

# Monsoon Season Post Harvest Losses in Traditional Fish Processing in India

Final Technical Report on Research Project R6817  
Funded by the Department for International  
Development's Post Harvest Fisheries  
Research Programme



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[DFID Project R6817 "Post Harvest Fisheries Research Programme"]



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It should be recognised that without the willingness of a number of small-scale processors to co-operate with the project at field level, this project and report would not have been possible. My hope is that the knowledge, time and experiences they contributed will be put to good use for their future benefit.



## Abbreviations

CBO	Community based organisation
CIFT	Central Institute of Fisheries Technology
CPDA	Coastal Peoples Development Association
DFID	Department for International Development
DRD	Department for Rural Development
FAO	Food and Agriculture Organisation
ICM	Integrated Coastal Management
NGO	Non-governmental organisation
NRI	Natural Resources Institute
ODA	Overseas Development Administration
OVI	Objectively verifiable indicator
PHFP	Post-harvest Fisheries Project
RNRKS	Renewable Natural Resources Knowledge Strategy
SCF	Save the Children Fund
SSP	Small-scale processor
UK	United Kingdom
WHO	World Health Organisation

## ***Executive Summary***

Post-harvest fish loss and the affect on the livelihoods of small-scale fish processors during the monsoon in India was identified as a priority for research at a needs assessment workshop in 1995 organised in India by the Department for International Development's Renewable Natural Resources Research Strategy Post Harvest Fisheries Research Programme. As a consequence the Natural Resources Institute of the University of Greenwich and scientists from the College of Fisheries, Mangalore, India co-ordinated a three year research project to provide a full understanding of losses, small-scale processors and processing during the monsoon and then to identify and field test appropriate loss reduction interventions.

Using informal research methods and working with communities in Kerala, Tamil Nadu, Orissa and Andhra Pradesh, teams of researchers generated and documented qualitative technical and socio-economic data. This includes information on the reasons and frequency of loss, the level of loss, the variables, which can influence loss, and information on processors' livelihoods. A short questionnaire survey was then undertaken to validate key qualitative data on losses and processing amongst communities in coastal Andhra Pradesh and Orissa.

The research found that the majority of small-scale processors, who are mostly women, incur physical and/or quality (selling at reduced prices) losses and the three main reasons for loss being:

- Fish in brine becomes infested with blowfly larvae
- Fish being dried is drenched in rain and washed away/lost
- Fish is drenched in rain and cannot be re-dried and becomes infested with blowfly larvae

It is estimated that the overall monetary loss to small-scale processors in Andhra Pradesh is between Rs 30,000,000 and Rs 187,000,000 ( £450,000 - £2.8 million) per monsoon and in Orissa the figure is between Rs 570,000 and Rs 37,000,000 (£8,500 - £550,000). This represents a loss in potential income to small-scale processors as a whole.

Based on the understanding from field research, the project drew up a list of potential interventions to reduce loss, improve income or reduce risk during processing. This list was based on processors existing coping strategies and appropriate interventions identified by secondary stakeholders. The options were presented to small-scale processors who then chose which ideas they felt may be beneficial to them. Processors were then assisted by the project to field-test these ideas during the monsoon. As a result the following seven interventions were identified as having positive benefits to processors and were thought relevant for promotion and dissemination:

- Cleaning vats with bleaching powder to reduce contamination of brine and spoilage/insect infestation of fish

- Gutting and washing fish after gutting to reduce spoilage of fish and brine
- Testing brine concentration to optimise the use of salt and the brining process
- Keeping fish submerged in brine to reduce blowfly larvae infestation by using a frame
- Use of heavy lids for covering vats to reduce contamination of brine and blowfly larvae infestation
- Drying fish on mats, and/or stackable racks to reduce drenching by rain
- Increasing drying speed to maximise limited available drying time

Of these, the research found that cleaning vats, submerging fish in brine and the lids for covering vats were particularly beneficial and appropriate. Processors perceptions were that these ideas reduced blowfly larvae infestation and produced better quality products, which sold more quickly in the market.

Dissemination of the research was undertaken during the project by way of workshops, meetings and published articles. The project also produced and distributed a video of the intervention phase in English, Telegu and Oriya and a poster in Telegu and Oriya. The target audience for these two outputs were primary stakeholders in Andhra Pradesh and Orissa. A summary report, in English, of the research was also produced and distributed to secondary stakeholders in India.

As a result of dissemination meetings with government officials in Andhra and Orissa in June 2000, the Director for Department for Rural Development (DRD) of Andhra Pradesh said the Department would incorporate the intervention work into their self-help group women's training programme. They were also to solicit the assistance of project researchers to conduct a "train the trainers" course based on the intervention work of the project.

The research has also contributed to the more general work with coastal communities of NGOs such as Integrated Coastal Management (ICM), an organisation which is involved in a number of post-harvest and coastal community initiatives in India and south Asia such as the DFID Policy Research Programme Sustainable Coastal Livelihoods Project. ICM were continually involved in the project and were provided with the research outputs in full.

The research has particularly complemented the work of R6467, R7008 and R5027. A further output from the project would be the production and distribution of a guide on the participatory approach used for identifying and field testing interventions, for use by secondary stakeholders.



## **Background**

Fish drying and processing is a traditional industry in India. It is practised in many coastal areas of the country. A significant proportion of the processed products are produced on the coast and then transported inland and consumed by the low income rural population who do not have ready access to fresh fish. Some dried fish is also used in the animal feed industry and some is used as fertiliser. It is recognised that in some coastal areas such as Orissa and Andhra Pradesh the level of small-scale processing has declined over recent years (Gordon 1997). Nevertheless, many people in the coastal communities rely on salting and sun-drying fish as a source of livelihood.

A needs assessment study of the small-scale fish processing sector by Joseph (1995) for the then Overseas Development Administration Post Harvest Fisheries Project (ODA PHFP) based in Chennai, generated qualitative data on post-harvest issues and losses in small-scale fishing communities in Andhra Pradesh, Tamil Nadu and Kerala. The report highlights several constraints faced by processors. These include a variable supply of fish, glut catches, lack of drying space, insect infestation, spoilage, costs of processing, lack of organisation and lack of credit. As a result of this study, the post-harvest fish losses incurred by small-scale fish processors during the monsoon season in India were identified as a priority for research at a needs assessment workshop held in Madras, India, in 1995 (Ryder 1995).

Support for research of post-harvest losses *per se* was provided by the Strategy for Post-harvest Fisheries Research in Asia report (NRI/SIFR 1995). This stated that “fish catches are stable or declining and therefore losses must be reduced and the utilisation of landings must be increased, primarily in order to increase the consumption of fish protein by the populations of the countries concerned”. The same report also states that “fish resources in the Asian region are in short supply and there is increasing pressure on limited stocks. In addition, high protein foods are limited for poorer members of the community. It is essential therefore that maximum use is made of fish that is caught and any wastage reduced.”

Preliminary research revealed a general lack of information on post-harvest fish losses in India, especially the losses incurred by small-scale fish processors. Previous research by NRI in collaboration with the Central Institute of Fisheries Technology (CIFT) had focussed on losses in specific fresh fish distribution chains, for example Gujarat to Bombay and Delhi by Bostock (1987), Veraval to Bombay by Digges & Clucas (1995) and Visakhapatnam to Madras by Ward et al (1996).

It was recognised that there was a dearth of qualitative and quantitative data on the post-harvest fish losses in Indian fisheries. This was seen as a constraint to planning for the post-harvest sector at state level in India and at sector level where projects such as the then ODA/DFID Post Harvest Fisheries Project were operating. The lack of understanding of post-harvest losses and the post-harvest sub-sector is reflected in the lack of awareness of attention/resources devoted to post-harvest issues in India compared to the attention given to the fish production sector. A report by Campbell and George (1994) for the ODA/DFID Post Harvest Fisheries Project highlights the problem of a lack of awareness. The report highlights the lack of information on key constraints to the development and expansion of the post-harvest sector. The

constraints being the problems associated with fish handling and marketing, low value species utilisation and the “needs and aspirations of the poorer participants in the transformation process”.

Consequently it was understood that there was significant scope to increase the general understanding of the post-harvest sector in India at government, NGO and private sector levels.

There had been previous work done on intervention in the Indian post-harvest sector. Notably by organisations such as CIFT, the ODA PHFP, Food and Agriculture Organisation (FAO) and the Department for International Development (DFID) Renewable Natural Resources Knowledge Strategy (RNRKS) Post Harvest Fisheries Research Programme. A recent example from the latter included R6467 – Opportunities for Value Added in Traditional Fishing Communities (Gordon 1997), which particularly highlighted the socio-economic conditions which needed to be in place for successful uptake of appropriate technical interventions. Information on, and experiences of, a range of possible interventions was therefore readily available.

Post-harvest loss assessment and reduction of post-harvest losses has gained in importance as the gap between supply and demand for fish and fish products has grown in recent years. NRI through RNRKS funded research (R5027) in Tanzania and R7008 in West Africa are developing field-based loss assessment tools (Ward 1996), Teutscher (1999) which could be used/tested or adapted for use in the Indian context to generate a better understanding of losses and possible loss reduction initiatives.

In light of these issues, this project was formulated by NRI and the College of Fisheries, Mangalore. The project was undertaken on the assumption that post-harvest fish losses during the monsoon season were thought to be significant and as a result much fish was being wasted and processors are unable to maximise income at this time of year.

### ***Project Purpose***

The purpose of the project was to generate a full understanding of monsoon season fish losses affecting small-scale fish processors and then to field test appropriate value adding and loss reduction processes and technologies. Successful ideas, which reduced post-harvest losses and improved the livelihoods of small-scale fish processors would then be promoted.

The improved understanding addressed the major development constraint of there being a “lack of data” on post-harvest losses in India. The identification of appropriate ways of reducing loss would add-value to the understanding and offer options for loss reduction initiatives by primary and secondary stakeholders.

Policy makers and planners would benefit from being better informed regarding post-harvest loss reduction and the livelihoods of small-scale processors in coastal communities. The project outputs will also aid decision-making and identification of fisheries research, NGO and private sector initiatives.

The project undertook the following key activities in order to achieve the purpose:

- Participative field research with small-scale processing communities
- Quantitative survey to validate key qualitative data generated by the participative research
- Field trials to test appropriate interventions.



## **Research Activities**

The College of Fisheries, Mangalore were the primary national project collaborators. As well as in-country co-ordination the College provided technical support and scientists were involved in field research throughout the project. NRI managed the project and provided technical, socio-economic and biometric support. The project leader of R6467 reviewed field reports and participated in fieldwork planning.

National experts undertook primary data collection and analysis using informal and formal research methods. Primary stakeholders and secondary stakeholders reviewed and validated the research findings during the project. Small-scale fish processors were involved in planning, implementing and evaluating intervention field trials. A cadre of national advisers assisted in project planning and reviews, mainly via six workshops. The national advisers were from the College of Fisheries, Mangalore; the Central Institute of Fisheries Technology; the ODA and then DFID PHFP; State Departments of Fisheries, Catalyst Management Services, Integrated Coastal Management (ICM) and NGOs (Coastal Peoples Development Agency (CPDA) Agriculture Man Ecology). A list of key people involved in the research including the advisory group members is given as Appendix 1.

The ODA/DFID Post-harvest Fisheries Project based in Madras was an important target institution for the research results. It provided in-country support and co-ordination, but ended less than mid way through R6817. Co-ordination was then undertaken solely by NRI and the College of Fisheries, Mangalore. Table 1 lists the key project activities according to date.

*Table 1: Key Project Activities*

<b>Date</b>	<b>Activity</b>
1995	ODA Needs Assessment Workshop in India identifies monsoon losses as a priority for research.
December 1996	Project memorandum agreed by DFID. Initial activity is a desk review of secondary data.
February/March 1997	Planning workshop held in India followed by research site selection.
June to September 1997	Exploratory fieldwork
November 1997	Draft exploratory report produced
February 1998	Workshop – review exploratory study and plan case studies
June 1998	Planning workshop and Case Study fieldwork begins.
September 1998	Case Study fieldwork ends.
November 1998	Draft Case Study report produced
March 1999	Workshop – review case study fieldwork and plan interventions
April/May 1999	Participatory Intervention Planning fieldwork
June 1999	Workshop – finalise intervention field trials
July/August 1999	Intervention field trials established
October 1999	Evaluation of field trials. Case Study validation survey begins. Two cyclones hit Orissa coast. Thousands of people die property, crops, livestock destroyed. Research stopped.
January 2000	Evaluation completed
April 2000	Workshop – review intervention work and plan final dissemination
April/May/June 2000	Production of dissemination material.
June 30 2000	Project end.

