, the richest 10% getting more than half of the total income. Part of the reason for the inequality is the legacy of *apartheid* and colonial rule from the days prior to independence from South African rule. An additional problem for the poorest groups in the country is the effect of HIV/Aids (affecting an estimated 22.5% of adults in 2001 (UNDP 2002)) that has led to reduced ability to work and an increased number of orphaned children. While Namibia has no Poverty Reduction Strategy Paper (PRSP), the government has outlined how poverty is to be tackled in the 2001 National Poverty Reduction Action Plan (NPRAP) and has been active in tracking developmental progress against the Millenium Development Goals (e.g. NPC 2004).

Namibia fishery background

Namibia is fortunate to have some important and productive fisheries. The Benguela current and the resulting upwelling system (with the Luderitz Upwelling cell in the south and Angola-Benguela Front in the north) is an example of a highly productive system that supports a relatively low number of species but with each having a high biomass and relatively simple interactions with other components of the system (Boyer and Hampton 2001).

Historically, because of the arid Namib Desert, few Namibians have lived on the coast and exploited the fisheries resources. Because of this, Namibai has not got a large artisanal fleet, in fact there are only about 300 licensed fishing vessels in the whole of the Namibian fisheries sector. In addition, the coastal topography means that Namibia has only two harbours (at Walvis Bay and Lüderitz) and no other significant landing sites. The simple interactions within the biological resource system together with the fact that the upwelling system and EEZ boundary largely limits fish stocks to Namibian waters and Namibia having no extensive artisanal fleet and only two harbours means that management for many stocks is less complicated and the fishery more controllable than it might have been (Sumaila *et al*. 2004).

Prior to independence, Namibian fisheries were exploited to a large extent, and in a largely uncontrolled fashion, by deepwater fleets from Europe and USSR. These fleets are estimated to have caught in the region of 20 million tonnes of fish from Namibian waters, greatly reducing the abundance of all major fish stocks, with little of the benefits from the fishery going to Namibians (Bonfil *et al*. 1998; Sumaila and Vasconcellos 2000, Nichols 2004). Following independence a new fisheries management system was developed that emphasised the development of sustainable fisheries, based on the best scientific advice available, that provided greater benefits to Namibians. Following the overfishing that occurred prior to independence, and in response to it given the importance of the resources to the country, the Ministry of Fisheries and Marine Resources was established in 1991 to protect, monitor, control and survey all marine living resources within the EEZ (Olsen 2004). The Ministry also had the responsibility for establishing a fisheries research institute that could assess stocks and provide advice on setting catch quotas. Overall

the ministry was committed to managing the fish stocks in Namibian waters with the objective of:

“to utilise the countries fisheries resources on a sustainable basis and to develop industries based on them in a way that ensures their lasting contribution to the countries economy and overall development objectives.”.

Management has been based on the setting of total allowable catches. The rationale for this being that the fishing industry is thus provided with knowledge about the expected catch levels for the year that they can then plan around. The purpose of this has been to promote economic efficiency within the industry (Nichols 2004). Since independence, the government has sought to ‘Namibianise’ the countries fisheries (through the 1992 Sea Fisheries Act) to ensure that the maximum benefit from the fisheries resources went to Namibia and Namibians. The main policy instrument used was to introduce rebates on the quota fees and rights to exploit the resources that were determined mainly on the extent of Namibian ownership, employment of Namibian crew and whether the vessel landed the catch in Namibia (Armstrong *et al*. 2004). Of the 163 rights held in 2003, all but one are majority held by Namibians. Also as a part of this policy, the government has committed to on-shore processing that would not only increase the value of the products from the fishery but that would also increase the employment opportunities for people from the north of the country (Sumaila and Steinshamn 2004). In addition, the Ministry of Fisheries and Marine Resources has also sought to ensure that the benefits from the fisheries also go to those who were amongst the most disadvantaged sectors of society. This ‘empowerment policy’ has led to the allocation in of fish quotas to Namibian newcomer applicants (Armstrong *et al*. 2004).

Currently Namibian fisheries are considered to be relatively well managed (Sumaila *et al*. 2004, Nichols 2004). The three main commercial fisheries are based on hake, sardine and horse mackerel. The total catch of all species in the Namibian fisheries has varied from about 500,000 tonnes per annum to about 800,000. While the contribution to GDP has varied over the years, the importance of the fisheries sector has been increasing with the contribution of the fisheries sector to GDP rising from about 4% at independence to 10.1% in 1998. Approximately 95% of Namibia's total fish production is exported (with the EU being a major recipient of Namibian fisheries products) and the value of these exports in 1999 was about N$2.3 billion (US$333 million). Fish and fish products contributed about 30% to total export earnings with the EU an important market (Nichols 2004). Around 14,220 people are employed in the fisheries sector in Namibia, approximately half of whom are employed in onshore processing. The policy of encouraging on-shore processing has led to an increase in the number of whitefish processing plants from zero in 1991 to around 20 by 2003 (Nichols 2004).

In addition to the contribution that Namibian fisheries make to the national economy, individual fishing companies also make important donations to social development schemes throughout the country, including school and clinic building (Nichols 2004). Nichols (2004) estimates that the companies have contributed some N$33 million to such causes over the past 11 years.

Orange roughy fishery

Orange roughy (*Hoplostethus atlanticus*) is a deepwater demersal species of whitefish. The fish is prized for its tasty firm white flesh and there is considerable

demand for this fish in the world market. As for the biology of the fish, orange roughy are generally associated with deep sea (500 to 1,500 metres) seamounts and plateaus. The fish aggregate around these seamounts in very large numbers during feeding periods and when spawning, making them available to deep water trawl gear. While they are able to grow to a maximum length of about 60 cm (approx 3.5 kg), they are usually caught at sizes between 35 and 45 centimetres (0.8 to 1.5 kg). With a lifespan of up to 150 years, orange roughy are considered to be one of the longest living of all marine fish species. However, because orange roughy mature have a low fecundity and only start reproducing between 20 and 40 years of age the species is particularly vulnerable to overfishing and stocks will be very slow to recover.

The Namibian orange roughy fishery started in 1994 after the first licence was issued for an experimental fishery in 1993 (Boyer and Oelofsen 2004). The species is present in the deepwaters (500-1000 metres) off the entire Namibian coast but commercially viable aggregations only exist in four spots (named Hotspot (discovered 1995), Johnies (1995), Frankies (1996) and Rix (1996)). As the fishery began to develop it was felt that there was a need to impose management controls and catch controls were introduced in 1997 based on biomass estimates from trawl data (Branch 1998). As Butterworth and Brandão (in prep) explain, the intention at this time was to implement a long term low risk fishing strategy based on the estimated orange roughy abundance that would see the TAC reduced from the initial level of 12,000 tonnes down to 5,000 tonnes (90% of the maximum sustainable yield (MSY) as estimated at the time) over 14 years. Once the viable fishery based on the aggregations on the four seamounts had been established there were three companies operating three medium size trawlers in what was essentially a single species fishery (Boyer and Oelofsen 2004).

