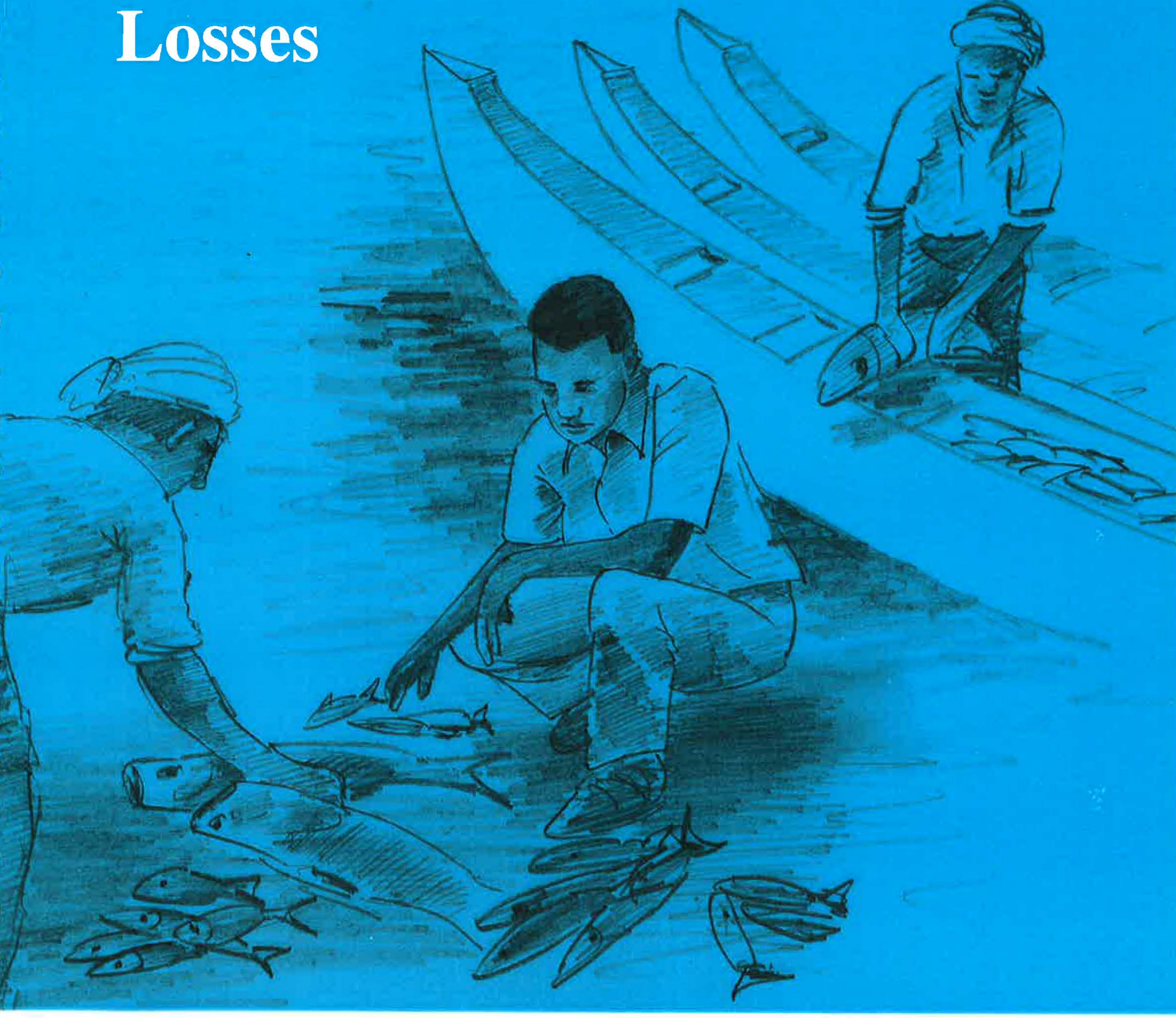
A Manual for Assessing Post-harvest Fisheries Losses



FLAC
FISH LOSS
ASSESSMENT
& CONTROL

PHFRP
POST HARVEST
FISHERIES RESEARCH
PROGRAMME

Natural
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A Manual for Assessing Post-harvest Fisheries Losses

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POST HARVEST FISHERIES RESEARCH PROGRAMME

Natural Resources Institute

The Natural Resources Institute (NRI) of the University of Greenwich is an internationally recognized centre of expertise in research and consultancy in the environment and natural resources sector. The Institute carries out research and development and training to promote efficient management and use of renewable natural resources in support of sustainable livelihoods.

WARD, A.R., JEFFRIES, D.J. (2000) A manual for assessing post harvest fisheries losses. Natural Resources Institute, Chatham, UK. vii + 140 pp. English.

This publication is an output from research funded by the Department for International Development of the United Kingdom. However, the Department for International Development can accept no responsibility for any information provided or views expressed.

[DFID Projects R5027, R7008, R6817 Post Harvest Fisheries Research Programme]

Natural Resources Institute

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Abbreviations

DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
FLAC	Fish Loss Assessment and Control
IFLAM	Informal Fish Loss Assessment Method
IIED	International Institute for Environment and Development
LT	Load Tracking
NGO	Non-Governmental Organization
NRI	Natural Resources Institute
PAR	Participatory Action Research
PALM	Participatory Analysis and Learning Methods
PHFRP	Post Harvest Fisheries Research Programme
PRA	Participatory Rural Appraisal
QLAM	Questionnaire Loss Assessment Method
RNRKS	Renewable Natural Resources Knowledge Strategy
RRA	Rapid Rural Appraisal
SSI	Semi-Structured Interview
WADAF	West African Association for the Development of Artisanal Fisheries

Acknowledgements

This manual is a result of the hard work, skills and enthusiasm of a number of organizations and individuals. At the co-ordination level, these include Dr T. W. Maembe, Director of Fisheries, and Yason Mdeme of Mbegani Fisheries Development Centre, of the United Republic of Tanzania. In West Africa, Dr Demba Yeum Kane, Executive Secretary and Joseph Ndenn, Socio-economist, of the West African Association for the Development of Artisanal Fisheries along with their network of collaborators, and Dr Amadou Tall, Director, INFOPECHE were central to much of the work of R7008 in the region.

In terms of field research, a number of key individuals played important roles and deserve special mention. In Tanzania much praise must go to the regional co-ordinators: Mariam Ndagala and F. M. D. Ntima of the Regional Fisheries Office, Dar es Salaam; E. S. Kilosa and Z. Kazula of the Regional Fisheries Office, Mara, Musoma; K.P. C. Kauswa and J. Mairi of Mwanza Municipal Council and Mr G. R. Mkoki and Mr F. O. Hemile of the District Natural Resources Office, Mafia Island. In West Africa, Gbola Akande of the Nigerian Institute for Oceanography and Marine Research and Dr Paul Anoh of University of Cocody, Côte d'Ivoire, along with their research teams, were instrumental in field testing and developing the methods further. Boubacar Diakite of the Institute of Technologie Alimentaire, Senegal and Nicholas Ntiamoah in Ghana also played important field level roles.

In India the work of Catalyst Management Services Ltd and the College of Fisheries, Mangalore in a separate research project (R6817) also contributed to the development of the methods in the manual.

Thanks must also go to Frans Teutscher of FAO who provided regular constructive advice and Jules Pretty of IIED, who reviewed an earlier draft of the manual. A number of colleagues from NRI also made key contributions these include: Derrick Akintade, Ulrich Kleih and Mike Pritchard of the Social Sciences Department with biometric support being provided by Sheila Green, John Sherrington, Sian Floyd and David Jeffries also of NRI. Biometric support was also provided by Dr Roger Stern of the University of Reading.

Chapter 1 *Introduction*

Background

This manual describes three loss assessment methods developed in the artisanal post-harvest fishery sector for use by researchers working for the development of artisanal fisheries in countries worldwide. The methods are the Informal Fish Loss Assessment Method (IFLAM), Load Tracking (LT) and the Questionnaire Loss Assessment Method (QLAM). They are designed to give the user the quantitative and qualitative understanding of post-harvest fish losses required for planning loss reduction measures. The improved understanding generated by application of the methods will also inform the fisheries planner and policy-maker with regard to decisions concerning the development of the artisanal post-harvest sector and the improvement of the livelihoods of those working in the sector.

The manual has been produced as a result of research over a 6-year period by the Department for International Development (DFID) Renewable Natural Resources Knowledge Strategy (RNRKS) Post-harvest Fisheries Research Programme and draws on the work of projects in Tanzania, West Africa and India. It is one of several outputs associated with the Programme's Fish Loss Assesment and Control (FLAC) initiative. Other FLAC tools are Costing Control Methods, Fishloss (database of loss information), Predictive Model (assessing impact of interventions), Trials Database (assessing impact of quality interventions), Ice Calculator and Sanitation Control (monitoring factory-based quality control) computer software.