The documents referred to in the following text and remainder of the report can be found on the accompanying CD. Each document has been given a number for easy reference. A list of documents and their numbers is given in Appendix 2.

### **Desk study to collate and summarise secondary source data on post-harvest fish losses**

The first activity of the project was a desk study to collate secondary data on losses and the socio-economic aspects of Indian fisheries. The study was undertaken by a NRI socio-economist. The study had two objectives; to review secondary sources of data on post-harvest fish losses in the monsoon season, and to act as a guide to data collection in subsequent stages of the project.

The study considers the type of fish loss suffered in the processing sector, the persons affected by that loss, reasons for losses, the market for fish, particularly processed products, and interventions in the sector.

*For further details see: Papadopoulos V (1997) Monsoon Season Post-harvest fish losses in India: Desk Review of Secondary Source Data and Suggestions for Research Themes. Project report. (CD ref: 1)*

### **Planning Workshop and Site Selection**

A two day workshop was held in Chennai, February 1997, to discuss and plan the implementation of the project.

The objectives of the workshop were:

- present an overview of the proposed research to national post-harvest fisheries specialists
- provide a forum for discussion of the research to aid planning field and dissemination activities

National post-harvest fisheries and development specialists, whom were to act as the project advisory group throughout the project, a socio-economist and project leader from NRI attended the workshop.

The workshop focused on the design of and arrangements for the Exploratory Study, the first primary data collection exercise. It identified topics to be covered during field research, the research methodologies to be used and team composition. Initiatives currently underway in India and of relevance to the research were discussed. Potential research site areas were identified by the participants.

Following the workshop between February and May 1997, researchers from NRI and the College of Fisheries Mangalore undertook visits to the four potential research areas to:

- identify communities within each area with which further research would be conducted
- raise awareness of the project amongst primary and secondary stakeholders
- make contact with relevant local organisations and establish on the ground support for future research activities

*More information on the workshop and site visits is available in: Ward A R, Papadopulos V, Joseph M J, Srikar L N (1997) Monsoon Season Post Harvest Fish Losses Research Workshop And Site Visits to Orissa and Kanyakumari. Project Report. (CD ref: 2)*

### **Exploratory Study**

An exploratory study was undertaken during the 1997 monsoon season. The study involved the communities of nine coastal villages in four site areas in south India (north Kerala, Tamil Nadu, Andhra Pradesh and Orissa). The aim of the study was to improve the understanding of the technical and socio-economic issues relevant to post-harvest loss during the monsoon season per se. The study was broad covering post-harvest practices from fishing to marketing.

Key research topics covered in the study were:

- Post-harvest practices currently used
- Trends in the post-harvest sector
- Seasonality of activities
- Who are the primary stakeholders involved in small-scale processing?
- Primary stakeholder coping strategies during the monsoon
- Post-harvest fish loss – type of loss, who is affected, indicative loss levels and frequency of loss
- Small-scale processing and marketing

The study research team comprised of a team leader and fisheries specialist from College of Fisheries Mangalore, a socio-economist from a private sector development consulting company (Catalyst Management Services Ltd) and a social worker from Institute of Social Work, Mangalore.

The primary data collection method used by the team was informal, based on observation and semi-structured interviews, guided by a checklist, with; key informants, groups and individuals from communities, private and public sector organisations. Post-harvest loss assessment was undertaken with an approach based on the Informal Loss Assessment method developed by R5074.

*More information on this activity and the results is to be found in: Joseph M M, Kumar N S and d’Cunha J J (1997) Exploratory studies on post harvest fish losses during the monsoon in south India. Project Report. (CD ref: 3)*

### **Exploratory Studies Review**

A draft report of the Exploratory Studies was reviewed by the project leader and a socio-economist from NRI. A revised report was then produced.

A two day workshop, attended by national project advisers, was held in February 1998 to discuss the findings of the exploratory study.



## **Case Study Planning**

A broad discussion document was produced by NRI to consolidate the research at this stage and present potential objectives and activities for a next phase of fieldwork, to be conducted in 1998/99. See (Ward, 1998) *Monsoon fish losses – phase two research, issues for discussion*. (CD ref: 4)

Key issues identified for possible further research were:

- quantitative survey to provide a better understanding of who small-scale processors (project beneficiaries) are and the monsoon losses incurred.
- what is the significance of loss to small-scale processors?
- micro level studies to examine the economics of small-scale processing and to explore further, post-harvest loss during the monsoon season in relation to financial income.
- discussing interventions with stakeholders and an analysis of intervention options to clarify loss reduction possibilities

These were discussed during at a three day workshop in Bangalore (24–26 June 1998). The aim of the workshop was to plan the second phase of primary data collection.

*More information on this workshop can be found in: (Ward, 1998) DFID Monsoon Season Post Harvest Fish Losses Research Project: Pre-Fieldwork Meeting, Atria Hotel, Bangalore 24 - 26 June 1998 and Initial Case Study Fieldwork in North Kerala. (CD ref: 5)*

## **Case Study Fieldwork**

A second phase of primary data collection was conducted during the 1998 monsoon season by a research team comprising of staff from Catalyst Management Services, the College of Fisheries, Mangalore, and an independent gender/post-harvest fisheries intervention consultant. The aim study developed the technical, social and economic understanding of monsoon losses incurred by small-scale fish processors (SSPs).

Three communities, which had participated in the Exploratory Study were purposively selected by the research team. The communities were in Andhra Pradesh, Orissa and Kerala. Andhra Pradesh and Orissa are two of the most underdeveloped states in India.

Semi-structured interviews were used to highlight community definitions of small/medium/large processors. A one-day preliminary study was made at each site to establish:

- locally relevant criteria for defining small-, medium- and large-scale processors
- numbers of small, medium and large processors in the site

- details regarding – gender of processors, heads of households and whether processing activity takes place in the site in monsoon
- numbers of processors (small, medium and large) who have abandoned processing, with reasons.

Two to three days of semi-structured interviews were conducted by the team with groups and key informants to generate an understanding of processing activities, trends, numbers of processors etc. At least three groups of processors were interviewed in each site. Four to eight hour semi-structured interview sessions, over a seven day period were then held with three SSPs from each community to generate a detailed understanding of livelihoods and losses.

*For more information refer to the report: Shiv Kumar N, Sudhakara N S, Gomathi B (1998) Post-harvest fisheries monsoon losses in south India: A study of small-scale fish processors. Volumes 1 and 2. Project Report. (CD ref: 6a summary report, 6b primary data including detailed case studies, 6c annexes).*

[Key findings from the study were later validated using a quantitative questionnaire survey administered in a random selection of coastal fishing communities of Orissa and Andhra Pradesh. *More information is in: Catalyst Management Services, Jeffries D (2000) Post-harvest fisheries monsoon losses: Phase III – 1999 validation of select findings. Project Report. (CD ref: 8)*]

### **Case Study Review**

A first draft report of the case study fieldwork was reviewed in December 1998 by an NRI socio-economist, a post-harvest fisheries specialist with long term India experience and the project leader. A revised report was produced, see case study fieldwork above.

A two day workshop was held in Chennai in March 1999 to: discuss the findings of the case study fieldwork and plan field testing of interventions with small-scale processors (SSPs). The workshop was attended by national project advisers, an NRI socio-economist and the DFID RNRKS Post-harvest Fisheries Research Programme Manager.

An initial list or menu of appropriate interventions for field testing, which would potentially reduce losses, add-value or reduce risks taken by small-scale processors, was drawn up by researchers from the College of Fisheries, Mangalore and NRI. The menu was based on:

- existing coping strategies used by some small-scale processors
- small-scale processors socio-economic profile
- reasons for post-harvest fish loss

The initial menu of intervention ideas was then circulated among secondary stakeholders for comment and additions.

*More information on the workshop can be obtained from: Ward (1999) Report of a Workshop to Discuss Phase II and Plan Phase III of the DFID RNRKS Monsoon Post Harvest Fish Losses Research Project, March 1999. (CD ref: 7)*

### **Participatory Intervention Planning**

The intervention menu was revised in line with comments from secondary stakeholders and then discussed with small-scale processors and major stakeholders from communities in Andhra Pradesh and Orissa in April-May 1999. The objective was to allow processors to decide which ideas from the menu were likely to lead to an improvement in their livelihoods (reducing loss, improving income or reducing risks). And whether processors would be willing to test the acceptable ideas during the forthcoming monsoon. As a result processors from three communities in Orissa and three communities in Andhra Pradesh were identified as participants for intervention field trials.

*More information on the meetings with communities can be found in: Joseph M M (1999) Report on Participatory Intervention Planning carried out in Orissa and Andhra Pradesh during April - May 1999 for field testing of interventions as phase III of the monsoon season losses in post harvest fisheries project. Project Report. (CD ref: 9)*

A three day meeting was then held in Chennai (June) attended by (nine) participants from College of Fisheries Mangalore, Integrated Coastal Management, Catalyst Management Services, Coastal Peoples Development Agency and the Fisheries Department of Andhra Pradesh. The aim of the meeting/workshop was to discuss results of the meetings with primary stakeholders and plan intervention field trials. The objective of which was:

**“In partnership with SSPs field test appropriate interventions. Determine the willingness of SSPs to adopt the interventions. Assess the effect of the interventions on income, losses and risk alleviation. Identify lessons learnt and constraints to adoption at the micro and macro levels.”**

Given the short period of time in which the trials are to be conducted. It was agreed that it would be difficult to generate reliable data on physical and monetary losses prevented – and for this reason the “willingness to adopt” would be used as an indicator of livelihood improvement. The improvement might be in aggregate income, or reduced risk, or less variable income, or in some other quality of life aspect (working conditions etc).

*More information on the meeting can be found in:*

*Ward A R (1999) Intervention field trials – planning meeting, Chennai 7 – 9 June 1999. Project Filenote. (CD ref: 10)*

*Gordon A (1999) Field Trial Guidelines: Proposed Phase III activities of the monsoon losses project. Project Filenote.(CD ref: 11)*

## **Intervention Field Trials**

Fieldwork to demonstrate and train processors in nine intervention ideas was undertaken at three sites in Andhra Pradesh and three sites in Orissa during July 1999. The training was given over four or five days by a team of researchers from the College of Fisheries, Mangalore, Integrated Marine Management, the Department of Fisheries Andhra Pradesh, and members of local NGOs.

Whilst eight of the intervention ideas were specific, one intervention was less so – “better handling practices”. In order to establish the improved practices, which may benefit small-scale processors, the team analysed the existing processing practices at each site and identified ‘critical control points’ at which improved practices may lead to a reduction in loss, reduced risk or an increase in income. In addition to the other eight intervention ideas the following practices were also introduced by the team where appropriate:

- cleaning vats using bleaching powder before starting a new processing operation
- treat seawater using bleaching powder and give adequate contact time for chlorination
- wash fish in treated water
- gut fish on plastic sheets
- wash gutted fish using treated water

Once the team had left the site three processors continued to use the interventions up until the end of the trial at the end of September. During the trial regular visits to each site were made by one of the research team. These visits enabled follow-on support for processors and assessed whether interventions were being used.

The project leader and the in-country project co-ordinator visited all six sites during August to undertake an interim evaluation.

*More information on the establishment of field testing with small-scale processors can be found in:*

*Salagrama V, Srikar L N, Sudhakar N S (1999) Research project on monsoon losses in post-harvest fisheries (R6817) Phase III: Field testing of simple loss reduction methods. Project Report. (CD ref: 12)*

## **Field Trial Evaluation**

An independent national sociologist with long term work experience with Indian fishing communities was commissioned by the project to undertake an evaluation of the intervention field trials. The evaluation was centred on gaining an understanding of the following:

- perceptions of the processors to each intervention introduced to them for trial.
- willingness of processors to adopt the interventions tested.
- perceived benefits of those interventions adopted in terms of loss reduction, improved income, reducing risk and any other benefits during monsoons.