While in all Namibian fisheries the importance of communicating with industry has been realised (though not always achieved), it was considered vital in the orange roughy fishery because of the developing status of this new fishery and the dangers of overexploitation. Cooperation between scientists and industry was ensured through the establishment of the Deep Water Fisheries Working Group (DWFWG) in 1995 (Boyer *et al*. 2001). This working group, consisting of researchers and senior industry figures was established in 1995 to enable the two groups to work together given the agreed objectives for the fishery. Up to 1997 a single company was licenced to operate in the fishery but in this year four more licences were issued (two for exploratory fishing only, not exercised) and the function of the DWFWG became a more formal institution in the management of the fishery with a role of providing guidance and advice on management (Boyer and Oeleofsen 2004). At this stage the fishery was faced by problems identified by Kashindi (1999) as lack of scientific information on current stock state and growth rates and a lack of time series data on the fishery. These were all problems that the project was designed to address.

Project objectives

The project was designed around two phases. In the first phase, new Bayesian statistical and decision analysis methods were to be developed that would enable stock assessment scientists faced with new or developing fisheries to derive precautionary effort-based management strategies. In the second phase, methods developed in the first phase, and associated tools, were applied to developing fisheries, including the Namibian orange roughy fishery, with the intention of enabling managers to make decisions about the fishery that were precautionary. This would thus reduce the risk of overfishing these fisheries during the crucial stage where not

much is known about abundance and dynamics and the stocks are vulnerable to such overfishing.

Fishery

As mentioned, the Bayesian methods developed in the first phase were applied to data from the Namibian orange roughy fishery, the intention was that these methods and tools would be used annually within the DWFWG by scientists appointed by the Namibian government in order to provide resource assessments that could then be used to recommend annual TACs. As the fishery develops, the need for these particular tools may diminish as more data is accumulated but in the first instance, where there is a need to avoid overfishing the aim was to provide precautionary advice.

Knowledge transfer

In terms of knowledge transfer, it was the aim of the project to disseminate widely through peer-reviewed papers in key journals the Bayesian statistical tools developed in the first phase. In addition, during the second phase the intention was to not only apply the methods, providing a worked example, but also train local stock assessment scientists in the use of these tools so that they could continue to apply them in the fishery as required.

Impact

Proper management of the nations' fisheries has been seen as being essential to the economy of Namibia and the development of the nation (Lange 2004). It is felt that the project was able to contribute to this through the development of fisheries management tools that have, when applied to the orange roughy fishery, led to the adoption of precautionary total allowable catches (TACs). The effect of these TACs is discussed in more detail below.

Fishery

During the project the Namibian Ministry of Fisheries and Marine Resources invited project staff to attend the DWFWG workshop to develop management strategies for orange roughy. Application of the methods developed in the project provided assessments of stock abundance and led to revised biological parameters for Namibian orange roughy. On the basis of these, risk analyses could be performed based on the assessments that allowed the scientists to explore the probable effects of various alternative management options. The findings of this workshop were subsequently used by the Namibian Ministry in support of the development plan for the fishery.

The findings developed through the project were used in the management process to set precautionary TACs for both 1998/1999 (12,000 tonnes) and 1999/2000 (9,000 tonnes). In addition, one of the fishing sites (Frankies) was closed to fishing in 2000 in order to generate new information about the dynamics of the orange roughy stocks given that abundance appeared to have declined between 1998 and 2000. These

management actions were agreed through the DWFWG, as described above and recommendations made to the minister. The process was much appreciated by those involved, both industry and scientists. Both groups were accountable to one another and the management arrangement worked to achieve consensus on the best TAC based on the information available.

Precautionary management of the fisheries and acting in a risk-averse manner when uncertainty is high, as in this fishery at that time, almost certainly reduced the chance of overexploitation in the initial years. This is important in a developing fishery, and especially a fishery for a species such as orange roughy that is so vulnerable to overexploitation because of its aggregating behaviour and that would also be slow to recover from any overexploitation because of its slow growth and late maturity. The benefits of the precautionary management early on will be seen in the years to come as more information becomes available about the fishery allowing the setting of catch quotas based on a better understanding of the fish stocks and their abundance. It was not possible with the limited data available and uncertainty over the stock dynamics to calculate what the effect of the precautionary TACs implemented was compared to the scenario under the TACs that might have been adopted if the project results had not been available to managers.

Post project

Currently the fisheries are believed to be in a healthy state, particularly in comparison with whitefish resources elsewhere in the world, and the outlook for the Namibian demersal fisheries sector is considered to be very positive (e.g. Nichols 2004). While orange roughy remains a relatively small sector in Namibia's fisheries, Kashindi (1999) believes that the fishery has produced significant economic profits for both industry and the Namibian government. As can be seen From figures 1 and 2, TACs and catches decreased between 1999 and 2001 as managers took precautionary action to ensure that the stock did not become overexploited. It can also be seen that the managers have been careful during this period to ensure that there were not more vessels entering the fishery, creating additional pressure on the stocks.

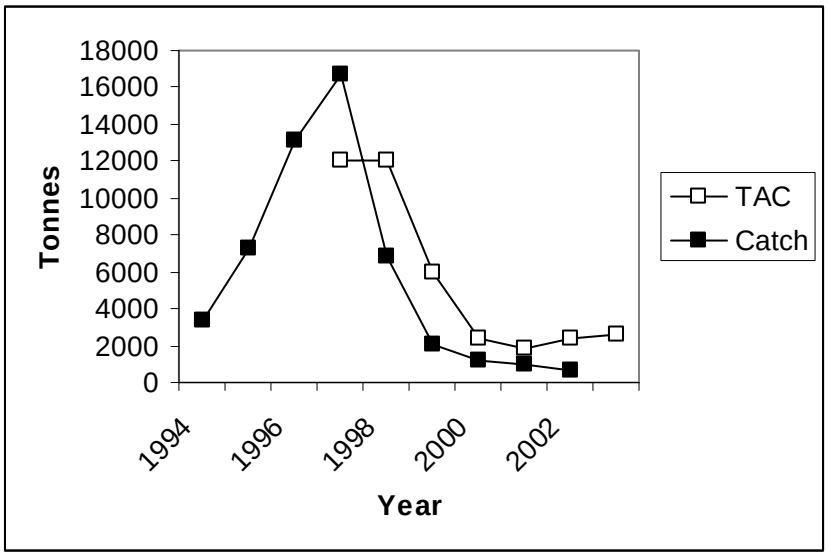


Figure 1. Total Allowable Catches (TACs) and yields from the Namibian orange roughy fishery (based on data from Sumaila *et al*. 2004).



Figure 2. Number of vessels licensed to operate in the Namibian orange roughy fishery (based on data from Sumaila *et al*. 2004).