The research to develop this manual was undertaken in response to a need to reduce the growing gap between static or dwindling fish supply in light of a growing demand for fish and fish products. It also recognized that in many fisheries the best available means are used to retard spoilage and preserve fish, but for economic, technical or social reasons these are not always adequate enough to prevent post-harvest fish losses. In most, if not all, fish marketing chains a certain amount of harvested fish is either lost physically or suffers a loss in value because of quality changes or market forces.

In some cases this loss can be cost-effectively reduced to increase the level of income to the artisanal sector and contribute to food security, by making more fish protein available to consumers. Changes in practice brought about by greater awareness or training and the adoption of appropriate technical and non-technical initiatives are seen as the key means to loss reduction in post-harvest fisheries.

Impetus for the development of methods was also provided by the meeting for the Strategy for International Fisheries Research in 1991, which recommended that post-harvest fish losses should be a priority issue for future research. It was concluded that there were no tried and tested techniques by which losses could be assessed.

Prior to this research, with the exception of work by FAO (FAO, 1981) and NRI (Wood, 1986), little effort had indeed been made to develop systematic and practical assessment methodologies that could be used to generate accurate information on post-harvest fish losses. Furthermore, there was the fact that what historical data there was available on post-harvest fish losses, especially loss levels, was derived from limited and unsystematic observations and studies. In many cases the way that data had been collected and interpreted is not clear, neither is the type of loss being measured.

So the research was undertaken against this backdrop, nevertheless, it was recognized that there were likely to be difficulties in developing post-harvest fish loss assessment methods. Morrissey (1988) sums up some of the key problems:

> "...the number of species of fish that are involved in fisheries in tropical waters, the lack of uniformity in weight and shape that occurs in small-scale fisheries and their variability of spoilage rates under differing conditions. In addition to this is the fractured distribution system of fresh fish that is found in....(many) countries with the involvement of many fishing groups and several levels of middlemen throughout the distribution chain".

As a further introduction to the manual the following provides an overview of post-harvest fish losses and includes a number of definitions of terms which are used throughout the manual. Following this there is a guide to assist the user decide the method(s) most appropriate for their needs and resources. The remainder of the manual consists of detailed descriptions of each of the three methods.

The manual includes a number of boxes and tips. The boxes provide examples and case studies to highlight key issues given in the main text. Tips likewise are designed to draw attention to key issues.

Post-harvest Fish Losses

This section provides a number of definitions of terms used throughout the manual. Post-harvest fish loss can be interpreted in a number of different ways. The definitions here are those that have been used during the research for this manual.

The term **post-harvest** refers to the period of time from when a fish is separated from its growth medium (Morrissey, 1988). This includes the time a fish enters a net, is caught on a hook or in a trap.

The methods described in this manual are designed to generate data primarily on **physical** losses, **quality** losses and to a lesser extent **market force** losses. Any of these types of loss can occur at any point in a fish marketing or distribution chain, from capture to consumer. A further type of loss is known as **nutritional** loss, this refers to specific biochemical changes within fish flesh, as a result of spoilage or processing. In terms of the research for this manual, nutritional loss was not seen as important and is not the focus of the methods described in this manual.

Physical loss refers to fish that is either, for example, thrown away or consumed by insects or animals. This type of loss can be measured or expressed in terms of weight and/or monetary value. In other words, a physical loss is also translated into a financial loss. It is the amount of money that would have been received by the owner if the fish had not been thrown away. This value is usually calculated using the price the fish would have sold for had it been of good or best quality. Expressed as a weight it is the actual weight of the fish or fish product that has been lost from the distribution chain for which no revenue has been generated. The following are examples of causes of physical loss:

- *spoilage*
- *attack by insects*
- *eaten by animals*
- *oversupply and no buyers so fish discarded*
- *theft*
- *discarded by-catch (trash fish).*

Quality loss is the difference between the potential value of fish or fish product if no deterioration had taken place (best quality) and the actual value of the fish after it had undergone change due to spoilage (lower quality) and was sold for a low price. Quality loss cannot be adequately expressed in weight terms alone. This is because in many cases, the proportion of a batch of fish that has suffered a loss in quality still has some residual value.

Examples of quality loss are:

- *fish has spoiled, but it is still saleable, and is sold for a price less than the price it would have been sold for had it been in good condition*
- *dried fish is damaged during processing or during transport and as a result is sold for a reduced price.*

BOX 1

On arrival at the market the smoked fish is sorted and the broken pieces put to one side. On average there are 15 broken pieces per kilo. Breakage is caused during processing and packing. In a load of 400 kg, 2.5% was found to be broken, and this can increase to 25% if the processing and packing are careless. This broken fish is sold for human consumption by the bundle (50 kg) for a low price. Breakage is also caused by rough journeys, and repeated handling at the marketing stage. Excessive breakage of smoked fish is one of the reasons why salting has become popular.

Fish that has spoiled and consequently sold for a reduced price is often said to have been downgraded. Fish that has spoiled and is not saleable in fresh form may be sold to a different market or is sold for another purpose (animal feed). These are sometimes referred to as rejected fish.

Table 1 shows why and where physical and quality losses can occur within a fish distribution system.

Table 1– Distribution Stages and Reasons For Losses

Distribution Stage	Cause of Loss
Fishing	fish falls from net during hauling back into water handling causes bruising fish spends too long in nets and spoils no chilling on board means fish is exposed to high ambient temperatures in the boat for too long
Landing	fish drops from containers during unloading and transport on shore spoilage occurs as fish is left on beach and no ice is used
Processing	capacity too low to absorb landing adverse weather conditions make drying difficult insect infestation
Transport	mechanical damage to fish delays
Storage	poor storage facilities leading to spoilage insect infestation
Marketing	insect infestation supply and demand

There are a number of general factors (variables) that can increase the likelihood of post-harvest losses occurring and the level at which they occur. These include:

* *unreliable transportation*
* *inadequate preservation techniques*
* *adverse weather conditions*
* *diligence, skills of worker*
* *species of fish*
* *fishing gear used*
* *type of processing method*
* *fish supply greater than demand*
* *market for fish not developed.*

Many people working in the post-harvest sector are aware of losses, some take these as granted and a normal part of business, unaware that there may be a way of successfully reducing the loss. Other people try to cope with loss in whatever way they can under the prevailing circumstances. This can include borrowing money or using simple technical ideas. These ways of dealing with loss are called **coping strategies** and they are important because they can form the basis of appropriate loss reduction initiatives.

Because of changes in demand and supply, but not quality, the price of fish can also change. In such circumstances if the price falls then the owner may incur what is termed a **market force** loss.

Market force losses are the most difficult to measure accurately since they could be defined as either a loss due to a drop in price below an optimum price, or a loss because marketing and production costs outweigh revenue earned.

Fish of poor quality that is sold for a reduced price may mean a financial loss to the seller, but such fish may also be a source of cheap protein for people who may not otherwise be able to afford higher prices for better quality products. The elimination of a financial loss may, therefore, remove a supply of cheap protein for people, particularly poorer people.

The monetary values of physical and quality loss are combined to give the **total financial loss**, which is used to quantify and summarize overall losses incurred by an individual or group in a particular fishery or distribution stage. For example, a fisherman may experience more than one type of loss at the same time. He may sell some fish for a reduced price and also throw away some fish from the same catch. The following shows how to **calculate the total financial loss.**

Lets say that a fisherman lands 100 kg of fish, 70 kg of which he sells for 200 per kg and 20 kg he sells for 150 because the quality of this 20 kg is not so good. The remaining 10 kg is not sold quickly enough and spoils so is discarded on the beach.

Total financial loss = value of physical loss + loss in revenue due to quality loss

The total financial loss to the fishermen is thus:

Value of physical loss = 10 x 200 = 2000

Loss in revenue due to quality loss = (200 - 150) x 20 = 1000

Total financial loss = 2000 + 1000 = 3000

Another way to represent the total financial loss is to calculate the maximum value of the whole catch had it all been sold for the **best** price. Then calculate the total financial loss as a percentage of the maximum potential value.

Maximum value of fish = 200 x 100 kg = 20 000

Total financial loss as a % = 3000/20 000 x 100 = 15.0%.

This tells us that the fisherman is losing 15.0% of the potential revenue he could have earned from his catch. With more understanding of this loss it should be possible for the researcher and fisherman to decide whether there are ways in which this loss could be cost-effectively reduced.