- constraints associated with each intervention and whether these constraints could be overcome by a feasible level of adaptation or further development to improve acceptability.
- appropriateness of interventions for use during non monsoon periods.

Primary data collection was undertaken using group and individual semi-structured interviews with the small-scale processors who had been involved in the field-testing. Group discussions were held with women's groups or *Mahila Mandal*, if they existed, at the village level. Village level meetings were also held to obtain the perceptions of non users. Observations were also made of the processing sites.

Discussions were also held with the field testing team. In most cases, representatives of the team were present at the village during discussion with the processors so that responses could be put in perspective and misunderstandings resolved.

The data collected from each processor over a period of three months was tabulated by the consultant and was used as points for discussion during primary data collection in the villages.

*More information on the evaluation is presented in: Sundararajan M (2000) An evaluation of Field trials Conducted by the RNRKS Monsoon Fish Losses Research Project. Project Report. (CD ref: 13)*

### **Quantitative Survey to Validate Case Study Data**

Catalyst Management Services Ltd undertook a questionnaire survey to validate qualitative data on small-scale processors and post-harvest losses in Andhra Pradesh and Orissa. The survey was planned by an NRI biometrician in conjunction with CMS and it validated qualitative data to determine whether it was representative of small-scale processors and losses across a larger geographical area. This was important especially if the results were to be used for policy level planning.

The data was analysed by the NRI biometrician and CMS. Graphical techniques were used to show intersecting relationships. Basic statistical analysis were performed to give means with 95% confidence intervals and medians where data distribution was skewed. Cross tabulations and distributions were analysed using chi-squared tests.

*For further details refer to: Catalyst Management Services, Jeffries D (2000) Post-harvest fisheries monsoon losses: Phase III – 1999 validation of select findings. Project Report. (CD ref: 8)*

### **Intervention Workshop**

In April 2000 a workshop was held in Chennai to discuss the intervention phase of the project and clarify final dissemination activities. The workshop was attended by the project national advisers and consisted of presentations by researchers on the participatory intervention planning, intervention field trials and the quantitative validation survey. A working group session focussed on the promotion and dissemination of the project results.

Following the workshop a meeting was held with Mangalore College of Fisheries scientists to prioritise the ideas, which came from the working group session. The

prioritised activities would be completed by the end of the project (June 30<sup>th</sup>). See dissemination section below.

### **Dissemination**

There were two discreet aspects to dissemination:

- Dissemination of the project and its findings undertaken during implementation.
- Formal project dissemination activities undertaken during the final three months of the project, after the final internal project workshop was held in April 2000.

There were three elements of dissemination during the project:

1. Field research activities were undertaken by a range of Indian specialists from the government and non-government sectors who as a result of their involvement became familiar with the project and its findings.
2. Four key internal review and planning workshops were held by the project attended by participants representing state governments, NGOs, academic institutions, central government research and private sector development consulting companies. This group are termed the project advisers. This group also contributed to the project in terms of reviewing fieldwork and planning field research. Initially, a core of the group was from the DFID Post-harvest Fisheries Project based in Chennai. The project was seen as a key target institution for the project outputs. Unfortunately, the project folded mid way through the research. The core group however remained involved in the research as workshop participants and as researchers, as they had a great deal of relevant experience to lend to the project. Thus a wide range of individuals representing a variety of different secondary stakeholder organisations were kept informed of the project and its findings.
3. In addition a number of wider dissemination activities were undertaken by the project during implementation. These are as follows:
  - Presentation on the first phase of the project by the project leader at the Advances and Priorities in Fisheries Technology Symposium organised by the Society of Fisheries Technologists (India) and the Central Institute of Fisheries Technology. The symposium was held in Cochin, India in February 1998 and attended by approximately 200 fisheries specialists from India, UK and Australia. The paper of the presentation was subsequently published in the symposium proceedings.
  - Presentation by the project co-ordinator at the Fifth Indian Fisheries Forum organised by the Asian Fisheries Society (Indian Branch) in Bhubaneswar, February 2000. The Forum was attended by several hundred fisheries specialists from India.
  - Presentation on the intervention phase of the project by the project leader at the DFID Symposium Eliminating Poverty: the Value of

Science to Rural Livelihoods held in London December 1999. DFID staff, representatives from NGOs, diplomats and DFID research programmes attended.(CD ref: DFID Symp)

- Presentation on the project in general by the project leader at an evaluation workshop for RNRKS Project R7008 – Validation of Loss Assessment Tools held in Abidjan, Côte d’Ivoire, September 1999. The workshop was attended by representatives from FAO, DFID, EU West Africa Regional post-harvest Fisheries Programme and primary and secondary stakeholders from the fisheries sectors of Ghana, Nigeria, Côte d’Ivoire and Senegal.
- The project leader discussed the project in broad terms with the Deputy Director General (Fisheries) of the Indian Council of Agricultural Research at a meeting in New Delhi, March 1999.
- Three articles on the early stages of the project were published in the DFID post-harvest fisheries project newsletter “PHF News”. This newsletter reached an audience of 615 government and non-government organisations, international organisations and development projects in Asia and the UK.
- A short article in Oriya written by a journalist on the intervention field trials in Orissa was published in the Paryabekhyak daily newspaper in August 1999.

From the project workshop in April 2000 until the end of the project, the focus was on primarily dissemination and promotion. A short video describing the intervention phase and appropriate loss reduction interventions was produced in English, Oriya and Telegu. The target audience for the video were seen as secondary stakeholders involved in coastal community development initiatives and small-scale fish processors who would be able to see interventions being used and described by other small-scale processors. The video (*CD ref: video*) was shown by the project to a variety of secondary stakeholders during the final stages of the project. Copies were also distributed in India for use at village level by State Departments of Fisheries in Andhra Pradesh and Orissa, Departments for Rural Development, Central Institute of Fisheries Technology, Central Institute of Fisheries Education and NGOs working with coastal communities. Master copies of the video on CD are held by the College of Fisheries Mangalore and NRI.

A poster depicting loss reduction interventions was produced for disseminating the project at community level. The target audience for the poster were small-scale fish processors in Andhra Pradesh and Orissa. The text of the poster is in two languages – Oriya, Telegu. 500 copies of the poster were produced and distributed to secondary stakeholders in India for distribution at community level. A copy of the poster is given as Appendix 3 along with an English translation.

In order to communicate key information on small-scale fish processors, processing, post-harvest losses and loss reduction interventions to a broad range of secondary stakeholders, 100 copies of a short (twenty page) summary report was produced and

distributed by post. *Joseph M M, Ward A R (2000) Understanding and reducing losses in traditional fish processing in India. Project Report . (CD ref: 14)*

The project held two meetings in June 2000 with key secondary stakeholders in Andhra Pradesh and Orissa to disseminate the project and its findings. The project team consisted of the project leader, Dr Mohan Joseph (College of Fisheries, Mangalore) and Venkatesh Salagrama (Integrated Coastal Management). The meetings were held in Hyderabad and Bhubaneswar. The meetings were attended by representatives of government and non-government organisations from each state. At the meetings an MS PowerPoint presentation was given by the project team and the project video was shown followed by a short discussion. Participants received copies of the project summary report. The Powerpoint presentation is on the accompanying CD (*CD ref: meetings presentation*). Table 2 shows those who attended the two main meetings or were met independently by the project team during the week of the visits.

*Table 2 Dissemination meetings, June 2000 - attendees*

Name	Designation	Relevant Work Related Activities	Video	Summary Report	Meeting
D.S Murty	Commissioner of Fisheries, Govt Andhra Pradesh	Development of fisheries and fishing communities	Seen	Received	Attended
S P Tucker	Commissioner, Rural Development, Govt Andhra Pradesh	General development of rural communities	Seen		
Dr V Khader	Director, Dept. of Foods and Nutrition, Acharya N G Ranga Agricultural University, Hyderabad	Community development	Seen	Received	
C M Muralidharan	Fisheries Specialist, Action for Food Production (AFPRO) Secunderabad	Improved traditional fish processing	Seen	Received	Attended
T Bhattacharya	Chief Advisor, Aparajita, Bhubaneswar	Rehabilitation of coastal communities in Orissa	Seen		
Dr G Srinivas Rao	Asst Professor, Swamy Ramananda Tirtha Rural Institute	Improved marketing of foodstuffs.	Seen	Received	Attended
Dr D Hanumankia	Asst Professor, Swamy Ramananda Tirtha Rural Institute	Improved marketing of foodstuffs.	Seen	Received	Attended
V Usha Rani	Director, Department for Rural Development, Andhra Pradesh	Community development.	Seen	Received	Attended
Dr E V Gopirathsai	Deputy Director of Fisheries, Andhra Pradesh	Fisheries development	Seen	Received	Attended
Shri Y Prahash Rao	Joint Director of Fisheries (Marine), Andhra Pradesh	Fisheries development	Seen	Received	Attended
Shri M A Quadeer	Joint Director of Fisheries (Brackish water), Andhra Pradesh	Fisheries development	Seen	Received	Attended
Shri C Ratnamechary	Deputy Director of	Fisheries development	Seen	Received	Attended

	Fisheries, Andhra Pradesh				
B C Misra	Assistant Director Fisheries (Marine) Puri, Orissa	Fisheries development	Seen	Received	Attended
Shri Shisirea Ranjav Deesh	Field Officer, Project Aparajita	Fisheries development	Seen	Received	Attended
N Chandra	Director of Fisheries, Orissa	Fisheries development	Seen	Received	Attended
S Kas	Managing Director, FISHFED, Dept. of Fisheries, Orissa	Fisheries development	Seen	Received	Attended
A Nayak	Deputy Director Fisheries, (Marine) Cuttack.	Fisheries development	Seen	Received	Attended
N C Baral	Joint Director of Fisheries (Marine) Orissa	Fisheries development	Seen	Received	Attended
Jo Yvon	Associate Professional Officer, Rural Development Office, Orissa, DFID, India	Livelihoods		Received	

As a result of the meetings a number of requests were made for copies of the video or suggestions of organisations who should receive it were made by those who had seen it (ActionAid, Save the Children Fund, CARE). The following said they would use the video in their own programmes of work to raise awareness of loss reduction and quality improvement:

- Department for Rural Development, Andhra Pradesh
- Integrated Coastal Management
- Department of Fisheries, Andhra Pradesh
- Aparajita, Orissa
- ANGR Agricultural University, Hyderabad

As a result of the Commissioner of the Department for Rural Development, Andhra Pradesh, seeing the video it was suggested the Department would sponsor a training course in Kakinada based on the intervention ideas identified by the project. Integrated Coastal Management or College of Fisheries Mangalore would be willing to act as trainers in any future activities. It was suggested that a train the trainer's course that would include Department of Fisheries extension staff and Rural Development field staff would be an appropriate follow-on activity. This group would be given training to enable them to conduct short courses for processors in communities along the Andhra Coast. The Department for Rural Development were to send a formal request for such a course to the project.



## **Outputs**

The research activities were undertaken in order to achieve three project outputs:

- 1) A technical and socio-economic assessment of wet season post-harvest fish losses in India described.**
- 2) Case studies of the causes and impact of post-harvest fish losses described.**
- 3) Appropriate technical and/or non technical interventions for loss reduction defined and tested.**

Outputs 1 and 2 are three key project documents:

- Joseph Mohan M, Shiv Kumar N, Jyothi d’Cunha J (1997) Exploratory studies on post-harvest fish losses during the monsoon in South India. Project Report.(CD ref: 3)
- Kumar N S, Sudhakara N S, Gomathi B (1998) Post-harvest fisheries monsoon losses in south India: A study of small-scale fish processors. Volumes 1 and 2. Project Report. (CD ref: 6)
- Catalyst Management Services, Jeffries D (2000) Post-harvest fisheries monsoon losses: Phase III – 1999 validation of select findings. Project Report. (CD ref: 8)

These documents provide qualitative and quantitative technical and socio-economic data on small-scale fish processors, processing and post-harvest fish losses during the monsoon. Village and individual processor case studies are also described in Kumar et al (1998).