One of the issues around the Namibian orange roughy stocks, and a source of contention between the government and industry scientists, has been the dynamics of the fish stock. In particular there have been alternative hypotheses as to why the fish stocks have apparently declined in abundance and some disagreement about the level of precaution that was necessary. In later years there have been conflicts within the DWFWG and agreement over TACs has not been possible within the group so that government scientists have made recommendations on more conservative TACs independently to the minister. The disagreements have been over whether the decline in abundances seen were due to the effects of fishing (either disturbance and habitat damage or catches) or whether it was in fact due to the fish only aggregating intermittently (Butterworth and Brandão in prep.). According to Butterworth and Brandão, the results of hydroacoustic surveys, which had indicated the declines in abundance at each of the sites, showed in 2002 that the declines in abundance seen were less likely to be due to the effect of catches. This was based on an increase in abundance at Frankies (closed since 2000) and allowed the fisheries assessments to be revised and showed a more optimistic picture. Because of this, the MSY for the fishery was revised upwards from 1620 tonnes to 2750 tonnes and a TAC was set for 2003 of 2650 tonnes (Figure XX).

In terms of the benefits from the fishery, because of the policy of Namibianisation of the fisheries it is thought that it is the formerly disadvantaged within the economy, who are newcomers to the fishery sector, who are set to benefit most from the fishery and the good management of it. In 1994/95 some 25% of the allowable catches were distributed to newcomers and Namibian vessel ownership (in all fisheries) had risen to 85% by 1998 and the share of Namibian employment in the fishing sector had also risen to 75% (78% in the deepwater fisheries) by the same year (Armstrong *et al.* 2004).

Knowledge transfer

The methods resulting from the first phase of the project, i.e. the Bayesian statistical methods that were developed have been published as a series of papers in peer-reviewed journals. The project has generated a total of nine peer-reviewed papers,

including an extensive review paper on Bayesian methods in stock assessment published in the ICES Journal of Marine Science and a contribution to one of the influential FAO Fisheries Technical Papers (see Annex 1 for details). Three of the peer reviewed papers have been co-authored by Namibian scientists. Subsequent papers have studied the application of these methods to precautionary management, and developed the approach further. In addition there have been six non peer reviewed publications produced and presentations of project findings have also been made at international symposia.

It has not been possible to measure directly the uptake of project results disseminated through the international journals and symposia in this project. However, it is likely that these results would influence subsequent work in this area, either through application or development of the methods within research projects, through application by fisheries management agencies worldwide or through a contribution to thinking and the development of methods in this field. What has been possible, at least for the peer reviewed outputs from the project is to examine the impact factor of the journals in which they have been published and the number of times the article has been cited to get an idea of how useful the results have been to other researchers and practitioners (Table 1). Citation analysis relies on the behaviour of scientists to "cite earlier publications because the work contained in them is, in some way, relevant to their own" (OECD, 1987, p. 34). Citation analysis therefore assumes that the number of citations for a particular article reflects how influential that particular article is articles relative to others. It can therefore act as an indirect, assessment of the quality of research. Citation analysis is attractive because it allows comparisons (given the underlying assumptions) to be made and enables a kind of quantitative assessment to be made. Though in regard to the latter it must be stressed again that this is more useful for the assessment of quality and an indicator of uptake rather than an assessment of uptake as the products of research should be used as a basis for implementing management actions that would not necessarily lead to further publications.
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Given the limitation to the application of citation analysis, there remain three broad assumptions that underpin the use of citation analysis: It is assumed that research output is consistently represented in journals, that the number of citations is a legitimate indicator of quality and impact, and that accurate data are available. While the use of impact factors and citation analysis has been criticised, and it may also under-represent the impact of the research by considering only a narrow range of media (scientific journals), it can provide some indication at least of the relevance of research.

While impact factors provide the mean citation rate of all articles published in the journal, it should be borne in mind that within journals it has been suggested that the most cited half of articles in a journal are cited up to around ten times more often than articles in the least cited half. It is therefore also useful to look at the actual citation rate for articles published in each journal (see also Annex 1 for details on the citations for individual outputs). This would seem to suggest that outputs from the project are, in almost all cases, and in some especially, having an above average citation rate. While this is a positive aspect, it has not been possible to identify the reason for citing the work or whether the citation is fundamental to the paper citing it or essentially trivial.

Table 1. Dissemination of research findings through peer-reviewed articles (Data from the Institute for Scientific Information).

Journal	Number of articles	Journal impact factor*	Times cited
South African Journal of marine Science	2	0.892	6
ICES Journal of Marine Science	3	1.063	39
Canadian Journal of Fisheries and Marine Science	1	2.432	19
Fisheries Research	1	0.956	2
Bulletin of Marine Science	1	0.826	7

* Figures for 2002, source: http://www.clib.dote.hu/dote-belso/jcranks03.html

Perhaps as interesting as the number of citations is the regularity of citation. As can be seen from Figure 3, excepting 2003, there has been a fairly regular citation of the peer reviewed outputs from the project. This suggests that the project outputs remain relevant to questions of fisheries assessment and continue to be useful to those conducting assessments and managing fisheries. Obviously articles citing the project outputs are peer reviewed contributions to research rather than examples of the uptake and application of the methods developed but it does at least provide an indication of the relevance of the research to fisheries assessment and management.

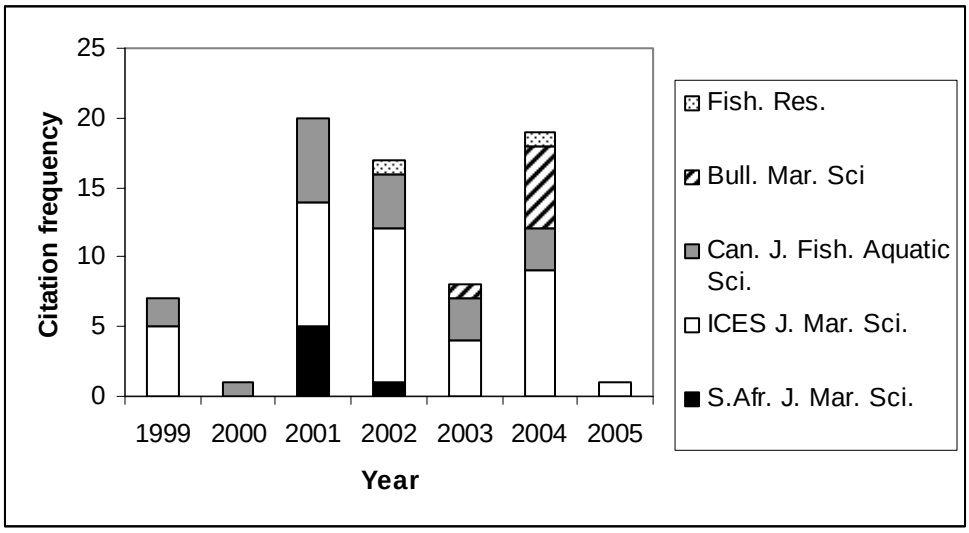


Figure 3. Frequency of citation of peer-reviewed articles over time.