At this point we have introduced the issue of prices. These can be used as an indicator of losses and for measuring losses. The way in which price is measured is important and information on price measurement is given in Appendix 1.

Losses Through a Distribution Chain – a Calculation Example

Often in reality loss is a more complex issue. Losses do not simply occur and their impact felt in a particular stage of a distribution chain. A loss in quality for example can have an impact through several stages of a distribution chain. If poor quality fish is processed then the processed product is likely to be of inferior quality and in some cases it may be more susceptible to breakage and be associated with higher losses than product produced from good quality raw material. An indication of the complexity of loss in terms of a distribution chain is shown in Figure 1. This shows what may happen to a batch of fish from landing through processing and sale by a retailer to the final consumer. It classifies the different qualities of fish and product into three grades: A – good quality, B – medium quality and C – poor or low quality. BP refers to the best price and lower prices are expressed as a proportion of BP and A refers to the price of Grade A product. For example, 0.75 BP means that the price was 75% of the best price. If the best price was 100 then 0.75 BP would be 75.

This example shows how loss can be calculated and described. It shows a clear and logical way of reporting loss and should be borne in mind when undertaking an IFLA or LT exercise.

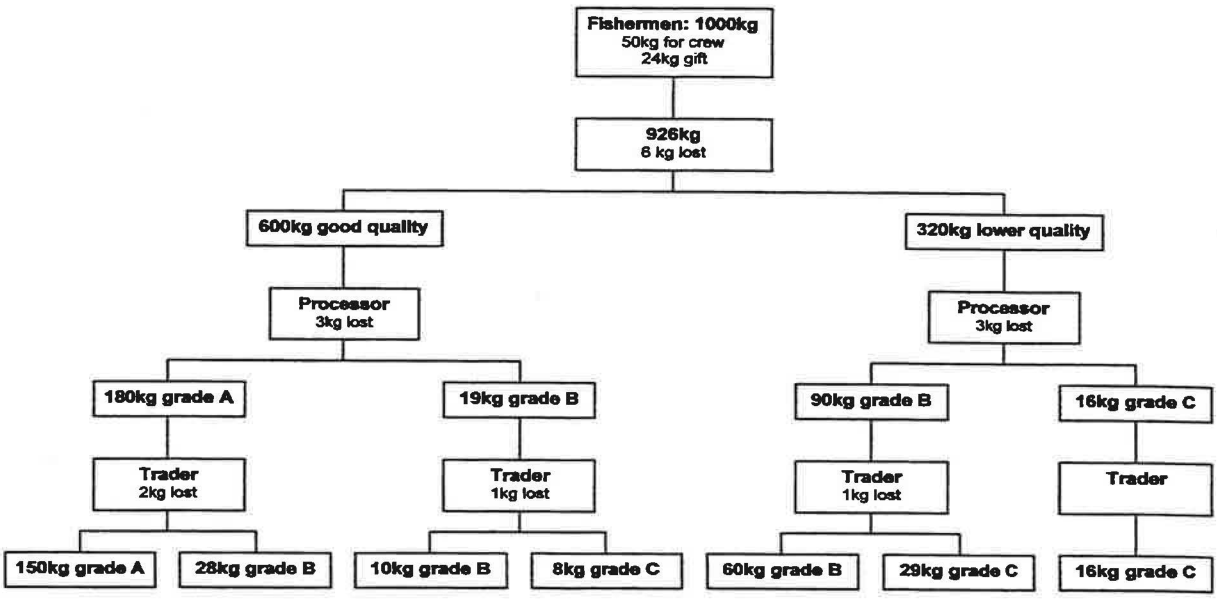

Figure 1 Case study of loss in a distribution chain.

A fishing canoe catches 1000 kg. At landing 50 kg is given to the crew as payment, 24 kg is given as presents to the people that unload the fish (1000 - (50 + 24) = 926 kg). 3 kg falls in the sea during unloading, 2 kg is squashed in the boat and 1 kg is stolen. Therefore, 6 kg are lost (926 - 6 = 920 kg). Of the remaining 920 kg, 600 kg is of good quality and sold at a best price of BP/kg; 320 kg lower quality fish is sold at 0.75BP.

Physical loss is 6 kg in weight, or 6BP in money, or 6/926 x 100 = 0.6%.

(NB: that the percentage is the same whether taken from the weight or from the value.)

(NB: this calculation has not taken the original 1000 kg as the baseline, this weight could be used as an alternative if so desired.)

Quality loss is 320 x (BP - 0.75BP) = 80BP in money, or 80BP / 926BP x 100 = 8.6%.

Total financial loss is 6BP + 80BP = 86BP

or, 0.6% + 8.6% = 9.2%.

Processor Who Buys Good Quality Fish

A processor buys her batch of 600 kg for smoking for which she pays 600BP. During transport she loses 1 kg raw material and during processing 12 fish fall in the fire ('droppers') representing 2 kg raw material. She produces 199 kg product of which 180 kg are good quality (grade A) sold at A/kg and 19 kg are grade B sold at 80% of grade A (B = 0.8A).

Her income is, therefore, 180A + (19 x 0.8A) = 195.2A.

Her gross income is 195.2A - 600BP.

From this must be deducted her other costs (firewood, oven, trays, etc.) to get the net profit.

Physical loss is 3 kg raw material equivalent to 1 kg of processed product worth 1A.

Her total batch in terms of final product weight would have been

199 kg + 1 kg = 200 kg.

Physical loss is: 1/200 x 100 = 0.5%.

An alternative is to use raw material weights: 3/600 = 0.5%.

As a percentage of the original landing her losses are 3/926 x 100 = 0.3%.

Quality loss refers to the 19 kg of grade B quality final product sold for price B:

19 x (1 - 0.8) A = 3.8A

or

3.8A/200A x 100 = 1.9% as a percentage of her batch.

Total financial loss is:

1A + 3.8A = 4.8A

or

1A + 3.8A/200A x 100 = 4.8A/200A x 100 = 2.4%

(0.5% + 1.9% = 2.4%).

(NB: 200 is total quantity of fish product if no losses.)

Processor Who Buys Poor Quality Fish

Another processor buys the 320 kg of lower quality fish for processing. She pays 320 x 0.75BP. During transport and processing she loses 3 kg, which could have produced 1 kg product. She produces 106 kg product of which 90 kg are of grade B quality and sold at 0.8A/kg, and 16 kg are of grade C quality and sold at 0.6A/kg instead of 0.8A/kg.

Her gross income is therefore (90 x 0.8A) + (16 x 0.6A) = 81.6A.

Her net income is 81.6A - (320 x 0.75BP).

From this must be deducted her other costs (firewood, oven, trays, etc.) to get the net profit.

Physical loss is 3 kg of raw material or 1 kg of final product worth 0.8A

or

3/320 x 100 = 0.9%

or

3/926 x 100 = 0.3% (of original landing).

Quality loss is based on Grade B being the best quality that she can produce from the raw material purchased and, therefore, the difference between Grade B and Grade C is the quality loss:

16 x 0.2A = 3.2A

or

3.2A/107(0.8A) x 100 = 3.2A/85.6A x 100 = 3.7%.

(NB: 107 kg is quantity of final product if no loss and the best price attainable is 0.8A.)

Total financial loss is:

0.8A + 3.2A = 4A

or

(0.8A + 3.2A)/107(0.8A) x 100 = 4A /85.6A x 100 = 4.7%.

Trading to Consumer

A trader buys his batch of all 305 kg products from the two processors: 180 kg Grade A, 109 kg Grade B and 16 kg Grade C. During storage he loses 2 kg of Grade A and 2 kg of Grade B and there is further quality deterioration so that at the end he sells 150 kg grade A, 98 kg grade B and 53 kg grade C.

The calculation assumes that the trader marks up the buying price by a percentage, which is even for all grades, to give the selling price. In which case prices A, B and C referred to below refer to the traders selling price, which, in terms of estimating value of loss is the more common price used.

Physical loss is 4 kg and in percentage terms this is:

$\frac{4}{305}$ x 100% = 1.3% (batch).

However, two grades (A and B) of fish were lost so the value of the physical loss to the trader is not simply 4A, it is:

2A + 2(0.8A) = 3.6A.

Quality loss is based on the quality deterioration of the product as it belongs to the trader (refer to Figure 1).

28 kg from Grade A to B = 28 x (A - 0.8A) = 28 x 0.2A = 5.6A

37 kg from Grade B to Grade C = 37 x (0.8A - 0.6A) = 37 x 0.2A = 7.4A.

Quality loss is: 5.6A + 7.4A = 13A.