Output 3 was planned and undertaken as a result of Output 1 and 2. It is presented as three following three project documents, which describe the intervention planning process, the field trials to test appropriate interventions and a qualitative review of the trials by an Indian socio-economist:

- Joseph M M (1999) Report on Participatory Intervention Planning carried out in Orissa and Andhra Pradesh during April - May 1999 for field testing of interventions as phase III of the monsoon season losses in post harvest fisheries project. Project report. (CD ref: 9)
- Salagrama V, Srikar L N, Sudhakar N S (1999) Research project on monsoon losses in post-harvest fisheries (R6817) Phase III: Field testing of simple loss reduction methods. Project Report. (CD ref: 12)
- Sundararajan M (2000) An evaluation of Field trials Conducted by the RNRKS Monsoon Fish Losses Research Project. Project Report. (CD ref: 13)

The following section provides an overview of the project outputs. Outputs 1 and 2 are presented together. Further data and information can be found in the above documents, which are available on the accompanying CD. These documents form the

objectively verifiable indicators (OVI's) of the outputs. To some extent the OVI's of the project purpose have already been met, further details are in the Contribution of Outputs section. A shorter summary of the outputs is given in Joseph M M, Ward A R (2000) Understanding and reducing losses in traditional fish processing in India. Project Report (CD ref: 14). This report was produced as a dissemination activity and distributed to secondary stakeholders to promote the project.

## **A Technical and Socio-economic Assessment of Wet Season Post-harvest Fish Losses Affecting Small-scale Processors in India.**

Three primary data collection and analysis studies were undertaken by the project to achieve Outputs 1 and 2:

**1) A technical and socio-economic assessment of wet season post-harvest fish losses in India described.**

**2) Case studies of the causes and impact of post-harvest fish losses described.**

These were a qualitative exploratory study during the 1997 monsoon, a more focussed study during the 1998 monsoon and then a quantitative survey to validate key qualitative data in coastal Andhra Pradesh and Orissa. This section provides a summary of these three studies. It describes small-scale processors, processing and the post-harvest losses incurred by processors during the monsoon season. It combines qualitative data derived from semi-structured interviews with quantitative data from a questionnaire survey. Whilst Andhra Pradesh and Orissa were the states where most research was focussed, some data is also presented from research in Kerala and Tamil Nadu. The relevant reports are mentioned in the Outputs introduction and are available on the accompanying CD. Background to the research process, site selection and methods are given in the Research Activities section.

### *Small-scale Processor Profile*

For the purpose of the research, small-scale processors were defined as those having Rs 3000 working capital or less. This group were the focus of the project as within the processing sector per se, they had been identified as the most vulnerable and poverty stricken. Within this section the term processor or processors refers to small-scale processors.

The research showed that 95% of traditional coastal small-scale processors in Andhra Pradesh and Orissa are women. Pockets of male processors (immigrants from Bangladesh) are found in Orissa. Processors had on average been processing for approximately 14 years.

Women have been traditionally fish processors and some do not know any other trade, having begun processing when children. The ease with which one can enter into processing, the lack of alternative income opportunities and the fact that processing can be undertaken near the house so that household chores can be attended to, are also reasons why women predominate in the sector. There is also evidence that processing is something, which gives the women an element of independence and esteem, as opposed to wage labouring.

Most processors use between Rs. 500 – 3000 working capital. A small proportion (22%) employ less than Rs.500 [exact chi-squared gives a p-value of 0.02, indicating that at the 5% level there is a significant difference in the distribution of working capital between men and women headed households, with the latter having less capital].

Seventeen percent of processors belong to households with no adult male member; i.e. woman-headed households. These women have been either deserted by their husband or widowed. Because women-headed households often do not have close links to a fisherman they have more restricted access to fish, the main source of income and food available in their communities. Alcohol abuse by men was cited as a cause of neglect of women by husbands.

Fish processing and fresh fish trading are very important to all processors, and critical to women headed households. Over half of processors (55%) derive incomes from all three (fish-related) activities – fishing (through men) and processing and fresh fish trading (through women). Involvement in *only fishing or trading alone* is rare, 11% of processors are involved in *only fish processing*. Table 3 shows the key sources of income for processors interviewed during the questionnaire survey.

*Table 3 All possible combinations of sources of income*

Fishing	Processing	Trading	Agricultural labourer	Other Labour	Own Agriculture	Count
Yes	Yes	Yes	Yes	No	Yes	2
Yes	Yes	Yes	Yes	No	No	40
Yes	Yes	Yes	No	Yes	No	1
Yes	Yes	Yes	No	No	Yes	3
Yes	Yes	Yes	No	No	No	88
Yes	Yes	No	Yes	Yes	Yes	1
Yes	Yes	No	Yes	No	No	3
Yes	Yes	No	No	No	No	23
Yes	No	Yes	No	No	No	1
Yes	No	No	No	No	No	1
No	Yes	Yes	Yes	No	No	8
No	Yes	Yes	No	Yes	Yes	1
No	Yes	Yes	No	Yes	No	8
No	Yes	Yes	No	No	Yes	1
No	Yes	Yes	No	No	No	31
No	Yes	No	Yes	No	No	3
No	Yes	No	No	Yes	No	1
No	Yes	No	No	No	Yes	1
No	Yes	No	No	No	No	25
Yes=163 No = 79	Yes = 240 No = 2	Yes = 184 No = 58	Yes = 57 No = 185	Yes = 12 No = 230	Yes = 9 No = 233	

It is clear that other labour and own agriculture account for a minority of SSPs and a useful summary of Table 3 can be obtained by using a Venn diagram to represent the first four columns.

Figure 1 Venn diagram for fishing, agricultural labour, processing and trading

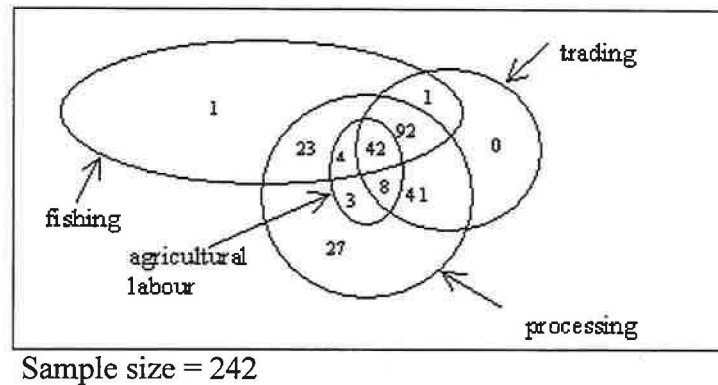
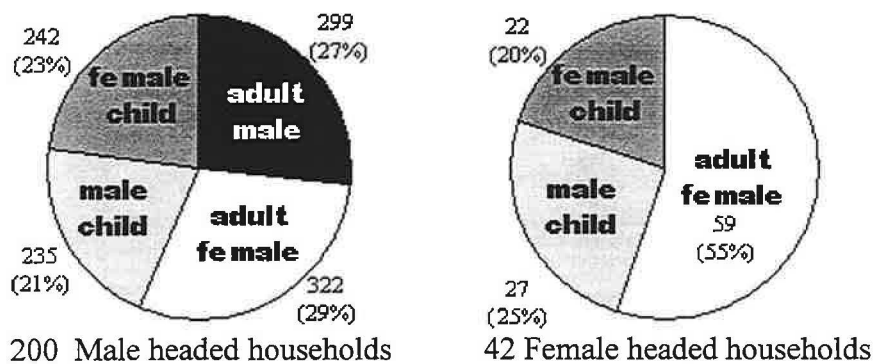


Figure 1 shows that 24% of SSPs obtain some income from agricultural labour and 5% from other types of labour.

Figure 2 shows the distribution of family members for both male and female headed households. The average family size for a male headed household is 5.5, (bootstrapping was used to calculate a 95% confidence interval of (5.2 to 5.8)). The average family size for a female-headed household is 2.6 (bootstrapped 95% confidence interval is (2.1 to 3.0)).

Figure 2 Distribution of family members for male and female headed households



In Andhra Pradesh processors involved in semi-structured interviews were between 40 and 60+ years of age and have 5–40 years of experience in processing. They generally processed throughout the year. Males in the family (husband and sons) fish through the year and also engage in prawn seed collection during the monsoon, a very important source of income during this time. Without the benefit of additional sources of income such as prawn seed collection, the reliance on processing is greater and the impact of losses more acute. These processors had annual household incomes ranging from Rs 10,800 to Rs 51,000. The lower figure referred to a household, which consisted of the processor only. Household per capita income ranged from Rs 7000 to Rs 16,600. In Andhra Pradesh expenditure on food, fuel, oil, wayside snacks, tea/coffee, etc. is 40–75% of family expenditure.



In Orissa all the processors who participated in semi-structured interviews had migrated from Andhra Pradesh. They were between 25 and 60 years old and their annual household income was between Rs 8,800 and Rs 41,000. Per capita income is between Rs 1,700 and Rs 23,000. The larger figure refers to a singleton processor. Food and related expenditure (condiments, vegetables, meat, fuel, oil, snacks, tea/coffee at eateries) made up the bulk (50–81%) of household expenditure.

In Kerala the processors who participated in semi-structured interviews were single women (widowed, deserted or divorced) between 32 and 48 years of age and mostly illiterate. They were involved in fresh fish sale and processing. Male members in family (son, brother, partner) involved in fishing and trading. Total annual household income was found to be Rs 47,000 to Rs 49,000, with per capita income Rs 3,000 to Rs 19,000. A high proportion of spending was on food and related items (>80%). During lean months, processors cut back on the quantity and quality of food.

Processors in all these states find that expenditure is greater than overall income during the monsoon. This is a result of lower overall landings and therefore less opportunity to earn income, post-harvest losses, which reduce working capital.

Four of the six processors interviewed in-depth in Andhra Pradesh face a temporary financial deficit in the monsoon, in spite of other income sources. Of the five families interviewed in Orissa, three borrow from year to year, with interest mounting and look for windfalls in some way to make up for the loans. They regularly borrow to repay borrowings. All three were seen to be in a downward economic spiral to differing degrees. One of the three processors interviewed in Kerala normally made a net financial loss during the monsoon season.

In order to cope with the financial deficit during the monsoon processors will save at better times of the year, borrow money at high rates of interest, compromise on food (quality and quantity), send their children to orphanages, and return to home areas where they may have the support of other relatives and other earning sources.

The processors who make financial surplus will save. Some will save Rs 10/day, with a private finance company or in chit funds to obtain loans when required.

Processors will borrow from money lenders within the village, in the neighbouring village or at the market where the fish are sold. Interest rates vary from 30 to 240 % per annum depending on where and whether collateral is used. Whilst money lenders were also used in Kerala, processors were also able to borrow at lower interest rates from banks and fishermen's societies.

Processors are faced with an increasingly difficult situation. Not only do they incur losses during the monsoon they are also facing increasingly stiff competition for fish from larger scale processors, who have better access to credit and markets and are able to afford to pay higher prices. There is also an increase in competition from fresh fish traders who supply major urban centres. This competition is made more acute by the general reduction in landings and increase in the number of processors in some villages. Unless there are alternative sources of income women will also borrow and

use up savings when they are unable to process because of these non-monsoon factors. There is also evidence that women have resorted to prostitution in-order to earn income as result of these problems.

### *Small-Scale Fish Processing*

In terms of the level of processing activity, the monsoon season is a period when fishing is hampered by poor weather and landings are moderate, but processing still continues. Table 4 shows the monsoon periods and levels of landings and processing.