Looking closer at the types of articles that are citing the project outputs, it can be seen that the majority (43) are articles on stock assessment and fisheries management (12) while there are also articles on Bayesian statistical methods (3), reviews of Namibian fisheries (4), which draw mainly on the articles in the South African Journal of Marine Science, and application of Bayesian methods to forest management (1). The citation analysis also provides an indication of fisheries where the stock assessment and management has, at the least, been influenced by project outputs. These include: Falkland Island squid, Scottish squid, North Sea flatfish, Mexican Pacific sardine, Mexican brown shrimp, Greenland walrus, Tropical tuna, South African pelagic, South African west coast lobster, Atlantic and Pacific salmon, Maine (U.S.) sea urchin, Australian south eastern fisheries, Australian abalone, Caribbean snapper and grouper and the North West Atlantic fisheries.

What the analysis does seem to indicate is that, currently, and with the notable exceptions of the important fisheries in Mexico and the Caribbean, most of the uptake of project outputs has been in the fisheries or research institutions of developed countries rather than developing. This pattern of application may be due to two important factors. The first is that the knowledge may not be as available to assessment scientists working in developing countries. Journals are expensive and for a library in a developing country to keep a range of the most important journals in the field can be prohibitively expensive. The second possibility is that the use of Bayesian statistics in stock assessments is still a relatively new area and the capacity to both understand and apply Bayesian methods may still be lacking or in its infancy amongst the assessment scientists working in many developing countries.

Within Namibia, the second phase of the project in Namibia led to substantial uptake of the methods that had been developed. A scientist was sent to Namibia to participate in the DWFWG and to assist the government scientists with their assessments of the orange roughy stocks. The methods arising from the first phase of the project, relating to precautionary approaches for lightly exploited fisheries, were presented at a workshop. In addition to this, the new methods were also disseminated to Namibian fishery scientists via tutorial workshops. Following this the methods were applied to the orange roughy fishery. In addition, project staff also conducted two tutorial courses on assessment methodology for Namibian scientists that included presentations on the methods developed. The first of these courses was attended by 22 national scientists. The second was a specialised instruction to the national scientist with primary responsibility for orange roughy assessments.

In both cases the intention was to ensure that the methods could be applied to the fishery after the project had ended. The project was fairly successful in transferring knowledge as the knowledge of the new methods that the Namibian scientists had was increased together their skill in using them. This was clearly demonstrated in the years after the project by the fact that the stock assessments have been conducted by the principal Namibian scientist. After the project ended the Namibian government continued to fund additional research and efforts to disseminate the results of the project. Longer term sustainability is less assured as the principal Namibian scientist has now moved on and is no longer working on the Namibian orange roughy fishery.

Conclusions

In the period since independence, Namibia is generally though of as successful in the management of its fisheries resources (Lange 2004; Gabeiras 1999). During this time the economic contribution to the nations' economy has increased and fisheries have become an increasingly important national asset (Lange 2004). Because deepwater species are slow growing, have low fecundity they have low productivity. Development of fisheries for these species requires care to ensure that the stocks are not overexploited during the early stages of the fishery.

In this case the tools developed in the project were able to successfully support the management decision-making process and provide assessments of the stock status and likely future status under a range of management options, based on the very little available data. These assessments were then able to contribute to the management of the orange roughy stocks based on a precautionary approach. It should be noted however that the contribution to management outcomes was facilitated by both the management arrangements in place (such as the DWFWG and the clear and agreed objectives that existed for the fishery) that enabled consensus to be reached on

management action and the nature of the fishery, which was not subject to any additional fishing pressure and that could be easily monitored. It was generally felt by the Namibian stock assessment scientists, and by scientist representing the industry within the DWFWG, that the project had made a positive contribution to the management of Namibian orange roughy stocks.

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Appendix 1: List of project publications

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Annex 8: An assessment of the economic benefits generated by project R7335

Xavier Irz and Colin Thirtle

Introduction

In this assessment our aim has simply been to assess the change in income stream attributable to the project and we are hence primarily concerned with the efficiency effect of the project (which should complement the livelihood analysis that centres on equity aspects). In order to assess the change in income stream we start by measuring profit from the exploitation of the water bodies in the sample during the two years of the project. In this assessment profit in each case is defined as total revenue from the fishery minus the cost of the fingerlings, gear use and labour input.

Values used in the assessment.

The rural areas of southern Lao PDR are not characterised by a very developed cash economy and in the community fisheries that are the focus of this study labour is effectively donated to the village by village members. Even so, with the existence of some sources of income such as working in the forestry or construction sectors a labour cost or opportunity cost for the labour input can be calculated using a cost of 3000kip/hour (UD$1 = 9000kip). For the stocking costs, the stocking density during the project was 3,500/ha and the unit price of the fingerlings of 50 kip per piece. This cost was inclusive of transport of the fingerlings. During harvesting a cost of the wear and tear on the gear of 140 kip/hour was used (based on information from local fishers and the Department of Livestock and Fisheries).

Data for the assessment came from two sources. The first source was data collected during project R7335 and the second source was data collected by the RDC in southern Lao PDR in 2003/04. From the original project data set, a few observations had no recorded output (i.e. no fishing had taken place in the waterbodies) and these were therefore excluded from the calculations. We were then left with 35 observations for the 2000/01 season and 37 observations for the 2001/02 season.

Results

Based on the data, the calculations indicated that the average economic profit per village was 10 million kip. This translates into $1,113 at an exchange rate of $1=9000 kip, or $250/ha. The bulk (>80%) of the cost is accounted for by the labour input, which means that if the assumed opportunity cost of labour is too high (because of unemployment and/or lack of alternative livelihood opportunities), we underestimate overall profitability.

It is not possible to do a meaningful economic analysis on the post-project data as information was not collected on stocking so it is not possible to assign a value to the catches. However, given the increases in mean yields that are indicated by Figure 1, it is reasonable to assume that incomes have also increased on average. This implies that the economic profit of $250/ha may have been achieved overall.

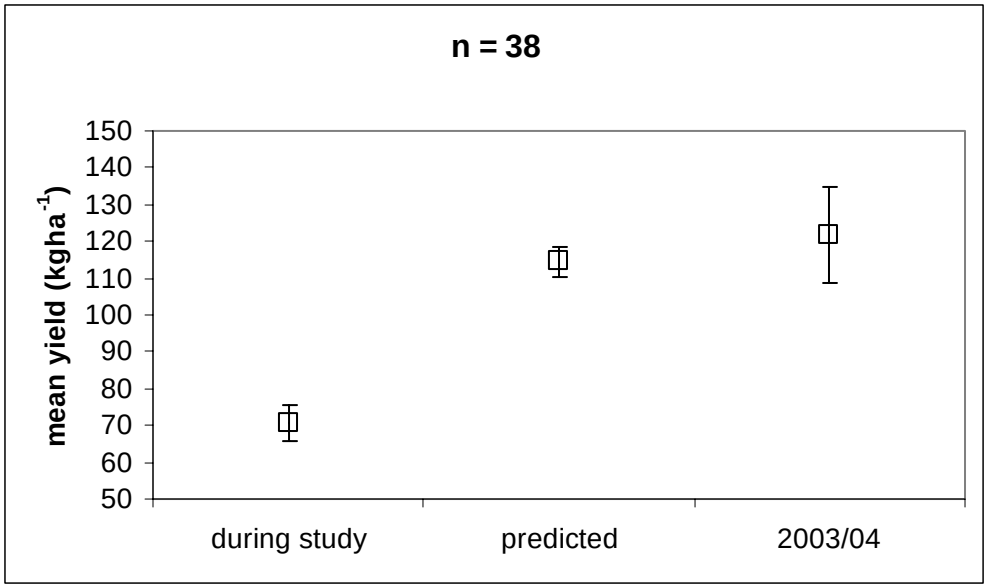


Figure 1. Mean yields during the project, as predicted if all waterbodies in participating villages were stocked at the same density as during the project but were stocked according to the project recommendations and the actual post-project mean yield per hectare based on data from only those waterbodies in participating villages.