The maximum value of the fish bought by the trader is, assuming no physical or quality loss:

180 A + 109 B + 16 C = 180 A + 109 (0.8A) + 16 (0.6A) = 276.8A.

Quality loss as a %:

13A/276.8A x 100 = 4.7%.

Total financial loss is:

value of physical loss + value of quality loss

3.6A + 13A = 16.6A.

As a % of the maximum potential value of the fish:

16.6A/276.8A x 100 = 6%.

Table 2 summarizes the loss level data giving the percentages in terms of value of the fish at the beginning of each stage. Quality loss is more significant in terms of value and the highest loss is incurred by the fishermen and the trader.

Table 2 – Summary of Case Study Loss

	Physical Loss	Quality Loss	Total Financial Loss
Fisherman	0.6	8.6	9.2
Processor 1	0.5	1.9	2.4
Processor 2	0.9	3.7	4.7
Trader	1.3	4.7	6

Which Method to Use?

The manual describes three very different methods for investigating fish loss: the Informal Fish Loss Assessment Method (IFLAM), Load Tracking (LT) and the Questionnaire Loss Assessment Method (QLAM). The methods vary in terms of the skills required to apply them, the degree of participation between researcher and fisherfolk, the data produced and its statistical validity. However, the methods have one thing in common and that is to implement them will incur expenditure, most likely on training, travel, fees and equipment. Within each chapter a list of likely expenditures is given for each method, this will enable users to make their own budgets and calculations of cost.

At some stage users must decide which method or methods best suit their needs. Table 3 provides a summary of key aspects of each method and is designed to provide users with ideas as to which method or methods best suit their needs.

In addition, the following are some potential scenarios the user may find familiar, with some recommendations on which method or combination of methods to use.

1. Very little is known about the post-harvest fish losses at a particular site, area, fishery or distribution chain and a quick assessment is required to identify whether losses are an issue and whether further action is required.

Recommendation: **IFLAM** and based on the results decide whether **LT** or **QLAM** are required to validate findings or test interventions.

2. Losses are known to be occurring in a particular part of a distribution chain. Information is required on the reasons and levels of loss.

Recommendation: **IFLAM** followed by **LT**.

3. An intervention to reduce loss has been identified, but information is required on its impact on losses.

Recommendation: **LT**.

Table 3 – Summary of Methods for Investigating Fish Losses

	Informal Fish Loss Assessment Method (IFLAM)	Load Tracking (LT)	Questionnaire Loss Assessment Method (QLAM)
Description	Quick way to generate qualitative and indicative quantitative data. Based on rapid and participatory rural appraisal (RRA and PRA).	Biometric sampling, replication and design to measure change in fish quality and quantify loss between stages in a distribution chain.	Based on a formal questionnaire survey approach. Questionnaires used by enumerators to interview a population sample in a community at a particular site.
Uses	(a) Identify opportunities for loss reduction	(a) Statistically valid assessment of loss between two stages in a distribution chain	(a) Quantitatively assess key aspects of post-harvest fish losses
	(b) Data for Predictive Loss Model	(b) Data for Predictive Loss Model	(b) Validate the findings of IFLAM and LT over a wide geographical area or within a number of communities.
	(c) Troubleshooting for businesses	(c) Troubleshooting for businesses	
	(d) Identify opportunities for quantitative loss assessment using LT or QLA	(d) Quick qualitative estimate of loss in a distribution chain	
	(e) Used to plan LT or QLA	(e) Measure the effect of interventions to reduce losses	
Data Generated	Qualitative	Statistically representative loss level	Quantitative
	Indicative physical and quality loss levels	Changes in quality	Type of loss
	Estimates of monetary losses	Why and where losses occur	Reasons for losses
	Reasons for losses	Estimate the value of losses in monetary terms	Frequency of loss
	Variables which affect losses		Variables which affect losses
	Seasonal variations in loss levels		Livelihood activities and profile of those affected by loss
	Perceptions of fish losses		

Table 3 cont.

	Informal Fish Loss Assessment Method (IFLAM)	**Load Tracking (LT)**	**Questionnaire Loss Assessment Method (QLAM)**
Data Generated	Importance of fish losses compared to other issues Ideas for loss reduction Historical levels of fish losses and trends over time		
Level of Participation	Potentially high. Team could include members of the community.	Works well if participation of community encouraged	Not high. Representatives of community, sample population, answer a list of predetermined questions.
Skills Required	Core research team of 2 or 3 who are educated, motivated to learn from fishing communities and have: an understanding of and experience in using informal data collection methods such as (RRA) (PRA) (PAR) (PALM) and enquiring minds.	Biometric support for design and analysis of data Two field-based staff with basic scientific training who have: good numeracy level good communication skills co-operate with communities basic knowledge of experimental design implementation of random sampling read quantitative measurements, such as weights training in data management.	Biometric support Experience of design and implementation of questionnaire surveys Database design Enumerators who are diligent, honest and have good interpersonal skills

Table 3 cont.

	Informal Fish Loss Assessment Method (IFLAM)	Load Tracking (LT)	Questionnaire Loss Assessment Method (QLAM)
Cost	Low, but depends on how many sites or communities involved and training needs	Good co-operation between local communities and researchers can reduce costs	Will vary according to number of communities, geographical area and frequency of interviews
Advantages	Broad, in-depth assessment possible	Produces representative data with an indication of accuracy of loss estimates	Produces representative data that will inform decision-making by planners and policy-makers
Disadvantages	Not useful for generating statistically valid data	Can be costly and time consuming to implement Sometimes not simple to design sampling procedure and data analysis can be complicated	Difficulties in recording data on: multi-species fisheries, prices, units of fish measurement, quality grades, and then analysing this data, means not easy to quantify loss levels

4. Information is required on losses occurring in a particular geographical area for planning purposes.

Recommendation: **ILFAM** in a few locations followed by validation of key data using **QLAM** over whole area.

5. A fisherman, processor or trader has approached you with a request for help to reduce the losses in his or her business (reduce wastage and improve income).

Recommendation: **IFLAM** and if required **LT** to confirm problem and test solutions.

Details of each method are now presented: Chapter 2 covers the IFLAM, Chapter 3 LT and Chapter 4 the QLAM. If after reading the manual any further information is required a list of resource organizations to contact is given in Appendix 2.

Chapter 2 *Informal Fish Loss Assessment*

This chapter describes the Informal Fish Loss Assessment Method (IFLAM), which is a planned yet flexible way to quickly generate qualitative and indicative quantitative data on post-harvest fish losses. This method is based on the tools and principles associated with rapid and participatory rural appraisal (RRA and PRA) research and development methods. A team of researchers use a variety of data collection tools and principles including **Semi-Structured Interviews** (SSI), direct observation and diagram tools in conjunction with members of fishing communities. The tools and principles facilitate dialogue and discussion from which data and information on post-harvest losses are derived. RRA emerged in the late 1970s, as a reaction to the general dissatisfaction with the biases inherent in the 'rural development tourist' approach (Pretty *et al.,* 1995). Conway (1986) defined RRA as:

> " a systematic activity carried out in the field by a multi-disciplinary team designed to acquire quickly new information on and new hypotheses about rural life".

In the context of post-harvest losses and this manual, rural life refers to fishing and fisheries communities and fish losses. The key components of the method are shown in Table 4. These are planning, fieldwork and reporting. Both RRA and PRA are referred to in the text. Whilst there are differences between the two methods, many of the tools and principles are common and references to both are used to describe IFLAM. However, PRA involves the community or beneficiaries much more in analysis and decision-making. The degree to which IFLAM is used in a participatory way is left to the end-user to decide.

The remainder of this chapter is a description of the method in terms of:

- *uses*
- *resources required*
- *planning*
- *fieldwork*
- *reporting*
- *examples from loss assessments*
- *problems.*

Table 4 – Key Components of the Informal Fish Loss Assessment Method

Planning	objectives sources of information site selection tools team roles when and how long equipment checklist
Fieldwork	tools principles
Reporting	report writing

Uses

IFLAM is used by researchers to assess post-harvest fish losses with communities and people working in small-scale and industrialized fisheries. It is used to produce data on the following:

- *indicative physical and quality loss levels*
- *estimates of monetary losses*
- *reasons for losses*
- *variables which affect losses such as fishing gear type, processing methods, species*
- *seasonal variations in loss levels*
- *perceptions of fish losses by those who are affected*
- *importance of fish losses compared to other issues*
- *ideas for loss reduction*
- *historical levels of fish losses and trends over time.*

Using IFLAM can identify opportunities for loss reduction. The data generated by the IFLAM could be used in the Predictive Loss Model which is designed to model the effects of loss reduction interventions. IFLAM can be used as a rapid way of troubleshooting for businesses which are having problems with poor quality raw material supplied externally or to analyse losses internally within their operation. Using IFLAM will also identify opportunities for quantitative loss assessment using Load Tracking. Its use may also identify whether a Questionnaire Loss Assessment should be used to validate data on losses over a wider geographical area or within a number of communities. If contemplating using Load Tracking or a Questionnaire Loss Assessment it is recommended that IFLAM is used first, to plan the use of these two methods.