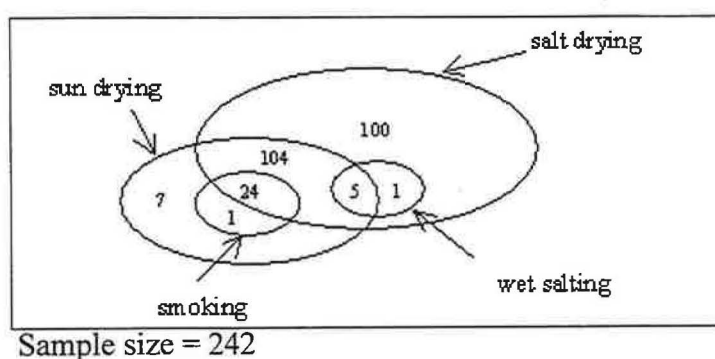
Table 4 Monsoon season, landings and processing

Site	Monsoon Period	Peak Landings	Peak Processing Activity	Low Processing Activity	Comments
Subbampeta & Jaggarajpeta	July to October	November to January	November to January	February to June	Rough weather restricts fishing in monsoon
Chandhrabhaga	July to November	December January	December January	March to June	Rough weather restricts fishing in monsoon
Virundukandi	June to August	September to March	June to August	April May	Rough weather restricts fishing in monsoon. Landings small with occasional glut.

The quantity of fish available to processors has dropped in recent years. This is due to an increase in processor numbers and a reduction in overall landings. There are less fish for more processors.

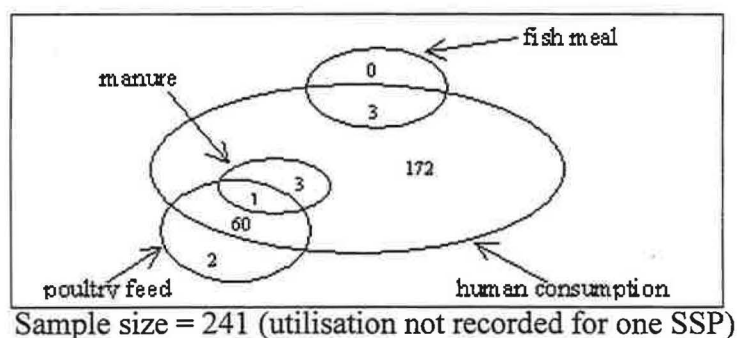
Salt drying is the most common processing method used with 97% of processors in Andhra and Orissa using this method. Sun drying without salt is also used by 58% of processors. A limited number of processors also smoke fish and some wet salt without drying. Figure 3 shows the relationships between the four recorded methods for processing fish.

Figure 3 Distribution of processing methods.



The majority of processors, 99% produce salted and dried fish for human consumption. Poultry feed is produced by 24% of processors. The utilisation of the processed fish is described in Figure 4.

*Figure 4 Utilisation of processed fish.*



A chi-squared test gives highly significant evidence for a preference for processors to process fish three times a week.

In Andhra Pradesh over 10 varieties of fish are processed with croaker, ribbonfish and sardines being the main species salted and dried. In Orissa the main species processed are croaker, ribbonfish, horse mackerel, hilsa, sardines and clupeids. The net profit realised for salted and dried fish was between 24 and 30%. The average costs of production in 1998 were Rs 25 per kg. The costs were raw material, transport, salt, labour and storage. Processors sold product for approximately Rs 30 kg. The cost of salt was said to be variable and could increase by 100%. Labour costs are generally low or minimised as processors or their families will tend to do most of the processing work.

The costs of producing sun dried product were similar to those of salting and drying. Although there was no expenditure on salt, raw material was slightly more expensive. In Andhra the main species sun dried without salt are ribbonfish, sardines, shrimps and anchovies. In Orissa it was mainly sardines and anchovies. The final products are sold for a slightly lower net profit than salted and dried fish (20 - 25%).

Grouping together with other processors to share and thus reduce transport costs is often practiced if the product is taken by road to markets away from the locality.

Fish are salted in cement vats for a minimum of 24 hours. In Kerala fish are often gutted, headed and washed and then salted. A weight and rack are used to keep the fish submerged in brine. By-products (heads, guts) are also sold and generate income. If the weather conditions are favourable the salted fish are dried on the ground, on mats on the ground, on cement drying platforms or raised racks. The dried fish are usually stored in the processors house, for not more than seven days.

Only 7% of processors in Andhra and Orissa sell all their produce within their own villages, 93% of processors sell at least some produce outside their village and 40% sell in other markets (mostly in small towns).

Product sold in and around villages is carried by processors on their heads. 86% of processors in Andhra and Orissa reported using headloading, and 90% some form of motorised transport. 80% of processors report using both in order to transport products to market.

#### *Types of Post-harvest Fish Loss*

Post-harvest fish loss, the discarding of fish or the sale of fish for a lower value than it could have realised, is a feature of all fish distribution chains worldwide. There are four common types of post-harvest fish loss:

- Physical loss - the discarding of fish for no revenue as the fish cannot be sold because of spoilage or reduction in the amount of fish because it may have been damaged due to insect infestation.
- Quality loss - the sale of fish for a lower than best price because of quality deterioration.
- Market force loss – fish is sold for a lower than best price not because of quality problems but because of over supply or poor demand.
- Nutrition loss – changes in the biochemical composition of the fish reduce its nutritional value.

In some cases it is possible to address the cause of the loss by adopting different handling, processing or business practices and/or investing in new or different technology. In other situations the loss may be at its minimum level, and it will not make economic sense to try and reduce it further.

Successfully addressing the cause of the loss and as a result reducing its level has two main consequences: increase the potential income from fish and increase the supply of animal protein available for human consumption. Both these results would potentially improve the livelihoods of operators and/or consumers.

The starting point for R6817 was observations by secondary stakeholders that traditional fish processors in coastal India were incurring significant post-harvest fish losses during the monsoon season and there was scope to reduce these losses. The project therefore set about building up a more accurate understanding of these losses, before attempting to address the causes. The following is an overview of the key characteristics of monsoon losses affecting small-scale processors in areas of coastal India. The main focus of the research were physical and quality losses, the two most common and clearly defined losses.

Table 5 summarises the types of loss, irrespective of processing method, which affect processors within the communities surveyed during the two qualitative studies. The case study data refers to small-scale processors only. The data clearly shows that in most cases physical as well as quality losses were common at all sites during processing and/or afterwards, during storage during the monsoon. In Kuthenguly only a quality loss was recorded. Small-scale processors interviewed expect and accept such losses during the monsoon as a normal part of business. The other common perception amongst stakeholders was that it would be difficult to reduce losses.

*Table 5 Types of post-harvest loss at processing during the monsoon*

Site	Location	Exploratory Study		Case Studies	
		Quality	Physical	Quality	Physical
Virundukandi	North Kerala	Y	Y	Y	Y
Puthiyappa	North Kerala	Y	Y	-	-
Kuthenguly	Tamil Nadu	Y	N	-	-
Colachel	Tamil Nadu	Y	Y	-	-
Daniapeta	Andhra Pradesh	Y	Y	-	-
Jaggarajpeta	Andhra Pradesh	Y	Y	Y	Y
Subbampeta	Andhra Pradesh	Y	Y	Y	Y
Chandrabhaga	Orissa	Y	Y	Y	Y
New Bakshipalli	Orissa	Y	Y	-	-

The qualitative research found that ten of the thirteen processors interviewed at length incurred post-harvest fish losses during the monsoon season. The frequency of loss, whether physical or quality, was between one and six times a season. Table 6 gives qualitative data on the frequency with which processors incurred losses.

*Table 6 Frequency of Loss Incurred by Small-scale Processors*

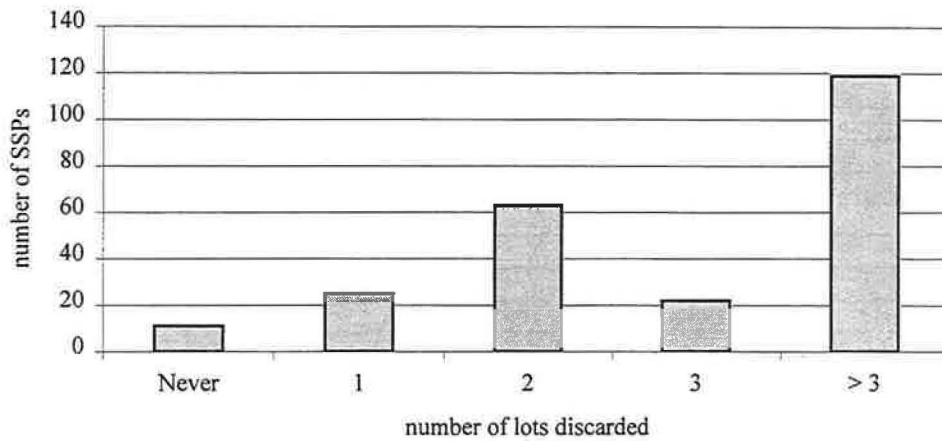
Site	Exploratory	Case Studies
	Frequency of Loss*	Frequency of Loss
Virundukandi	-	1 – 6
Puthiyappa	-	-
Kuthenguly	-	-
Colachel	-	-
Danaipeta	3 – 4	-
Jaggarajpeta	4 – 5	2 – 6
Subbampeta	4 – 5	2 – 6
Chandrabhaga	1 – 2	1 – 4
New Bakshipalli	4 – 5	-

\* processors per se

The quantitative survey conducted in Andhra Pradesh and Orissa showed that the majority of processors incur a physical loss during the monsoon. Figure 5 shows that almost 50% of processors surveyed discarded fish more than three times during the monsoon.



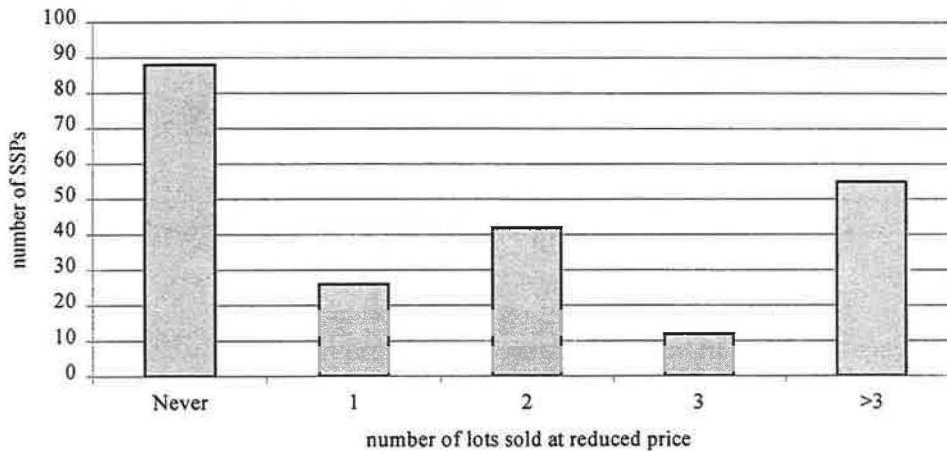
*Figure 5 Number of lots discarded during monsoon*



Whilst physical loss still occurs the level and frequency of the loss has reduced over time due to: rising demand for fish and a constant level or decline in landings; better access to markets; more availability of ice.

Processors also reported incurring quality losses, however, a large proportion of them (36%) did not incur such a loss during the monsoon season. The frequency with which processors reported sales at reduced prices (a measure of quality loss) is shown in Figure 6.

*Figure 6 Number of lots sold at reduced price during monsoon*



*Reasons for Loss*

Qualitative information on the reasons why physical and quality losses occur is shown in Table 7. The reasons can be summarised as:

- rain wetting product during drying causing spoilage and blowfly larvae infestation;

- drying conditions are poor so the fish are held for long periods in brine leading to quality deterioration and blowfly larvae infestation;
- glut landings where supply outstrips demand.