The second stage of the economic assessment involves calculating the level of profit that was generated by the water bodies prior to implementation of the project. This seems necessary because most of the ponds were used more or less productively before the project took place. We used data from the project when available, but also had to rely on average yields and effort levels reported by Garaway (1999) for each management system when no data was available.

Using this data we were able to calculate that the average pre-project profit per village was 5.4 million kip or just under $600 per village, or $134/ha. It is therefore clear that the project was able to increase the income stream generated by the water bodies considered here since the level of profitability almost doubled. In addition to these aggregate results, the calculations show that profitability increased for a vast majority of water bodies thanks to the project (76% in each year). Overall, the increased profitability derives from a rise in total revenue and a decrease in total cost of roughly the same magnitude. This confirms the finding of Garaway (1999) that a key benefit from community management of the type advocated by the project is to limit fishing effort and hence increase CPUE, and not only to increase yield.

By comparing the two situations described above for the sample of ponds and villages considered here, the total increase in profit attributable to the project amounts to 167 million kip for each of the two years of the project, or $18,561. When discounted at 5%, the infinite net present value of the increased income stream from the project is just under $390,000; with a discount rate of 10%, the corresponding figure is $204,172; with a discount rate of 7%, it is 283,720. This compares with the cost of the project, which are shown in Table 1.

Table 1. Costs of implementation of the adaptive learning approach 1999 - 2002

Activity	Cost (US$)
Total project costs (DfID project R7335)	342,547
Project core costs (e.g. minus overheads)	244,535
Local collaborator costs	49,500
Field costs (stocking, data collection, transport, equipment, workshops for sharing information)	34,650
Stocking costs	5,712

On the basis of a discount rate of 5%, it can be seen from the above table that the benefits to the villages from the project is greater than the total costs of the project by a factor of 1.14. However, some caution needs to be taken in interpreting this as the analysis is based on the recommendations being adopted for all the waterbodies considered forever. A highly unlikely scenario.

While it is unlikely that all the waterbodies would be managed this way, it is also reasonable to assume that the recommendations would also be taken up and applied in other waterbodies, for example other waterbodies in participating villages and waterbodies in other villages that had heard about the recommendations. In fact, data from southern Lao PDR indicates that the recommendations were actually taken up in some 67% of villages that had participated in the project. In addition, some 15 additional villages had started managing community fisheries in the two years since the end of the project and are taking up the project recommendations. With a total area of some 21.8 hectares this represents an increase over average pre-project value of some $2,529 annually.

Overall it can be seen that the result of participation in the project was increased yields overall and the potential for increased incomes. The results also indicated that the infinite NPV of the management recommendations applied over all the project waterbodies assuming a 5% discount rate outweighed the project costs. It should be stressed that this analysis covers only the technical recommendations from the project and does not include the application of knowledge gained outside of the community fisheries.

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Annex 9: Assessment of the wider impacts of project R7335

Introduction

The purpose of the adaptive learning project was to develop and promote adaptive learning approaches to fisheries enhancement. The management of enhanced fisheries must be carefully tailored to local social, ecological and institutional conditions in order to provide maximum benefits in a sustainable manner. Adaptive learning approaches, whereby external institutions (governmental and non-governmental research-based organisations) can facilitate experimental learning by resource users, hold the key to the development of locally appropriate enhancements. The project aimed to develop a strategy for the implementation of adaptive learning approaches, including criteria to identify priority areas for adaptive learning and tools to evaluate adaptive experiments.

A case study of adaptive learning was implemented for small, village- managed, waterbodies in southern Lao PDR, in order to provide a test for the strategy and provide a "worked example" for later dissemination and training activities. This involved coordinated experiments across 38 communities to investigate stocked species performance and to gain insights into the costs and benefits of community fisheries management systems. Implementing the approach in these communities would benefit individuals, communities and governments participating in the use and management of enhanced fisheries, and those potentially developing such fisheries in the future through the development and testing of an 'adaptive learning' approach for enhancement fisheries management.

The immediate beneficiaries of the case study in Lao PDR are the participating communities. Previous research in Lao PDR[38] showed that enhanced community fisheries provide benefits to all sections of the community, and that no groups suffer significant disadvantage or perceive themselves to be disadvantaged.

Implementing the adaptive learning approach resulted in local learning and capacity building objectives. The project sought both to increase the knowledge on community fisheries by generating new information through planned cross-community experiments based on what those managing the resources wanted to know, sharing of this knowledge in timely and appropriate ways, and building the skills of key stakeholders involved in the adaptive learning approach. Specific objectives for each stakeholder group are shown in Table 1.

[38] See R6338CB and see also the theme sheet produced by the RDC [Regional Development Committee of southern Lao PDR] to see how this research fitted in with activities undertaken in Lao PDR on community fisheries systems.

Table 1. Specific capacity building objectives for each of the key stakeholder groups involved in implementing the adaptive learning approach in southern Lao PDR.

Stakeholder group	Knowledge objectives	Skills objectives	Methods used	References
Provincial staff	* Community fisheries management, including costs and benefits of different systems * Fish species (carps and tilapia) performance in different productivity waterbodies	* Use of participatory methods * Workshop design, conduct and evaluation * Planning * Fish preservation * Fish species identification * Water sampling	* Workshops * Practical demonstrations * Training course	* Workshop reports * FTR Annex 6 * FTR Annex 9
District staff	* Community fisheries management, including costs and benefits of different systems * Fish species (carps and tilapia) performance in different productivity waterbodies	* Stocking * Nursing * Fish preservation * Record keeping	* Workshops * Practical demonstrations * Training	* Workshop reports * FTR Annex 6 * FTR Annex 9 * Arthur & Garaway 2004*
Village administration	* Community fisheries management, including costs and benefits of different systems * Fish species (carps and tilapia) performance in different productivity waterbodies and which species would be most suitable for their waterbody.	* Stocking * Nursing	* Workshops * Practical demonstrations * Training	* Workshop reports * FTR Annex 6 * FTR Annex 9

* http://www.streaminitiative.org/Library/pdf/pdf-journal/2004/sj3(1).pdf

Through building capacity and knowledge within the village administration it was hoped that management capability could be increased. The project did not work with individual households but these would be expected to benefit through improved management (this may include increased management flexibility) of the community fishery. The result of improved management was intended to be increased benefits from the community fishery.[39]