Resources Required

The Team

Implementation of the IFLAM relies on a core research team of 2 or 3 people who:

- *have an understanding of, and experience in using informal data collection methods such as RRA and PRA, or similar methods such as Participatory Action Research (PAR) and Participatory Analysis and Learning Methods (PALM)*
- *are motivated to learn from fishing communities*
- *have enquiring minds*
- *are educated.*

In addition, the team could include members of the community or communities with which the loss assessment is to be conducted. Including such people in the assessment not only can give a sense of ownership of the research to communities, but it also can make introductions to the community and the relationship with a community easier. This will improve the quality and efficiency of the research.

A small team is usually best as it can work discreetly. In some cases it may be practical to have more than one team for a study, especially if there are number of sites to cover in a short space of time.

TIP 1

A typical core team for a study of losses in a distribution chain would include a socio-economist, a post-harvest fishery technologist and a marketing specialist.

> "PRA is not mainly a matter of techniques. The most important quality an individual needs in order to conduct a successful PRA is an appropriate attitude towards participatory methods and the members of rural communities. This is often quite different to the attitude of many development professionals in which the educated expert knows what is best for the less educated farmer. Central to participatory approaches is the need to learn directly from the rural community members (Nabasa *et al.*, 1995)."

Training

Training, or some form of orientation is likely to be required for the core team and other team members such as fishermen, processors or traders, representatives from NGOs and fisheries departments.

If it is not possible to identify a core team which has relevant experience of informal research methods then running a comprehensive training course should be considered. It should be possible for an experienced RRA/PRA trainer, preferably with fisheries experience (but not essential), to use this manual to develop the necessary training course and materials needed. Complementary training guidelines can be found in Townsley (1993a) and Pretty *et al.* (1995). Training advice and materials may also be available from the contact organizations listed in Appendix 2. The following is from a report of a previous training course.

"The training utilized a number of learning approaches including lecturing, role-play, class-based work, group-based activities as well as fieldwork. Over the duration of the training programme, the participants were introduced to a number of informal research tools including transects, maps, seasonal calendars, scoring, matrices and semi-structured interviews. Fieldwork provided the participants with the opportunity to apply the full range of tools covered."

If the core team has RRA/PRA skills and they have not been involved in fisheries or loss assessment research then they should undergo some familiarization/ orientation, again the manual can be used as a basis for this. The minimum would be that each of the team reads through the manual and that as a team they ensure that they understand the adaptation of the method and what is required. If need be, the team should discuss any outstanding issues with someone who has conducted loss assessments before. A list of resource organizations to contact is given as Appendix 2.

Other team members will also require some degree of orientation or training depending on their background, skills and role in the loss assessment. If a training course is to be run for the core team then elements of this would provide an opportunity for orientation. Alternatively the core team may wish to brief the other team members. Experience has shown that fishermen, processors and traders who are illiterate can readily accept and use some of the data collection tools, especially the diagram tools.

Finance

This section on finance does not provide any specific cost figure but it outlines the activities and costs which should be budgeted so that those intending to use IFLAM can calculate their own costs. Typical expenditure associated with the use of the IFLAM will be:

- *staff fees (training, planning, fieldwork, report writing)*
- *travel (training, planning, to and from fieldwork, during fieldwork)*
- *accommodation (training, planning, fieldwork)*
- *stationery (training, planning, fieldwork)*
- *equipment (i.e. computer, weighing scales, thermometer and waterproofs).*

Fee rates may or may not apply and will vary from country to country and organization to organization. Training costs, if training is required, will depend on who conducts the training and from where they travel. The fieldwork cost will depend on the size of the team, how much travel will be involved and whether air travel will be necessary. It will also depend on the number of sites or communities to be involved and the length of time the team stays in the field. Accommodation costs will also vary from place to place.

TIP 2

A poorly planned study will fail to address its objectives and will not provide adequate information to decision-makers.

Planning

A guide for team planning is given in Table 5. The team should aim to address each task and if possible the discussions should include other people who are able to contribute at the planning stage or who have an interest in the results of the assessment. It may be possible to arrange a preliminary workshop to discuss the fieldwork with relevant government departments, NGOs, field-based fisheries staff and fisherfolk (Townsley, 1993b). The order in which the tasks are addressed is flexible, although setting objectives should always be done first.

Table 5 – Planning Framework Summary

Number	Task
1.	set objectives
2.	where will the data come from? – secondary sources – fieldwork
3.	site selection – where should fieldwork be conducted?
4.	what are the key tools to use during the fieldwork?
5.	team roles – who will do what?
6.	when should fieldwork be conducted and for how long?
7.	what equipment is needed for fieldwork?
8.	checklist to assist data collection

Bear in mind that no matter how well thought out beforehand, you may need to adapt a plan once fieldwork begins.

TIP 3

For example, during fieldwork an important data collection site may be identified that was not included in the original plan, if possible the site should be incorporated into the fieldwork.

The following is a description of the planning tasks.

Objectives

> "..... setting objectives. This is so often ignored, or taken as being obvious, that it is necessary to affirm its importance at every possible opportunity" (Gilling and Cropley 1993).

An objective is a statement which describes what the IFLAM will do or achieve. Setting the objective or objectives is one of the most crucial steps in an IFLAM. Some typical objectives for IFLAM's are:

- *to assess the importance of post-harvest fish losses in the fishing sector in both qualitative and quantitative terms*
- *to define the perceptions of smoked fish losses by women fish processors in fishing village A*
- *to assess post-harvest fish loss(es) in fishing (from capture up to processing stage)*
- *to identify areas where post-harvest losses take place*
- *to identify when post-harvest fish loss(es) occur*
- *to determine post-harvest losses during processing and marketing*
- *to identify sites where post-harvest losses take place during processing*
- *to quantify post-harvest losses during processing and marketing.*

Sources of Information

There are two main sources of information: **primary** and **secondary**.

Primary sources are those encountered during fieldwork. These include:

- *fisherfolk, processors, transporters, traders, wholesalers, retailers*
- *the owners of capital equipment, i.e. boats, shops, etc.*
- *community elders*
- *other members of the community*
- *national and local government staff*
- *staff of transport organizations*
- *consumers of fish*
- *processing factory staff.*

The team should make a list of the sort of individuals and groups they would like to meet with during the fieldwork.

Secondary sources of information can be used before (during planning), during and after fieldwork. Secondary sources include reports, journals, statistics and newspapers. Surveys of sites or areas can be useful sources of secondary data on population, livelihood and key issues and problems. Fisheries department offices and agricultural departments may hold relevant reports and surveys. Multilateral organizations may have libraries to which researchers could have access. University libraries are also another source of secondary data. It is also worth talking to people who have been to the fieldwork sites or who work there or who are familiar with the issues of the study.

Secondary source data should be used to provide background information to help the study team understand some of the issues likely to arise during fieldwork. Secondary source data can be used to identify when the best time for conducting fieldwork will be, i.e. when fish catches are high, during particular seasons of the year. The extract below from a marketing bulletin (November 1996) clearly highlights some of the key issues which should be explored during fieldwork. It would give a team an idea of when will be the best time to observe losses.

> "The rainy season is virtually over, sea conditions have become relatively calm and fishing activities are intensifying. Consequently, landings have increased appreciably and major post-harvest problems are beginning to reappear... increased *bonga* landings caused the price of the product to plummet by 50% in the first two weeks of October. In the last two weeks of the month landings were so abundant that fresh *bonga* was being discarded in the dump due to lack of storage facilities (Infopeche, 1996)."

Try to be objective about the information in secondary sources, some information may be old and some data may have missed relevant issues or be inaccurate or biased. It can also be a waste of resources trying to spend too much time collecting data from secondary sources.

Site Selection

An important part of the planning process is to decide where fieldwork will be conducted and with which communities. For most studies it will not be practical to talk to every fisherman or processor or trader in a fishery or sector, unless the fishery is very small. So sites or communities should be selected which are representative of the fishery or fishery sector. (More information on site selection can be found in Chapter 4 on page 106.)

Often the resources available for fieldwork will determine how many sites can be visited and for how long. As a rule of thumb it is best not to be over optimistic about the number of sites that should be visited for data collection. It is better to concentrate on a few representative sites rather than visit many sites quickly. Too many sites in a limited time can mean the study will be rushed and results possibly weak.