*Table 7 Main reasons for loss incurred by processors*

Site	Exploratory studies		Case Studies	
	Quality	Physical	Quality	Physical
Virundukandi (Kerala)	Sundried material absorbs water or cannot be dried.	Sundried material absorbs water or cannot be dried.	Long brining times Poor quality raw material (discoloration)	Long brining times Poor quality raw material (discoloration)
Puthiyappa (Kerala)	Sundried material absorbs water or cannot be dried.	Sundried material absorbs water or cannot be dried.	-	-
Kuthenguly (Tamil Nadu)	Not known (loss minimal)	Not known (loss minimal)	-	-
Colachel (Tamil Nadu)	Glut landing Blowfly larvae infestation Rain wetting sundrying material	Glut landing Blowfly larvae infestation Rain wetting sundrying material	-	-
Danaipta (Andhra Pradesh)	Rain for 2 – 3 days prevents sundrying	Rain for 2 – 3 days prevents sundrying	-	-
Jaggarajpeta (Andhra Pradesh)	Rain preventing sundrying or wetting product leading to deterioration	Rain preventing sundrying or wetting product leading to deterioration	Blowfly larvae infestation	Blowfly larvae infestation
Subbampeta (Andhra Pradesh)	Rain preventing sundrying or wetting product leading to deterioration	Rain preventing sundrying or wetting product leading to deterioration	Blowfly larvae infestation	Blowfly larvae infestation
Chandrabhaga (Orissa)	Rain wetting product leading to deterioration	Rain wetting product leading to deterioration	Blowfly larvae infestation Discoloration	Blowfly larvae infestation Discoloration
New Bakshipalli (Orissa)	Rain wetting product leading to deterioration	Rain wetting product leading to deterioration	-	-

Table 8 gives a summary of the results of the quantitative survey which shows the main cause of both physical and quality losses to processors in Andhra and Orissa, as perceived by the processors, are:

- Fish held in brine becomes infested with blowfly larvae
- Fish being dried is drenched in rain and washed away/lost

- Fish is drenched in rain and cannot be re-dried and becomes infested with blowfly larvae

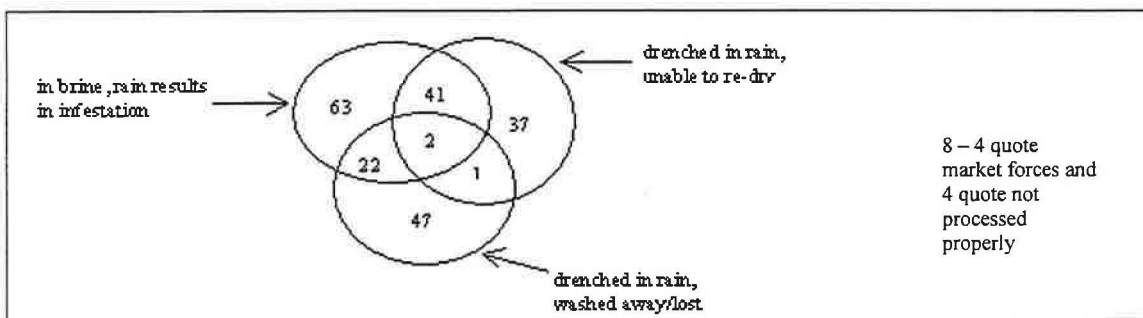
*Table 8 Causes of monsoon losses*

Material in brine, continuous rains resulted in infestation	Material drying drenched in rain, washed away/lost	Material drenched in rain, unable to redry, infestation	Material stored, infestation	Low quality material processed, infestation in brine	Market forces	Not processed properly	Count
Yes	Yes	Yes	No	No	Yes	No	1
Yes	Yes	Yes	No	No	No	No	1
Yes	Yes	No	No	No	No	No	22
Yes	No	Yes	No	No	No	No	41
Yes	No	No	Yes	No	No	No	1
Yes	No	No	No	Yes	No	No	1
Yes	No	No	No	No	No	Yes	1
Yes	No	No	No	No	No	No	60
No	Yes	Yes	No	No	No	No	1
No	Yes	No	No	No	No	No	47
No	No	Yes	Yes	No	Yes	No	1
No	No	Yes	Yes	No	No	No	1
No	No	Yes	No	No	No	No	35
No	No	No	No	No	Yes	No	4
No	No	No	No	No	No	Yes	4
No	No	No	No	No	No	No	21*
Yes = 128 No = 114	Yes = 72 No = 170	Yes = 81 No = 161	Yes = 3 No = 239	Yes = 1 No = 241	Yes = 6 No = 236	Yes = 5 No = 237	

\* Note 13 of these SSPs did report monsoon losses, but gave no reason.

The highlighted rows give the most important combinations and the table can be summarised by considering a Venn diagram representation of the first three columns (Figure 7).

*Figure 7 Venn diagram for combination of most important losses*



Sample size is 221 (21 SSPs who came up with no reason are taken as non-respondents)

### *Variables Which Influence Loss Levels*

The following is a list of the variables identified by the research, which influence the likelihood or level of losses. The following section on Level of Losses highlights the variations in loss level between individual processors.

#### Retail Door to Door

Processors who retail product door to door are more likely to discard material of the wrong quality in order not to sell poor quality product and risk losing customers.

#### Small Quantity

Processors incur lower losses when processing small quantities of fish. Handling small quantities is easier, especially moving them into shelter when it rains. Small quantities can be quickly disposed of if quality deterioration sets in.

#### Assistance in Processing

A woman processor has multiple roles. She is a mother, trader, processor, and takes care of household chores. The more help she has in processing or taking care of children, the more attention she can give to taking care of her fish and minimising the risk of loss. Therefore help from household members and/or neighbours can allow more attention to be devoted to processing and reduce the risk of loss.

#### Weather

The more sunny rain free days the less the chance of losses. If there is rain for more than 5–8 days loss is more likely. The greater the number of days of sunshine and clear skies, the less chance of losses.

#### Brining Time

The longer the fish remain in brine the more chance there will be quality deterioration and damage from blowfly larvae infestation.

#### Storage

The less time processed product spends in storage the less likely there will be losses. Shorter storage time reduces losses and risks. The more the processor checks her stocks for quality deterioration (and take corrective action like adding more salt), the less chance of losses.

#### Raw Material

Poor quality raw material will increase the chances of loss.

#### Processing Method

Losses are associated with sundrying rather than wet salting, although losses occur in both processes. Sun dried varieties are more prone to losses than salt sundried. Processing for poultry feed and manure is less profitable, but also less risky.

#### Species

The quantitative survey also showed that in Orissa and Andhra Pradesh small-scale processors associate post-harvest loss with certain species of fish. The six species most commonly associated with losses are sardines, ribbonfish, mackerel, anchovy, croaker and mullet.

### Experience of the Processor

The longer a processor has been processing and the more experience she has can influence whether she will incur losses and to what extent.

### *Loss Levels*

Semi-structured interviews with a sample of processors provided indicative quantitative data on the level of loss incurred by individual processors. Table 9 summarises this data. It shows that a processor who incurs losses can lose in financial terms 6 to 30% of the value of their turnover or between Rs100 and Rs 6750 per monsoon. The physical loss ranges from 3 to 20 % of product processed and a processor will sell between 7 and 50% of product for a reduced price.

*Table 9 Qualitative Data on Loss Levels Incurred by Processors During the Monsoon*

Site	Product	Rs Loss Per Processor per Monsoon	% Physical	% Quality	% of Turnover
Virundukandi (Kerala)	Sundried Wet salted	230 – 2406	3	7	1 – 17
Puthiyappa (Kerala)	Sundried	211,000 *	10	50	20
Kuthenguly (Tamil Nadu)		Negligible			
Colachel (Tamil Nadu)	Sundried Wet salted	2380	10		11
Danaipta (Andhra Pradesh)	Sundried Wet salted	992			8.5
Jaggarajpeta (Andhra Pradesh)	Sundried Wet salted	600 – 3750	10		
Subbampeta (Andhra Pradesh)	Sundried Wet salted	600 – 3750	20	50	
Chandrabhaga (Orissa)	Sundried Wet salted	104 – 4000	10	50	6 – 31
New Bakshipalli (Orissa)	Sundried Wet salted	6750			

\* specifically large scale operators.

An analysis of quantitative survey data shows that for every 10 active fishermen in Andhra Pradesh and Orissa, there is one small-scale processor. Because no secondary data was available to the project on number of processors and number of marine fishing villages this ratio was used to calculate the number of small-scale processors in each State. Based on the ratio, the project estimates that there are approximately 50,000 small-scale processors in Andhra Pradesh and approximately 5,500 in Orissa.

Using qualitative loss level data generated by the research (Table 9) it is estimated that the monetary loss to small-scale processors in Andhra Pradesh is between Rs 30,000,000 and Rs 187,000,000 per monsoon and in Orissa the figure is between Rs 570,000 and Rs 37,000,000. See Table 10.

*Table 10. Extrapolated loss level data*

State	Number of Processors	Loss per Processor (Rs)	Macro Loss per Monsoon (Rs)
Andhra Pradesh	50,000	600 – 3750	Rs 30 – 188 million
Orissa	5,500	104 – 6750	Rs 0.5 – 37 million

The monetary macro loss represents a loss in potential income to small-scale processors as a whole because of post-harvest fish loss during the monsoon. The calculations assume that at all processors incur losses during the monsoon. The research showed that the majority of processors in fact incur a loss. For the purposes of estimating the magnitude of loss these figures should be viewed as indicative. Some of which will be covered by borrowing at high rates of interest or savings (see section on coping strategies below).

### *Coping Strategies*

Although processors incur loss the research found that they use various coping strategies to try and control or minimise loss as much as possible. These coping strategies are summarised in Table 11, with the most important combinations highlighted.

Making up for losses in subsequent processing and borrowing money are the most common coping strategies use by processors. Of the 202 processors surveyed who use these two strategies, 88 make up loss in subsequent lots only, 43 borrow money only and 71 use a combination of the two. Nearly half (47%) of the sample report having to borrow to stay in business after suffering monsoon losses. 50% of the 42 SSPs from women headed households are also in the same situation. As shown earlier, the cost of borrowing is high, and represents a heavy burden, especially on the poor households.



Table 11 Coping strategies for monsoon losses

	a	b	c	d	e	f	g	h	i	J	k	count
Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	6
Yes	Yes	No	No	No	Yes	No	No	No	No	No	No	1
Yes	Yes	No	No	No	No	No	No	No	No	Yes	No	1
Yes	Yes	No	No	No	No	No	No	No	No	No	Yes	2
Yes	Yes	No	No	No	No	No	No	No	No	No	No	61
Yes	No	Yes	No	No	No	No	No	No	No	No	No	4
Yes	No	No	Yes	No	No	No	No	No	No	No	No	6
Yes	No	No	No	Yes	No	No	No	No	No	No	No	1
Yes	No	No	No	No	Yes	No	No	No	No	No	No	2
Yes	No	No	No	No	No	Yes	No	No	No	No	No	2
Yes	No	No	No	No	No	No	Yes	No	No	No	No	5
Yes	No	No	No	No	No	No	No	No	No	Yes	Yes	8
Yes	No	No	No	No	No	No	No	No	No	Yes	No	5
Yes	No	No	No	No	No	No	No	No	No	No	Yes	3
Yes	No	No	No	No	No	No	No	No	No	No	No	52
No	Yes	Yes	No	No	No	No	No	No	No	No	No	1
No	Yes	No	Yes	No	No	No	No	No	No	No	No	1
No	Yes	No	No	No	Yes	No	No	No	No	No	No	4
No	Yes	No	No	No	No	No	No	Yes	No	No	No	2
No	Yes	No	No	No	No	No	No	No	No	Yes	No	1
No	Yes	No	No	No	No	No	No	No	No	No	No	34
No	No	Yes	No	No	No	Yes	No	No	No	No	No	2
No	No	Yes	No	No	No	No	No	No	No	No	No	2
No	No	No	Yes	No	No	No	No	No	No	No	No	4
No	No	No	No	Yes	No	Yes	No	No	No	No	No	1
No	No	No	No	No	Yes	No	No	No	No	No	No	4
No	No	No	No	No	No	No	Yes	No	No	No	No	3
No	No	No	No	No	No	No	No	Yes	No	No	No	12
No	No	No	No	No	No	No	No	No	Yes	No	No	1
No	No	No	No	No	No	No	No	No	No	Yes	No	2
No	No	No	No	No	No	No	No	No	No	No	Yes	2
No	No	No	No	No	No	No	No	No	No	No	No	7*
Yes	159	114	15	11	2	11	8	19	1	17	15	
No	83	128	227	231	240	231	234	223	241	225	227	

\* Only three of these SSPs reported no physical or quality loss

Key to columns:

a	Made up in subsequent lots	g	Take up other work
b	Borrowed money	h	Brought in own money
c	Reduced turnover	i	Sold assets
d	Increased Turnover	j	Discount from fishermen
e	Stopped processing	k	Got credit facility
f	Pledged gold jewellery		

A consequence of loss is that 6% of processors reduce turnover and 1% cease processing. These are presumably households with no access to credit, very likely the

poorest in the community. Given the criticality of processing to poor households, the impact of monsoon losses is particularly harsh for them.