[39] see Annex 8 of the Final Technical Report (FTR) [Garaway et al. 2002 Adaptive learning approaches to fisheries enhancement: final technical report. Available at www.fmsp.org.uk] for explanation of the types and levels of benefits from each of the community fishery

Because the project was concerned with developing and testing a learning-based approach there was constant evaluation of the process as well as the outcomes during the project. Within the project, and subsequently in PhD work by Arthur (2004), there have been attempts to assess the impact of the project in terms of perceived improvements in capacity as well as in terms of benefits to the villages (see Annex 9 of FTR – Project Final Technical Report, available on the FMSP website – see above footnote). These existing assessments of impact indicated that all stakeholder groups felt that their capacity had increased as a result of participation in the project. Whilst increases in knowledge were due to information gained during the project, skills were improved as a result of the *way* it was implemented. Village visits conducted in May 2004 to a number of villages also indicated that while the information generated in the project might not lead to increased yields and income from community fisheries, in a number of cases it enabled those managing the resource to take a more flexible approach to management and to continue to get benefits from the resource of differing types depending upon the circumstances that the community found itself in.

Poverty Reduction in Lao PDR

The Lao PDR poverty reduction strategy takes place in the context of market-oriented development moving away from the centrally planned economy of pre-1986. Despite rapid recent economic development challenges to poverty reduction are extensive: the average per capita income of the country as a whole is low ($310 per annum in 2002: World Bank, 2003), with 73.2 per cent of people living below the income poverty line ($2 a day: 1990 – 2001). Evidence suggests, however, that recent rapid economic growth has benefited poor people, although an increase in inequality has acted against the very poor (Fare, 2003). Within this context, and despite significant regional variation poverty incidence is generally higher in rural than urban areas, where possibilities for income generation are limited, infrastructural development low and service provision weak.

Being a landlocked country, the people of rural Laos depend on the inland fishery for all of their aquatic resources. In this respect, Laos has a broad inland aquatic resource base, which it is argued is of "over-riding importance given the lack of alternative sources of food for much of the population" (Bush, 2003: 21). Despite the importance attributed to fisheries it has been noted by Funge-Smith (2000) that the livestock and fisheries sub-sector as a whole is critically under-funded relative to other agriculture sector activities and does not generate income like forestry. This is illustrated by the fact that government statistics show that the sector receives only 3-5% of local resources, while irrigation gets 66%. In addition, the focus of foreign public investments have been irrigation and forestry (MAF, 1999). Funge-Smith goes on to stress that "the livestock and fisheries sub-sector is probably one of the few reliable options for alleviating poverty of the rural poor of Lao PDR" (Funge-Smith, 2000 p9). This underfunding is possibly a result of the fact that the development of aquatic resources is not placed in a central position within the Government's National Poverty Eradication Programme. Nevertheless a place can clearly be identified for aquatic resource development and fisheries in particular, given that the most important policy-related objective of the agricultural/forestry sector is household food security, to which fisheries contributes an important form of livelihood diversification (NGPES, n.d.: 7).

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management types.

The fact that in developing countries small waterbodies, such as those that were the focus of R7335, can ensure food security and improve the living standards of rural communities (Sugunan 1997 p.145) is widely perceived to be the reality. Despite this, there has been little research on these resources and they are rarely afforded a high priority in national policies or the research agenda. Garaway (1999) suggests that a possible reason for this include the fact that they are used for subsistence and fish are consumed locally. This means that such resources do not contribute substantially to a country's GDP and, because catches are consumed within households, it is very difficult to obtain catch statistics that indicate how important the resources are. Both of these factors have the effect of giving these resources a low policy profile.

Despite the low profile afforded to small waterbody fisheries, the government of Laos has stated that "priority in the short, medium and long term is to be given to the reduction of declining harvests and the development of fisheries in the rivers, lakes and reservoirs..… these actions could allow the fisheries sub-sector to increase gradually its production figures from the current estimates."(Phonvisay, 1994)p.2. The enhancement initiatives in small waterbodies that were the focus of R7335 would support this objective.

Alongside the importance of developing key livelihood sectors for rural poverty reduction, the Government's poverty reduction strategy recognises service provision – e.g. schools and clinics, infrastructural development – e.g. roads and rural electrification, and improved access to produce markets as essential.

It is within the context of the extensive nature of aquatic resources in Lao PDR and their significance for rural livelihoods and poverty reduction, that the FMSP R7335 adaptive learning project can be located.

Purpose of this assessment.

The purpose of this particular impact assessment is to examine the impact of project R7335 to examine whether the project has had, or is likely to have, a positive and sustainable impact on poverty reduction through improving the livelihoods of poor people.

This includes consideration of the sustainability of the process and outputs (i.e. usefulness, application and institutionalisation), the poverty focus of the institutions involved, and poverty reduction impacts for poorer members of the communities who participated in the project. To do this the impact assessment considered four themes:

(i) Knowledge generation and transfer: how have the dissemination pathways used in the research affected poor people's ability to influence the research process and access the research outcomes? How do poor people view, respond to, or trust the pathways used?

(ii) Institutions and processes: how do different policies, institutions and organisations mediate poor people's ability to access research outcomes and convert them into positive livelihood streams?

(iii) Assets and livelihood activities: how has poor people's capacity to access and manage assets affected their ability to access the research outcomes and convert them into positive livelihood streams?

(iv) Social differentiation: how has social differentiation mediated the impact of the research on poor people?

Methods for the impact assessment

The project worked in 38 villages spread over 12 districts in two provinces. Logistical constraints meant that not all villages in all districts could be visited. Instead it was decided to concentrate on selected districts and villages within Savannakhet province. Savannakhet was where the project was based and where the RDC is based so where initiatives utilising the knowledge and skills developed are most likely to originate. It is also the province with the majority of districts (8) and villages (32) involved in the project. Within the province it was decided to visit villages within four districts. Two of these districts (Outhomphone and Sombuli) had several villages who had participated and were districts that had a large number of water resources while the other two (Saybouli and Khanthabouli) had fewer. See Table 2 below for details of the districts selected.

Table 2. Details of districts selected for visits during the assessment exercise

District	**District staff involved**	**Number of villages**
Outhomphone	Mr Phoulien	7
Sombuli	Mr Khamsouk	5
Saybouli	Mr Singkham	2
Khanthabouli	Mrs Nilavan	1*

* The village involved changed. In 2000/01 Nong Deun village was involved but dropped out and was replaced in 2001/01 by Maybeungtalay village.

Villages were selected on the basis that they provided a representative cross-section of villages involved in the project. This included:

- Villages that were interested in community fisheries and were supported by the project to start as well as those with existing community fisheries.
- Villages that had experienced problems in implementing the community fisheries and participating in project activities as well as those that had not.
- Villages with community fisheries that represented the three management types (rental, group fishing and fishing day).