TIP 4

*Researchers should be aware of the **bias** that is related to site selection. Spatial bias refers to the actual geographic position of the site which often dictates how easy the site is reached. For example, it may be decided by the team that there are several potential sites for fieldwork. Some sites may be relatively easy to get to and others not so easy. It may be tempting to only visit the sites that are easy to reach. But how representative will the study results then be?*

The fish landed at sites (fishing villages) where vehicle access is relatively easy may be easily transported to markets. However, the fish landed at villages that are relatively inaccessible may have to be processed, which may result in a financial loss to the fisherfolk, or fish may even be thrown away because access to the village makes it difficult for buyers to visit and traders to move out with fish.

The assessment survey will be much more conclusive and representative if data were collected at both easily accessible and inaccessible sites.

An element of bias will occur if the sites that have been chosen have been the focus of other projects. Sites that are highly recommended because they are good examples of successful projects in the past may also provide bias information. If these types of site are chosen then other sites should be included in the study which have not been the focus of other projects.

People and communities at sites which are favoured by researchers may become fatigued from receiving a large number of researchers, especially if they do not see anything in return in terms of positive change or development. Research fatigue can have a negative affect on the relationship between team and community, resulting in a poor assessment. (More information on bias can be found on page 57.)

Which Tools?

It is a useful practice during planning to think about the way in which the information will be collected during fieldwork. What tools could be used to stimulate dialogue and discussions? Semi-structured interviews, observation, ranking, mapping are some of the key tools. These are all described in the Fieldwork section. Decide how these tools could be used during fieldwork, with and by whom.

Introduction to Community

An important issue to think about at this stage is the introduction to the community or people who are to be involved in the IFLAM. If the team has already co-opted members of the local community and these people have undergone orientation or training then the introduction will be relatively straightforward. If there is no community involvement then an effort should be made to contact the community in advance to discuss the assessment and identify a suitable time for fieldwork to begin. A contact in an NGO or fisheries department may be able to arrange the first introduction. Fisheries departments or NGOs often have field staff at sites or in the area and they could be asked to be with the team at the beginning of fieldwork and introduce them to key fisherfolk, traders, etc.

Team Roles

Discuss and identify during planning the roles of the team in the field:

- *who will take notes*
- *who will lead semi-structured interviews*
- *who will write up the notes*
- *when will the data be reviewed and discussed*
- *who will use particular tools*
- *reporting and report writing.*

A flexible approach may be appropriate with the team sharing roles and responsibilities.

When and For How Long?

In deciding when to conduct fieldwork the team should consider the urgency with which the assessment is required, the availability of the team and the activities of the community. The duration of the study will be determined by the resources available and any other commitments the team members may have. Theis and Grady (1991) suggest "use at least four days but not more than three weeks" for fieldwork. The total time the assessment will take will be related to:

- *travel times to fieldwork sites*
- *time for fieldwork*
- *time for data analysis and report writing.*

Allow plenty of time for fieldwork and try not to make the travel schedule too tight, especially if there will be little chance of follow-up once the fieldwork has been completed.

TIP 5

It may be useful to conduct fieldwork at times when processing conditions are poor and losses are possibly high and then when conditions are good and losses perhaps low.

TIP 6

If fishing is seasonal or is done according to lunar cycles the team should choose a time for fieldwork when fisherfolk are likely to be available for discussions.

Equipment

During planning the team should decide what, if any, items of equipment will be required during fieldwork. Common items include:

- *stationery*
- *dictaphone for recording notes and observations*
- *thermometer for assessing fish temperature*
- *small spring balance weighing scale for estimating price in standard units*
- *camera for recording losses and observations*
- *waterproof clothing*
- *camping equipment – if accommodation is a problem.*

Stationery will be required for recording data and writing reports, i.e. notebooks, plain paper, graph paper, pens, pencils, waterproof plastic wallets for field notes. A small tape recorder (dictaphone) can be useful for taking notes after an interview is over, especially when it has not been possible to take written notes during the interview.

For the post-harvest technologist a thermometer can be useful for checking the temperature of fish to determine the effectiveness of any chilling practices.

> "Temperature readings of prawns awaiting sorting at a factory were between 1 and 8 °C. Prawns at 8 °C would be spoiling at a high rate."

In many fisheries traditional units are used to measure quantities of fish as opposed to kilograms or pounds. Quantification of amounts of fish will require samples of traditional units to be measured. This can be done for smaller units in the field with weighing scales. Ideally pocket-sized spring balances should be used for ease of carrying.

> "Dried fish are stored in sacks, normally there are 6 *debes* per sack. A *debe* is an empty cooking oil container used as local unit of measurement. Each *debe* contains about 5 kg of dried fish."

It may be difficult to judge by eye the weight of an individual fish or an amount of fish. For example, a fisherman's catch may be divided into different qualities or grades and to estimate rapidly the proportion of a grade of fish in a batch it may be helpful to weigh a sample and then, if practical, to count or estimate the total number of fish to estimate the weight.

A camera, preferably small and auto focus so as to attract the minimum of attention, can be useful for recording observations. Photographs can jog the memory and help in explaining issues later on after fieldwork is over. Likewise, photographs can be used to good effect in reports.

The team should be equipped with appropriate clothing for fieldwork. If it is likely to be wet then make sure the team has the right clothing, i.e. waterproofs.

In some field locations it may not be feasible to find accommodation so camping equipment, tent, stove cooking utensils, etc., may be necessary.

Checklist

Last but by no means least, the team should draw up a checklist of key topics, and if necessary key questions. This is to be used by the team as a guide during discussions and dialogue with communities. Using a checklist avoids the "I wish I had asked about that" scenario, which can occur after fieldwork has been thought to have been completed.

The checklist should be clearly written or ideally typed on as small a sheet of paper as possible. Each member of the team should have a copy. The checklist should be revised accordingly as fieldwork progresses. It may be possible to remove topics from the original list because the team is satisfied that enough data have been collected or the topic is not relevant any more. Likewise new topics may arise that were not thought relevant at the planning stage.

The checklists can be protected from wet conditions encountered during fieldwork by using plastic wallets.

TIP 7

A checklist should only be used as a guide to interviews, it should not be used as a questionnaire. By doing the latter the survey would stray away from the flexible, probing approach of this method.

Table 6 is an example of a comprehensive checklist. The whole checklist, or parts of it, could be used for a broad study of losses in a fish distribution chain. Whatever the case, a section on losses should always be included in the checklist.

Table 6 – Checklist for Exploratory Study

General Heading	Factors to Consider
General/Fishing	method(s) fishing cycle monthly calendar seasons – fishing cycle catch levels and seasonality losses during fishing and landing ownership (gear and vessels) organization of fishing activity – decison-making other occupations of fisherfolk number of fishing units and catch per unit species caught
Losses	types of loss perceptions – are losses a problem or not? seasonality of losses reason for losses quantities of fish sold for a good price quantities of fish sold for a reduced price/downgrading quantity of fish thrown away and what happens to it/ discards? loss avoidance strategies

Table 6 cont.

General Heading	Factors to Consider
Processing	products markets method(s) grades how often, how much fish and by who? other occupations effect of weather and seasonal variations storage number of processing units ownership of fish and processing facilities
Storage	where and facilities how long and how much? seasonality of storage problems during storage
Marketing	who does marketing? where are the markets? journey time to market journey frequencies seasonal variations of quantities of fish marketed transport costs preservation of fish before marketing other occupations customers (who, what, where and how?) transport types prices and fluctuations grades of fish sold, reasons and prices – who buys? seasonality when is business best, bad and why?
Traditional Units	quantify in kg values
Others	other activities, occupations and sources of income gender and who does what? labour (who, what, where and when?) mobility and migration of sector population who makes decisions?
Other Problems	i.e. access to credit
Changes	how has the sector changed over the last 1, 2, 3, etc. years?
Questions from Respondents	make sure that you encourage/allow questions from the respondents

Fieldwork

Fieldwork with IFLAM is focused on data collection. There are three aspects of data collection, i.e. the tools for collecting data, using tools to generate indicative quantitative data on losses and the principles to guide data collection.

Tools

A number of tools are commonly used in an IFLA (see Table 7) for generating data.

> "Methods are used during the fieldwork to facilitate communication between the external team members and local people, and amongst local people themselves. These methods enhance the understanding and analysis of local situations, problems and possible opportunities" (Pretty *et al.*, 1995).

The most important tool is the semi-structured interview (SSI). Other tools are based on diagrams and observation, these are usually used in conjunction with SSIs.