The qualitative studies revealed a number of other coping strategies used by some processors at some sites. Some of these formed the basis of intervention ideas.

- Drying fish in accessible places, in front of the house (e.g. on a cot, mat). So that if it rains, material can be quickly gathered.
- Vigilance during drying by the processor or neighbours so that if rain starts the fish can be quickly removed to the house.
- Drying fish on nets and plastic sheets so that it can be quickly removed when rain starts.
- Plastic sheets are used to cover fish and protect it from rain.
- Drying fish on racks, protecting it from sand, dirt and pigs.
- Purchasing semi-dried fish, thus avoiding the risks associated with the early stages of processing. These fish are further processed, by sundrying, and sold.
- Insecticides such as “gamaxin”(trade name) are used to control insect infestation (practiced more by larger scale processors who deal in larger quantities of fish and tend to store for longer periods).
- Cow-dung and washing soda are used during processing to improve the final product colour.
- Increasing the proportion of fish sold in fresh form and minimising the proportion dried.
- Processors also get some returns from the sale of by-products such as heads, guts and oil.
- Fish is washed before salting and weights are used to keep fish immersed in brine to minimise spoilage and damage from blowfly larvae infestation.
- Processors knowledge of new and distant markets and prices as a result of good communications has helped reduce losses.

### **Appropriate Technical and/or Non Technical Interventions for Loss Reduction Defined and Tested.**

The intervention phase involved small-scale processors identifying potential appropriate interventions they would like to test from a list based on existing coping strategies and technical ideas suggested by secondary stakeholders derived from the improved understanding of processors technical and socio-economic situation and capabilities. The coping strategies and technical ideas were based on the socio-economic and technical understanding generated by Outputs 1 and 2. Small-scale processors in Andhra Pradesh and Orissa chose the interventions they felt would benefit them and were assisted by the project to test these during the 1999 monsoon. The objective of the field trial was to assess small-scale processors willingness to adopt any of the interventions. The project then based dissemination material and activities on the successful interventions.

As background, the project undertook a short review of previous intervention experiences before the 1997 exploratory study and produced a basic guide to intervention, described in Papadopoulos 1997. The DFID Post-harvest Fisheries Research Project, based in Chennai, had already been involved in technical, socio-economic and community development, interventions and initiatives. R6817 employed former project staff as consultants during the intervention phase. DFID PHFP staff also attended all the main workshops along with staff from CIFT and Catalyst Management Services. Both these latter organisations also have experience of intervention in the post-harvest sector, CIFT particularly technical intervention and CMS more on marketing initiatives.

By the Chennai workshop of March 1999 R6817 had established a detailed qualitative understanding of monsoon losses affecting small-scale fish processors in a number of communities. It had also established an understanding of small-scale processors and their livelihoods and had explored the potential for intervention to reduce post-harvest losses during the 1998 fieldwork. The March 1999 workshop was therefore an important transition stage between generating the understanding of the researchable constraint (monsoon losses) and planning a course of research to address the problem.

At the March 1999 workshop the findings of the second phase of fieldwork (micro level fish loss assessments and exploration of loss reduction interventions) were reviewed and discussed and the intervention research planned (Ward 1999) (CD ref: 7). The outcome of the workshop was that the Output 3 of the project should focus on testing appropriate interventions based on processors existing coping strategies and technical improvements to processors existing practices, which would either: reduce losses, reduce operating costs, add value to the final product or reduce risks. The potential benefits of interventions were seen as increased income to processors or a reduction in risk or time spent processing.

An initial list or menu of intervention ideas was drawn up immediately after the workshop by the Project Leader, an NRI socio-economist and collaborating scientists from College of Fisheries Mangalore. The menu was based on the following:

a) **existing coping strategies** used by traditional fish processors in India (not only small-scale) - The field research had identified a number of technical and non-technical coping strategies adopted by processors in Kerala, Tamil Nadu, Andhra Pradesh and Orissa to minimise loss during processing or compensate for loss. Interestingly some simple coping strategies such as drying fish on mats rather than the ground to enable quick collection of fish when rain started, were used by some processors in some villages but not all. Likewise, some processing techniques used in Kerala and Karnataka were improved practices compared to those used by processors in Andhra and Orissa. The aim was to disseminate these existing ideas.

b) **small-scale processor socio-economic profile** (availability of credit, available capital and net profit margin) - Field research showed that processors operate with low margins and are not able to access cheap credit and loans suggesting that it would have been inappropriate to try and introduce relatively expensive technical interventions, even though these may technically prove effective in reducing loss. Furthermore, there was evidence that some technical interventions had eventually left the intended beneficiaries (small-scale, women) marginalised, as effective technical ideas and interventions were eventually adopted by large-scale processors and entrepreneurs who were able to capitalise on their more advanced marketing and business skills and squeeze out the small-scale processor at the supply and market levels.

c) **reasons for monsoon post-harvest fish loss** - Insect infestation had been identified as a key cause of loss during the monsoon. Simple technical ideas reduce the problem were identified. It was decided not to investigate the potential use of insecticides recommended by the FAO/WHO or the use of natural insecticides, due to time constraints.

The initial menu is shown in Table 12. This was circulated to secondary stakeholders for comments and additions. It was subsequently revised and expanded before being discussed with small-scale processors in Andhra Pradesh and Orissa (Joseph M M.1999) (CD ref: 9). This exercise was called participatory intervention planning and enabled the project to shortlist a number of interventions which processors were interested in testing.

It was decided after the workshop to focus on technical interventions rather than socio-economic. This was a reflection of several issues: the historic focus of the RNRKS programme; and the Project Leader's interpretation of the purpose of the project: to identify value addition and loss reduction measures. The background and skills of the key researchers and the resources and time constraints of the project also influenced the decision. However, this is not an indication that non-technical initiatives, such as those related to credit and training were not considered appropriate interventions. There is scope for further research on these issues.

*Table 12 Menu of intervention options*

Physical Loss	Physical & Quality Loss	Quality Loss	Others
Hang fish in baskets to protect during storage	Correct quantity of salt	Improve aeration of fish during drying	Cut costs of production ie buy salt in bulk (groups)
	Use of mats to move fish out of rain quickly	Submerge fish in brine	Pickles, cutlets
Improving fish collection during drying i.e. cot	Reduce drying time		Awareness of Govt savings schemes
	Low cost folding drying rack.		Appropriate packaging
Covering with nets (crows)	Changing brine more often		Sorting out valuable species (acetus/anchovies)
	Vigilance when drying		
	plastic sheet to cover fish		
	palm leaf for drying		
	adding extra salt		
	covering vat with plastic sheet		

Whilst the project had also worked in Kerala and Tamil Nadu it decided to focus the intervention phase in Andhra Pradesh and Orissa, primarily because of the relative under development of communities surveyed in those states, especially in Orissa. The involvement of an appropriate locally based NGO was seen as important in terms of co-ordinating and monitoring field activities. The two key NGOs involved were Integrated Coastal Management in Andhra Pradesh and the Coastal Peoples Development Association in Orissa. With the assistance of these two organisations the project worked with small-scale processors to establish field trials to test a number of interventions. The trials are described in (Salagrama et al 1999) (CD ref: 12). The shortlist of interventions that formed the focus of the trials is as follows:

- Brine Concentration
- New Processing Methods
- Improved Drying Speed
- Prevention of Blowfly larvae infestation by keeping fish submerged in brine
- Covering fish/vats
- Changing brine
- Portable/stackable racks & mats
- Value addition
- Better handling practices

Whilst eight of the intervention ideas were specific, one intervention was less so – “better handling practices”. In order to establish the improved practices, which may benefit small-scale processors, the team involved in setting up the trial analysed the existing processing practices at each site and identified ‘critical control points’, at which improved practices may lead to a reduction in loss, reduced risk or an increase

in income. As a result the following interventions were also introduced by the team where appropriate:

- cleaning vats using bleaching powder before starting a new processing operation
- treat seawater using bleaching powder and give adequate contact time for chlorination
- wash fish in treated water
- gut fish on plastic sheets
- wash gutted fish using treated water

Once the team had left the site three processors continued to use the interventions, for two months. A monitoring procedure was established and regular visits to each site were made by one of the research team. These visits enabled follow-on support for processors and assessed whether interventions were being used.

Given the short period of time in which the trials were to be conducted, it was agreed that it would be difficult to generate reliable data on physical and monetary losses prevented – and for this reason the “willingness to adopt” would be used as an indicator of livelihood improvement. The improvement might be in aggregate income, or reduced risk, or less variable income, or in some other quality of life aspect (working conditions etc).

The trials were evaluated by a former DFID Post harvest Fisheries Project socio-economist (Sundararajan 2000) (CD ref: 13). Her findings were that three of the interventions were readily accepted by the processors involved in the trials. These interventions were:

#### *Cleaning vats with bleaching powder*

This idea was one of the improved processing ideas identified by secondary stakeholders. Processors found this was a fast and effective way of cleaning which resulted in longer use of clean brine reducing costs (salt) of processing, risk and the quality loss of fish.

#### *Submerging fish in brine*

This idea originated from a coping strategy used by processors in Kerala where locally made racks are used to keep fish submerged in brine during salting. This visibly reduces infestation by blowfly larvae. This idea was widely accepted by the processors who found it simple to use and effective. Some processors started making their own versions of the frame using locally available materials in various sizes and shapes to suit their processing vats.

#### *Use of lids for covering vats*

Due to heavy winds, traditional covers for vats are blown off and rain water seeps in resulting in a diluted brine, spoilage of fish and blowfly larvae infestation. The project designed a two piece cement lid with an interlocking edge which overcame this problem. The lids could be easily removed for access to the vat's interior. The processors found this very effective in maintaining brine concentration and reducing the risk of loss, although, some processors felt that the lids should be made lighter.



These key interventions could form the basis of a future quantitative experiment. If there was a desire to measure impact. At the moment these interventions are recommended by the project based on the perceptions of those processors who have used them and found them beneficial during the monsoon.

Based on the research and the perceptions of College of Fisheries scientists the project also recommends the promotion of four other interventions:

#### *Gutting and washing fish*

Fish were gutted in order to reduce decay and spoilage. This prevented fish from floating in the processing vats. Although most processors agreed on the advantages of gutting all fish, they felt that it is not practical to gut small varieties, especially when there are large quantities to handle. Larger fishes were gutted and washed afterwards to remove blood and other unwanted matter. They found this practice useful as it helped in keeping the brine clean for a second cycle, thus reducing the cost of salt used.

#### *Testing brine concentration*

The project designed a simple field tool for testing brine concentration. A wooden “egg” ( of the same specific gravity as that of concentrated brine) was made and provided to the processors. This egg sinks in dilute brine while it floats in concentrated brine. Many processors found this useful as it offered them a simple and fast method for checking brine concentration, helping reduce the risk of loss and optimise the use of salt.

#### *Drying fish on mats, stackable racks*

Sudden and unexpected rains are characteristics of the monsoon and when these happen, the processors have to rush in to the rain to prevent the partially dried fish from getting wet. Quite often, such efforts result in getting the fish wet and spoiled. This can be prevented by using a stackable rack or mats, which are easily carried indoors in case of sudden rains. The Project designed small easy to transport racks which can be stacked one over the other in case of rain and kept either covered by plastic sheets or carried indoors. Many processors felt that these are handy, but not very useful when dealing with large quantities of fish. Some processors were concerned about the cost of making these racks.

#### *Increasing drying speed*

In order to maximise the limited drying opportunities during the monsoon, drying fish should be turned frequently so that both sides of the fish dry equally well. Another improvement to current practices is to dry fish on bamboo screens to improve air circulation. Mats made of split bamboo have the added advantage in that they can be rolled up with the fish inside during rain.