A summary of the villages selected is provided below in Table 3. The data collection relied on the use of semi-structured interviews with key respondents' among the provincial and district staff as well as within the village administration of the selected villages and where possible with groups of villagers from amongst those in the village most likely to have been adversely affected by project activities or to have benefited the least.

Table 3. Details of the villages selected for visits during the assessment exercise.

District	Village	Waterbody	Waterbody Area (Ha)	Project Facilitate Establishment	Management (03/04)
Outhomphone	Phin			Yes	Fishing Day
Outhomphone	Kang Phosy	Nong Kham Yard			Rental
Saybouli	Nong Saphang	Nong Sa Ngai		Yes	Fishing Day
Saybouli	Nong Sa	Nong Sa		Yes	Group fishing
Sombouli	Kong Knak	Khoud Kong Knak		No	Group fishing
Sombouli	Xieng Hong	Khoud Nong Bua		No	Group fishing
Khanthabouli	Maybeungtalay			No	Group fishing

Interviews were not held with villagers in all cases, either because there was not time to do so or because detailed data already exists regarding the distribution of benefits and costs within the community (e.g. Garaway 1999).

Results

Knowledge generation and transfer

(i) How have the dissemination pathways used in the research affected poor people's ability to influence the research process and access the research outcomes? How do poor people view, respond to, or trust the pathways used?

The objectives and methods for knowledge generation and transfer to different categories of stakeholder are presented in Table 1. Findings concerning the impact assessment can be summarised as follows:

For provincial and district staff a core component of the project was skills development in technical knowledge for fisheries promotion together with participatory techniques for collaborative learning at village-level. Interviews suggest a consensus that the technical skills and increased knowledge of the benefits of community fisheries – as summarised in Table 1 – imparted by the project were and continue to be useful in the work of personnel at provincial, district and village levels.

The acquisition of knowledge about participatory techniques and the principles behind collaborative learning more broadly, helped to generate a new approach to fisheries promotion amongst government officials, whereby villagers' experiences and skills were considered important. This enabled officials to involve the village administration in the decision-making process concerning the project. By implication this facilitated a process in which the village had considerable ownership over decision-making, while technical inputs enabled them to improve the skills on which decisions could be based. The collaborative learning approach was contrasted positively by certain government employees with projects funded by other donors, in which objectives were pre-established and villagers were simply involved in the implementation process, possibly resulting in quick returns but with the danger of undermining long-term sustainability through knowledge acquisition.

Together with the explicit project training objectives regarding technical information and participatory techniques, both provincial and district officials reported that they improved their learning about project planning and budgeting, and the process of working with outsiders, which has helped in their interactions with other more recent donor projects.

Interviews suggest that knowledge and skills gained during the project continue to be useful to provincial and district officials, which has positive implications for project sustainability. In this respect the project's approach of capacity building government officials, rather than bringing in local or international experts for the sole duration of the project, was useful and has helped to retain skills within the locality. Inevitably, given financial constraints within the civil service, the ability of officials to carry out monitoring and evaluation or to take ideas and practices forward after the end of the project is impeded by lack of government funding. However, there are examples of learning activities being conducted without outside support and also other external organisations building on the adaptive learning approach put forward by the project.[40]

As part of the process of knowledge acquisition, several interviewees at provincial and district levels emphasised the positive benefits of knowledge sharing – through workshops and visits - for the learning process. This involved the development of closer ties between provincial and district staff, learning between government officials and villagers, and training of staff in other organisations (e.g. WorldFish Center, Lao Belgian). It also included sharing understandings with other provinces through workshops (2-3) in the process of trying to scale up the idea of community fisheries as officials in other areas heard about the success of community fisheries in Savannakhet province and wanted to learn more.

From the perspectives of people living in villages covered by the project, interviews with members of the village administrations suggest knowledge sharing and skills development through collaborative learning at workshops was a positive experience. This led to the development of successful community fisheries and in several instances also had the spin-off of improved learning on the part of individuals with privately owned fish ponds.

Technical skills imparted to villagers included learning how to nurse fish fry prior to release into waterbodies, about stocking, the different management systems, management techniques, and how to make rules for the waterbody as a community owned project. It would seem that there have been many successes in the take-up and transfer of this learning into village-level management practices. In addition, a feature that appears to have been applauded was the opportunities the project gave in enabling villagers to share learning with people from other villages concerning what works in practice and the problems they were having.

In summary, the collaborative learning approach taken by the project appears to have been very successful in enabling knowledge and skills to be taken up through the dissemination pathways – workshops, practical demonstrations and training – by poor people and by those district and provincial level officials working on their behalf. The process of collaborative learning suggests a high degree of trust on the part of village people concerning skills training by the project, as evidenced in the success of the community fisheries.

[40] For example Lao Belgian, the WorldFish Center, and with interest expressed by DIDA and WWF

(ii) Institutions and processes: how do different policies, institutions and organisations mediate poor people's ability to access research outcomes and convert them into positive livelihood streams?

In general the context favoured implementation. The project chose to work through the government system as it was felt that this provided a much better chance of sustainability and scaling up (which seems to have been occurring through the workshops between the 6 southern provinces) through the institutionalising of knowledge and methodologies. The government system is very poorly funded and welcomed the opportunity that the project presented so that staff were both willing and available to work with the project. Also, as mentioned in the evaluation annex of the FTR, the fact that there were fairly homogenous communities with essentially representative administrations also facilitated the process. The only real problems faced during the implementation of the project were with the problems between RDC and DLF that occurred with the personnel changes.

The main institutional collaborators on the project were state institutions at provincial, district and village levels. At the provincial level this involved the Department of Livestock and Fisheries (DLF) in Savannakhet and Khammouane provinces and the RDC, an association of the heads of the DLF in the six southern provinces of Lao PDR that includes Khammouane and Savannakhet. The RDC is the organisation through which a number of externally funded projects have been implemented.[41] Beneath this were district officials from the DLF in 12 districts, then the village administrations of the 38 villages encompassed by the study. The main organisation involved in the project was DFID itself, and MRAG who undertook the research though links were developed with the Mekong River Commission, Asian Institute of Technology, WorldFish Centre and University of Sydney.

In general findings from the impact assessment suggest that the provincial and district institutions played a positive role in mediating poor people's ability to access research outcomes and convert them into positive livelihood streams through the mechanism of the village administration. Section (iv) below suggests that community benefits from the project have been good in terms of promoting local development and that this has had a positive impact on poor people's livelihoods. Nevertheless there are inevitably institutional fault lines where communication, co-ordination or clarification of roles could have been improved between government departments. For example there was some confusion about the different roles of the RDC and the DLF in the project, which made planning and getting budget approval more difficult. One interviewee from the provincial administration commented an administrator working at the provincial level who could explain how the project supported government goals to improve involvement of other sectors would support the project would have facilitated the project process. However, such problems are an inevitable part of the process of project implementation, particularly given the challenge of working through under-funded government institutions, and should not detract from the overall success achieved by the project.