Some tools can be used to generate indicative quantitative data on fish losses. Some are used to generate general qualitative data on the fishery or community. For example, observation and calendars can be used to generate specific data on fish losses, whereas mapping produces more general data, i.e. on fishing grounds, and ranking can be used to produce specific data on qualitative issues such as the importance of other livelihood activities.

The choice of which tool or tools to use is influenced by the circumstances in which the team finds itself. A tool should not be used just for the sake of using it.

Table 7 gives an overview of the most commonly used tools and indicates the type of data that can be generated by each.

Table 7– Fish Loss Assessment Tools

Tool	Type of Loss Data
Semi-structured Interviews	qualitative indicative, quantitative
Secondary Sources (see also planning)	qualitative, quantitative, historical
Observation	qualitative
Mapping	qualitative
Calendars	qualitative
Ranking	qualitative
Scoring	qualitative
Percentage Loss	indicative, quantitative
Flow Diagrams	qualitative

Semi-Structured Interviews

The most important data collection tool is the Semi-Structured Interview (SSI) – a conversational interview/discussion conducted by the team or team members with people who are likely to be knowledgeable about the study issues.

> "At the heart of all good participatory research and development lies sensitive interviewing. Without it, no matter what other methods you use, the discussion will yield poor information and limited understanding" (Pretty *et al.*, 1995).

An SSI does not involve the use of a questionnaire, but a checklist of key topics. This is used to guide the team so that they cover all the relevant topics on which data are required.

One person in the team should lead the interview by asking informal questions, another member of the team should take notes and a third can also ask questions and probe answers. These roles can be swapped around between team members during the course of fieldwork.

> "The team must be able to put the informant(s) at ease and give them the confidence to share their knowledge and perceptions by showing a sincere interest in learning from the community" (Nabasa *et al.*, 1995).

The people/respondents/interviewees who are to be interviewed are usually interviewed as either key informants or as a group.

Key Informants

A key informant is someone who has specialist knowledge of a topic or topics relevant to the assessment. Key informants are important people to interview in a study. For example, a fisherman will have first hand knowledge of fish losses that occur during fishing, likewise a fish transporter will have knowledge about fish losses in that sector. Other key informants are fish factory managers, public sector fisheries workers, fisherfolk's leaders, fish retailers, local government officials and fish traders.

Below is a summary of an SSI with a fisherman. The interview was conducted during an exploratory study of losses in the fishing sector. It shows the sort of qualitative information that can be gleaned from patient and probing interviewing. It shows the issues that would form the basis of further investigation such as the seasonality of losses.

BOX 2

Case Study: Fisherman

John started fishing in 1978 and moved to Buzaga in January 1994 because of net theft and poor catches in Magu district.

The canoe in which he fishes is sail powered, has a total crew of 3 and carries 41 gillnets: 20 x 6 inch, 14 x 6.5 inch and 7 x 5.5 inch. Three fishermen are employed on board. One of the crew is in charge and liaises with the owner of the gears.

Unless there are any problems with the gear or boat then fishing continues every day. Canoes generally leave around 4 pm (16.00 hours) when they catch a wind (*buhanga*) that takes them to the fishing grounds. Another wind (*nkomaji*) brings them back the next morning. The choice of fishing ground depends on the weather and the moon.

It takes about 1.5 hours to set the nets, which are hauled at 5 am (05.00 hours). It can take 2–4 hours to return to the village depending on the wind speed.

The catch is less during the dry season of May to October, 19–30 (57–90 kg) pieces or fish per day. During the rainy season of November to April the catch can be up to 80–100 pieces per day (240–300 kg).

From February to April more stale fish is landed. This fish is sold to processors (salters). The high proportion of stale fish he says is attributed to warm water.

Small fish rejected by factory buyers are sold to processors as well or bartered by fishermen for other goods within the village.

During the warmer months more fish is thrown away before landing.

Fish kills occur in April and such fish is normally sold by fishermen – probably to processors. All sizes of fish die in these kills.

In another study fish auctioneers were ideal key informants.

BOX 3

Mr Ibrahim and Mr Kapera have been auctioning fish at this beach market for many years. They say that often fish that spoils is that which has been at the bottom of an ice box. Sometimes out of 250 baskets of fish (2500 kg) one can have 50 baskets (500 kg) of spoilt fish. This normally occurs in the warm season whereby out of the 50 baskets of fish, 30 are sold at a reduced price Tsh 500–600/= per basket and 20 baskets at a very low price (almost free), i.e Tsh 200/= per basket. During the cold season fish spoilage at the market is minimal.

If the spoiled fish are to be auctioned then they alert customers to the fact the fish is of poor quality. Whoever buys the spoiled fish will not then be allowed to return the fish. Spoilt fish are normally bought by women for frying and by fish driers.

According to the auctioneers, the amount of spoiled fish nowadays is much greater than previously due to:

- *fish transporters now stay for longer periods at sea because fish are scarce, possibly due to the increased competition (number of collector boats)*
- *an inadequate supply of ice due to power shortages*
- *damage to ice boxes (although this is rare).*

According to the auctioneers the number of traders and friers has increased recently. In earlier times the fish trade and frying was mainly done by middle aged and old people but nowadays youths have involved themselves in the fish business.

Market officials are also sources of data.

BOX 4

In terms of physical wastage, the amount of waste appears to be minimal both at the wholesale and retail market levels. Fish inspectors who have the power to condemn produce which is unfit for human consumption reported that the quantities which are condemned are insignificant (Digges and Clucas, 1995).

In another example below, the data have been derived from interviews with exporters.

BOX 5

Downgraded fish originally intended for export manifest themselves through rejections by the exporter and the switching of these products to other markets usually through another type of trader or fish curers. Reasons for rejections include soft fish, belly bursting and bruising. The level of price discounting associated with poor quality is potentially significant with discounts of up to 85% given for poor quality fish sold to curers. The question is, how significant are these rejections by the exporter and the switching of products to other markets? (Digges and Clucas, 1995).

Fish processors are obvious candidates for interview.

BOX 6

Fish curers, those who dry and salt fish for human consumption are potential end-users of downgraded fish and as such are a potentially useful indicator of post-harvest losses (Digges and Clucas, 1995).

People who are not directly associated with a fishery activity but who are resident in a study area may also be classed as key informants, for example, teachers, doctors and shopkeepers. Such people may be able to provide data on activities related to post-harvest losses.

Groups

An interview with a group of people is a good way to get a lot of information quickly, although it often provides general data usually in the form of opinions. Ideally groups should not be too large, 10–15 is recommended as the maximum number of people.

> " As soon as you arrive in the community, try to identify locations and times where people gather and talk. Such natural meeting places are often the best spots for picking up information on subjects of current local interest and can be very good places for discussing general issues which the team is interested in investigating" (Townsley 1993b).

In large groups some people may dominate, voicing opinions and providing information. This is probably a reflection of the social and personal hierarchies and relationships within a community or particular group. To overcome this bias, members of the group who did not contribute as part of the group should be interviewed later on their own.

There are three types of group:

- *formed for an interview*
- *encountered while doing fieldwork*
- *focus group.*

A group formed for an interview will often be dominated by community leaders and officials. A group encountered during fieldwork may be more free and interactive. A focus group consists of a small number of people who have specific experience or knowledge of a particular topic or topics.

Group dynamics are important if the team is to make the respondents feel at ease.

> "Of the two sessions, the first with fishermen flowed much better then the second with processors. This was partly due to the sitting arrangement of team and group. In the session with the fishermen the group sat on the ground among the fishermen. However, during the interview with the processors the team sat in one group and the processors in another. There was very much an 'us and them' feel to the arrangement which may have unsettled the processors".

Questions and How to Use Them

Questions should be formed as the interview progresses rather than be pre-determined. The checklist should be referred to, make sure the questions cover the issues of interest. If need be, a list of questions can be compiled before an interview to make sure that all the important issues are covered. As a rule of thumb, the interview by the team should start with general questions which become more focused as the interview progresses.

Try to avoid asking questions that lead to a yes or no response, unless you are trying to verify something. For example "are fish losses highest in summer?" is a leading question. A better question would be "when are fish losses highest?"

How to ask questions and the type of questions to ask is one of the most important components of an SSI. The best questions to ask are those that are open ended. For example, questions that begin with what, when, who, where and how are generally good to ask. The following are examples of open-ended questions:

- *can you tell us about your work?*
- *how do fish losses affect your business?*
- *is your business affected by fish losses?*
- *what are the weekly resources for the business?*
- *can you tell us about some of the problems you face?*
- *can you tell me more about that?*
- *can you give us an example?*
- *could you explain that to me?*

"It is very difficult to ask open-ended and non-directive questions and to probe carefully the responses. Yet effective interviewing will only occur if this happens" (Pretty *et al.*, 1995).