The tangible benefits to small-scale processors of using these four additional interventions are less well understood. The concepts though are technically sound and would involve slight changes to current practice with minimum investment. There is scope for further examination of these ideas. Nevertheless, the project has included

these in the intervention package, which it is recommending for promotion.

### **Further Activities**

Examples of participatory research within the post-harvest fisheries sector are rare. The project however, has demonstrated a number of examples of how participation of secondary and primary stakeholders can be encouraged in post-harvest fisheries research. Perhaps the most significant of these has been the approach taken to identifying and field testing interventions. This could form a useful case study. The methodology could be written up as a guide for others to use, validate, modify and adapt.

Outputs 1 and 2 involved the use of a participatory approach and a quantitative survey to assess post-harvest losses. This has complemented the use of a similar approach in West Africa (RNRKS R7008). Lessons learnt and experiences of loss assessment in India under R6817 should be incorporated when finalising R7008.

### ***Contribution of Outputs***

The project has contributed to DFID's wider development goal of improving poor people's livelihoods by addressing the DFID Post-harvest Fisheries Programme purpose of "appropriate value adding technologies and loss reduction processes in small-scale fish processing developed, packaged and promoted".

A package of simple low cost technical interventions to reduce post-harvest loss, improve income or reduce the risks associated with processing during the monsoon (in other words improve processors livelihoods) has been recommended by the project and disseminated at primary (poster, video) and secondary stakeholder (summary report, video, meetings) levels. The interventions are based on existing coping strategies used by processors or appropriate ideas identified by secondary stakeholders. Most of the interventions are also applicable to the non-monsoon period. Due to time constraints it was not possible to quantitatively assess the impact of the interventions. However, the processors who have used the interventions during the research noted less insect infestation during processing and produced improved quality products, which were sold more quickly.

The research has contributed to the poverty alleviation initiatives by Indian organisations such as the State level Departments for Rural Development, the Department of Fisheries in Andhra Pradesh and Orissa, and the Central Institute of Fisheries Technology (CIFT). It has done this by providing information on appropriate technical interventions for livelihood improvement via fish processing, which can be incorporated into relevant work programmes. As a result of dissemination meetings with government officials in Andhra and Orissa in June 2000, the Director for Department for Rural Development (DRD) of Andhra Pradesh said the Department would incorporate the intervention work into their self-help group women's training programme. They were also to solicit the assistance of the College of Fisheries Mangalore and/or Integrated Coastal Management to conduct a "train the trainers" course based on the intervention work of the project.

It is worth mentioning at this point that R6817 has complemented the research of R6467 – Opportunities for Value Added in Traditional Fishing Communities, which in part stressed the need for primarily group formation and savings scheme's to be in place before technical initiatives are feasible. This reflects the current DRD emphasis on self-help group formation and savings. Bearing this in mind the DRD interest in promoting the results of R6817, and the fact that the non-technical requirements are in place will significantly strengthen the likelihood of uptake and impact of the interventions identified by R6817. However, some of the interventions recommended by R6817 require minimum investment on the part of processors: improved cleaning, racks to submerge fish, and it is anticipated that group formation and savings may not be as important for the uptake of these interventions. Dissemination of the intervention ideas to small-scale processors will be more important.

The project has contributed to addressing the "lack of data" on post-harvest fish losses in India, by generating, through qualitative and quantitative research methods a comprehensive understanding of the small-scale fish processing sector of India and the post-harvest fish losses incurred by processors during the monsoon. This includes information on the reasons and frequency of loss, the level of loss, the variables which

can influence loss and information on processors livelihoods. Key information has been provided by the project to the state governments of Orissa and Andhra Pradesh to inform the policy and planning process regarding the post-harvest sector and some of the poorest people within that sector.

The research has also contributed to the more general work with coastal communities of NGOs such as Integrated Coastal Management (ICM), an organisation which is involved in a number of post-harvest and coastal community initiatives in India and south Asia such as the DFID Policy Research Programme Sustainable Coastal Livelihoods Project. ICM were continually involved in the project and were provided with the research outputs in full.

As well as R6467, the research also contributed directly to the work of two other Programme projects: the completed R5027 and the current R7008. Both these projects are concerned with the development of tools to assess post-harvest fish losses. R6817 involved the use of a participatory approach to the field assessment of losses and the use of a quantitative survey to characterise the reasons and frequency of loss. These approaches form the basis of two of the three field based tools being developed by R7008 in West Africa. The experience of using modified approaches in India will complement R7008 and the especially the finalisation of a field loss assessment manual.

In terms of intervention research the project has contributed to the development of a participatory approach for the post-harvest fisheries sector to intervention identification and field testing. In essence the approach hinged on small-scale processors knowledge and existing practices, their perceptions of a range of potential interventions, their decision to participate in field trials and the production of dissemination material (video). The process was facilitated by secondary stakeholders, who also identified appropriate interventions for consideration by processors. The approach used may well be of use to secondary stakeholders involved in intervention work such as CIFT, ICM and other NGOs in India as well as secondary stakeholders in south Asia and Africa. A follow on activity from the project would be to produce and disseminate a guide on the approach for use, validation and adaptation by other secondary stakeholders.

A secondary impact of the project, although difficult to measure, has been the development of skills and experience of individuals involved in the field research. Two scientists from the College of Fisheries, Mangalore were given a basic understanding of participatory field research methods and were involved in field research, working in teams led by professional development consultants. As a result, they gained skills in participatory research methods and became familiar with working in difficult field conditions, gaining a better understanding of the traditional fish processing sector as well as improving report writing skills. It is anticipated that their experiences under the project will stand them in good stead for similar work in the future. Catalyst Management Services Ltd were one of the private development consultancy organisations involved in the project throughout. In a final communication under the project they commented, “ we learnt substantially and hope we contributed similarly”.

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### Appendix 1 List of Key Individuals Involved in R6817

Name	Organisation	Role
Prof. Mohan Joseph Modayil	College of Fisheries, Mangalore	In-country co-ordinator, field research
Dr L N Srikar	College of Fisheries, Mangalore	Adviser, field research
N S Sudhakar	College of Fisheries, Mangalore	Adviser, field research
Ansen Ward	Natural Resources Institute	Project Leader
Victoria Papadopulos	Natural Resources Institute	Socio-economist
Ann Gordon	Natural Resources Institute	Socio-economist
Ulrich Kleih	Natural Resources Institute	Socio-economist
David Jeffries	Natural Resources Institute	Biometrician
Duncan King	DFID	Reviewer, adviser
N Shiv Kumar	Catalyst Management Services Ltd, Bangalore	Field research, adviser
M S Ashok	Catalyst Management Services Ltd, Bangalore	Development Adviser
Jyothi d'Cunha	Institute of Social Work, Mangalore	Field research
Venkatesh Salagrama	Integrated Coastal Management	Field research, adviser
Binod Mohapatro	United Artists Association, CARE	Field research, adviser
B Gomathi	Private consultant, Trichi	Community development, field research
P Sreeramalu	Department of Fisheries, Andhra Pradesh	Field research, adviser
Lachman Nayak	Coastal Peoples Development Association, Konark, Orissa	Field research, adviser
A Kamila	Agriculture Man Ecology, Trichi	Socio-economic adviser
Meera Sundararajan	Private consultant, Chennai	Socio-economic adviser, field research
Isaac Rajenderan	Bay of Bengal Programme, Chennai	Adviser
George Mathew	DFID PHFP now US Embassy, Chennai	Socio-economic adviser
Dr Imam Kasim	Central Institute of Fisheries Technology, Vizag	Adviser
Dr P K Vijayan	Central Institute of Fisheries Technology, Cochin	Adviser
Dr Krishna Srinath	Central Institute of Fisheries Technology, Cochin	Adviser



## **Appendix 2 Project Documents**

Papadopoulos V (1997) Monsoon Season Post-harvest fish losses in India: Desk Review of Secondary Source Data and Suggestions for Research Themes. Project report. (CD ref: 1)

Ward A R, Papadopoulos V, Joseph M J, Srikar L N (1997) Monsoon Season Post Harvest Fish Losses Research Workshop And Site Visits to Orissa and Kanyakumari. Project Report. (CD ref: 2)

Joseph Mohan M, Shiv Kumar N, Jyothi d'Cunha J (1997) Exploratory studies on post-harvest fish losses during the monsoon in South India. Project Report. (CD ref: 3)

Ward A R (1998) Monsoon fish losses – phase two research, issues for discussion. File Note. (CD ref: 4)

Ward A R (1998) DFID Monsoon Season Post Harvest Fish Losses Research Project: Pre-Fieldwork Meeting, Atria Hotel, Bangalore 24 - 26 June 1998 and Initial Case Study Fieldwork in North Kerala.(CD ref: 5)

Shiv Kumar N, Sudhakara N S, Gomathi B (1998) Post-harvest fisheries monsoon losses in south India: A study of small-scale fish processors. Volumes 1 and 2. Project Report. (CD ref: 6a, 6b, 6c)

Ward (1999) Report of a Workshop to Discuss Phase II and Plan Phase III of the DFID RNRKS Monsoon Post Harvest Fish Losses Research Project, March 1999. (CD ref: 7)

Catalyst Management Services, Jeffries D (2000) Post-harvest fisheries monsoon losses: Phase III – 1999 validation of select findings. Project Report. (CD ref: 8)

Joseph M J (1999) Report on Participatory Intervention Planning carried out in Orissa and Andhra Pradesh during April - May 1999 for field testing of interventions as phase III of the monsoon season losses in post harvest fisheries project. Project report.(CD ref: 9).

Ward A R (1999) Intervention field trials – planning meeting, Chennai 7 – 9 June 1999. Project Filenote. (CD ref: 10)

Gordon A (1999) Field Trial Guidelines: Proposed Phase III activities of the monsoon losses project. Project Filenote. (CD ref: 11)

Salagrama V, Srikar L N, Sudhakar N S (1999) Research project on monsoon losses in post-harvest fisheries (R6817) Phase III: Field testing of simple loss reduction methods. Project Report. (CD ref: 12)

Sundararajan M (2000) An evaluation of Field trials Conducted by the RNRKS Monsoon Fish Losses Research Project. Project Report. (CD ref: 13)

Joseph M J, Ward A R (2000) Understanding and reducing losses in traditional fish processing in India. Project Report . (CD ref: 14)

Presentation on the intervention phase of the project by the project leader at the DFID Symposium Eliminating Poverty: the Value of Science to Rural Livelihoods held in London December 1999. (CD ref: DFID Symp)

Joseph M J, Ward A R (2000) Traditional fish processing in the monsoon: reducing loss and risk. Project Video. (CD ref: video)

Ward A R (2000) Understanding and reducing losses in traditional fish processing in India. MS Powerpoint Presentation. (CD ref: meetings presentation)

### Appendix 3 Poster

The following is translation of the poster text which is in two languages. The text on the left hand side is in Telegu (Andhra Pradesh) and on the right it is in Oriya (Orissa).

#### DO YOU EXPERIENCE LOSSES WHILE PROCESSING FISH DURING THE RAINY SEASON ----

Do you have to change the brine often as the brine gets spoiled fast ?

Do you spend more money on salt ?

Does poor quality brine lead to spoilage of fish and adversely affect the quality of the processed fish ?

Clean the processing tanks regularly

Use clean water for washing fish and making brine

Remove the gut and wash fish after gutting, whenever possible

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Do the fish float in the tank and maggots appear causing damage and loss?

Keep fish fully submerged in brine using a frame and weight

-----  
Does the brine in the tank get diluted and fish spoil quicker, causing quality loss?

Check brine concentration with “wooden egg” and add salt if necessary

Prevent seepage of rainwater by covering the tank with lid

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Does rain make drying of fish difficult, leading to maggot infestation ?

Increase drying speed by turning over fish many times

Use split bamboo screen for drying fish faster . It will be easy to roll up and carry indoors when it rains

Dry the fish on stackable racks which can be moved indoors when it rains  
Cover the fish with plastic sheet during light rains