At the village level, the project appears to have worked well through the mechanism of the village administration, although inevitably conflicts did arise – such conflicts are

[41] Including WorldFish Center, Asian Institute of Technology, Sydney University and a number of DFID funded projects – KaR, FMSP and AFGRP) have been implemented. The RDC has received considerable support from, and maintains strong links with the Asian Institute of Technology Aqua Outreach programme and Aqua Outreach has been responsible for developing the systems used by the RDC and in shaping the direction of the organisation.

to be expected when people's existing access to a particular natural resource is challenged (see iii and iv below). In several of the villages the project is held to have contributed to strengthening the village administration and increasing levels of harmony amongst villagers. Because Lao PDR is a communist state this solidarity between the workers is an important one and the ideas of solidarity and workers in harmony reaches from the top to the bottom. Even at village administration level there are regular party meetings attended by the headmen of several local villages and each administration has a party man in it. There were problems in certain places where a waterbody was shared between two different village administrations. This did arise on at least three occasions, one of which led to a failure because the villages couldn't agree the benefit sharing. However it was generally not considered to be a problem.

One structural impediment to sustainability of project learning is that the headman and deputy headman of the village administration change approximately every 3 years so that in some cases the district officials need to explain again to a new administration about community fisheries (though this has only happened in four cases so far). It is unclear to what extent renewed explanations and training by officials will continue to happen into the future. Likewise, this 3-year change can mean that the headman can change the communal fisheries management system bringing to an end transformations initiated by the project, with implications for sustainability. In some villages local monks have been drawn into the management of the community fishery, helping to provide continuity beyond the 3 year time frame of the village administration.

In summary, the approach taken by the project in supporting government officials and village administrations played a positive role in mediating poor people's ability to access research outcomes and converting them into positive livelihood streams.

(iii) Assets and livelihood activities: how has poor people's capacity to access and manage assets affected their ability to access the research outcomes and convert them into positive livelihood streams?

In the context of rural development in Lao, fish culture is seen as a means to escape poverty; there is a need to generate income for community projects and helping poor people with community fisheries is seen a mechanism to do this. To consider the extent to which this specific project enabled poor people to convert research outcomes into positive livelihood streams it is helpful to elaborate on how the project worked.[42]

The community fisheries promoted by the project takes place in waterbodies under the ownership of one or two adjacent villages, with management being organised by the village administration, generally involving the stocking of cultured fish. Although there are variations between villages, after stocking has taken place, restrictions are placed on individual access to fish, with fish typically being harvested by village fishing teams and sold to raise village income or used for village activities. In some villages community fisheries already existed but for those waterbodies where it was introduced by the project this implied a change in people's access to aquatic resources: typically, before individuals had been able to fish or collect resources such as snails for household consumption but after communal fisheries were instigated individual household access to resources in the waterbody became restricted. This lack of household access, typically where it existed in the past raises questions about

[42] See Annex 8 of the Final Technical Report for a fuller explanation.

the impact of the project on groups of poor people who may have previously depended directly on the waterbody (see Garaway, 2004: 5 –).

Garaway (2004) has conducted a detailed examination of whether the allocation of fish yields from the community fisheries in four villages has tended to redistribute benefits to richer members of the community more than to the poor, as a direct result of the project. Although there is some variation between villages, she identifies three categories of benefits: nutritional, financial and improved services. In terms of nutritional benefits, fish might be bought by individual households, used as payment in kind, or given as gifts, in which cases there is increased household nutritional contribution. It might also be used as payment in kind for community work, for guests, or for village festivals; in each case leading to the potential of a reduced household contribution to village funds. In terms of financial benefits, income from fisheries to the community development fund would be used to support village committee activities and the fishing teams; this implies a reduced household monetary contribution to support these activities. In terms of improved services, money from the community development fund has typically been spent on electrification, the building of schools and/or temples, and road improvement. The capacity of the project to generate income for such community projects should not be underestimated given the limited opportunities that exist for rural income generation.

In each of the villages every household had the potential to benefit directly from reduced household monetary contributions to the village administration, from generating income to develop infrastructure and services such as electrification and schools. For some there was also the opportunity of increased fish consumption. Where households lost out was in being able to use aquatic resources directly on an individual basis. In short the main benefits from the project were to the community, rather than to individual households, although households including poorer households did realise some benefits.

The Impact Assessment identified (and project reports) highlighted that some opposition was generated to the project process – as one would entirely expect when changes are made to people's access to resources. For instance in Nong Saphang village, the waterbody had been an important source of fish and other aquatic organisms and there was conflict. Nevertheless in all 7 villages covered by the impact assessment, interviews suggest that people perceive community benefits accrued through the project to have outweighed individual losses.

This view is supported by the in-depth findings of Garaway (2004) who suggests that there is little evidence that new communal fisheries management was benefiting richer households at the expense of poorer ones. "Poorer and richer households had similar access and while the increased commoditisation…[of fish]…did benefit richer households more, it could be argued that the reduced household financial contribution to the community development fund was more beneficial to poorer ones" (2004: 31).

In several villages the effects of building a school, health clinic, temple or improvements to road infrastructure or development of electrification were substantial in terms of the growth of small shops and services, as well as access to markets. These developments promoted by the project are in keeping with the Government's poverty reduction strategy (NGPES, n.d.). The impact on local development was particularly marked in the case of Nong Saphang village, which was chosen as a district 'cultural village', in which development could be promoted (e.g. teaching women textile making and selling) largely due to the fisheries project. In another village, Kong Knak, electrification mean't they were able to pump water and therefore

grow a second crop of dry season rice to sell as surplus for extra household income. Another indirect positive livelihood impact from the project has been the way in which individuals have gained better knowledge of fisheries management and applied it to improvement of private ponds.

In summary, the project has heralded change to people's access to assets in the form of aquatic resources and for some households this has meant restricted access to fish and other edibles, however community and individual benefits accrued through the project have on balance outweighed individual losses. In addition, despite some changes to access to assets, on balance richer villagers do not appeared to have gained at the expense of the poor.

(iv) Socio-economic differentiation: how has socio-economic differentiation mediated the impact of the research on poor people?

Village level socio-economic data was collected and analysed as part of the project process by Garaway (1999) and Garaway and Arthur (2004). Therefore the impact assessment did not seek to generate further information, simply to confirm existing knowledge through a small number of interviews with villagers.

Villages within the project area are relatively homogenous in terms of economic differentiation between households, with all households being considered poor although some are poorer than others. A key form of social differentiation with a bearing on project impacts is gender and change to women's access to aquatic resources, because women fish using lift nets, drag nets and scoop nets, and also collect edible aquatic resources such as frogs, snails and bamboo shoots. By transforming management of waterbodies into community fisheries, this has clearly had gender impacts because it has acted to exclude women's access and therefore household consumption, particularly in the case of the poorest households. For instance in Phin Village, people now have to travel a long way to fish in the nearest reservoir and only men now do this where before women also fished in the village waterbody. Only relatively few interviews were conducted with village women, and poor women specifically, however they would support the findings listed in (iii) that even where there have been individual costs these have been outweighed by benefits introduced through the project.

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