In some situations admitting to post-harvest fish losses and throwing fish away may not be easy for fisherfolk. Discussing poor quality can also prove difficult. Nobody wants to admit to selling poor quality fish. So to overcome this problem it is often best to talk in terms of 'grades' of fish, rather than quality.

"Can you explain about the different grades of fish you land or sell?" will usually lead to a more informative answer than "do you sell poor quality fish?"

Observation is a good way to form questions during an SSI. For example, while waiting to interview a fish trader some fish may have just been landed and it can be seen that fish are being sorted or graded. A question could then be put to a trader "can you explain the grading of fish over there?" indicating where the grading is taking place (Figure 2).

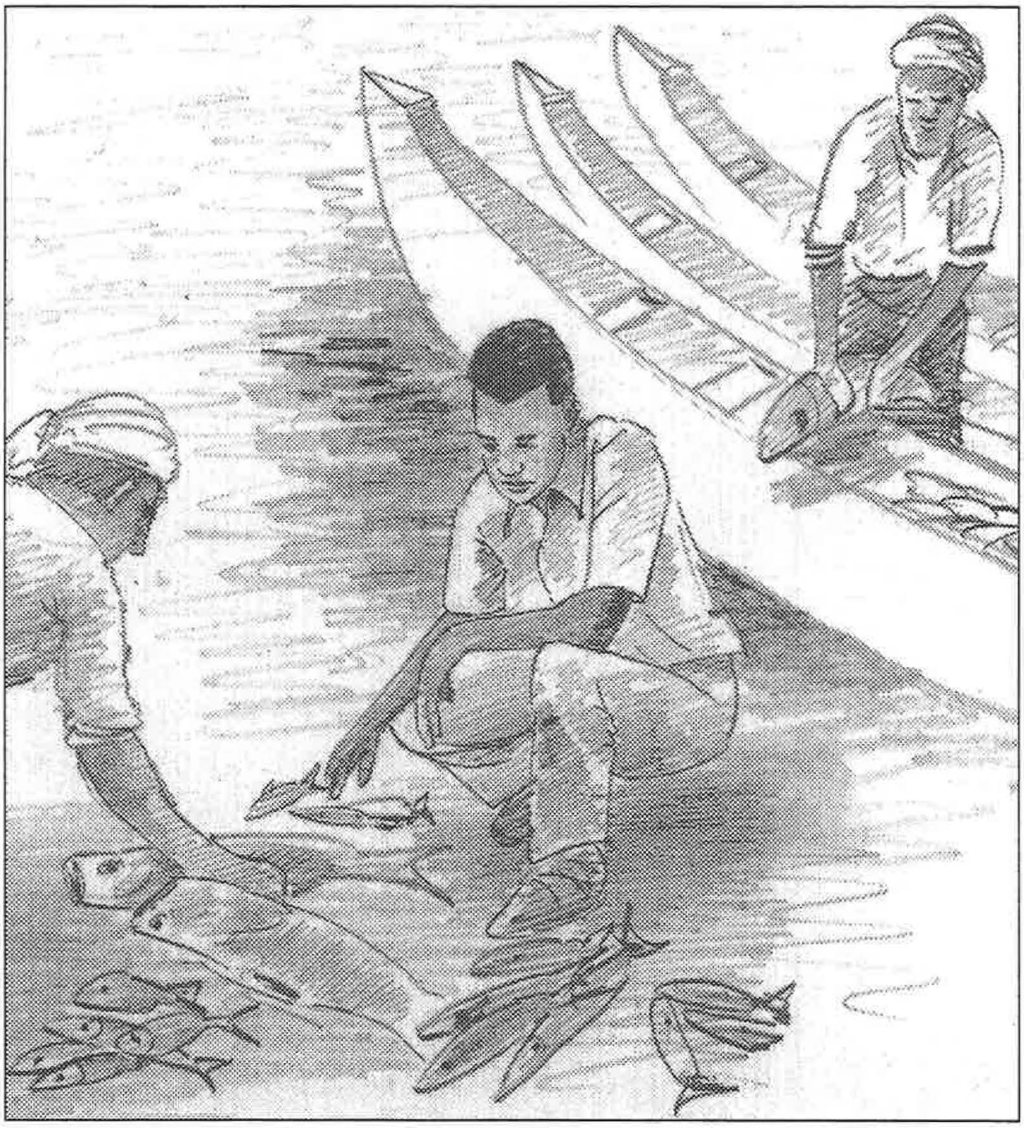

Figure 2 Researcher and trader discussing grading of fish.

Whether interviewing an individual or a group the team should discuss not only recent events and the current situation, but also the past to try and establish how loss levels have changed over time.

"In the late 1980s losses were high. This was before freezing became more organized and efficient. Up to 50% of fish could be lost because of spoilage. Nowadays losses are rare and not perceived as a significant problem."

TIP 8

General Guide to Using Questions

- *explain the interview purpose to the interviewee*
- *if necessary prepare a short list of key questions, have a checklist of questions/topics*
- *questions should be open ended and not produce yes/no answers*
- *make questions short and easy to understand*
- *ask only one question at a time*
- *probe answers*
- *wait for the interviewee to finish an answer and do not interrupt or finish sentences for the interviewee*
- *do not make comments about the quality of answers to questions even if you disagree with them*
- *show a genuine interest in what the interviewees are saying*
- *finish the interview politely, thank the interviewee*

Probing

Probing is the process of thoroughly investigating or exploring issues raised during an interview. Often when probing has not been done then the study report will be weak with gaps in the data.

The focus of this methodology is post-harvest fish losses, it is important that when the subject of losses arises in an interview/discussion that probing is used to produce as much data as possible.

For example, during an interview a type of loss may be mentioned that was not expected by the team. By careful probing the team should be able to reveal as much information as possible on this new type of loss.

One of the topics on a checklist used to guide an interview with a major fish trader was 'general' problems with the trade. When this subject was raised in the interview it was revealed that one of the major constraints to business was a loss due to non-payment of credit. By probing, which involved asking questions about this loss, the team learnt that:

"Some of the consignment of fish is sold wholesale on credit to the many small-scale retailers in the city. He tries to sell to retailers who have storage facilities as there is more chance they will sell fish successfully at a reasonable price. There are two problems with this: working capital is tied up and some retailers don't pay for fish taken on credit. This means that in a year he can lose 100 000 Tsh."

During another assessment it was revealed that one of the causes of fish loss was problems with rail transportation. Probing was used to find out what the problems with transport were in more detail:

"Losses as a result of rail transport are more specifically caused by mechanical breakdowns, floods on the line, switching of carriages and delays clearing the fish once it has arrived in the city."

Guide To Conducting Semi-Structured Interviews

- Make sure that at the start of any interview you explain why you want to conduct the interview, who you are/represent and what is the purpose of the fieldwork. It may not be a good idea at first to be explicit about your intentions to study fish losses, mainly because fish loss and wastage may be something people are not happy about discussing. Also, being explicit may lead people to tell you what you want to hear. It may be appropriate to say that you are not involved in any taxation or licensing activities which would conflict with the data collection exercise.
- Try not to raise people's expectations. This can be done by stating clearly why you are collecting data and be honest about the likely outcome of the research. If expectations are not met later this may create some ill feeling or mistrust within the communities or sites and make any further work in these places difficult for the team and other researchers.
- It is important to interview respondents at the most appropriate time for them and this may not be the best time for the team. Making appointments to meet key respondents and groups can give people a chance to choose a time and place which are comfortable for them. This can make the interview much easier to conduct.

TIP 9

A good time to interview fishermen is when they are in a relaxed mood repairing gear on the shore. It is difficult to talk freely with them when they are active selling fish or tired after fishing. For processors a good time may be when the fish is drying or freezing, rather than when it is being packed or transactions are being carried out. One of the most difficult groups to interview are fish retailers. You should arrange to meet them outside working hours or wait until there are no customers.

- Try to make sure that an interview takes place somewhere comfortable for both the interviewee and the team. Make sure that the arrangement of the team and key informant does not create an 'us and them' situation and that the interviewee(s) do not feel intimidated or uneasy.

TIP 10

To offer or actually take part in an activity alongside the interviewee can often ease discussion. By assisting with the preparation or processing of fish and other activities, such as going fishing or net repairing, can make discussion easier.

- Show an interest in what the interviewee is saying and doing, even if what they are saying may not be relevant to the study.
- Although fish losses will be the focus of a study, try not to show surprise or excitement when losses have been identifed or become the subject of an interview. However, make sure that you carefully probe to reveal as much about fish losses as possible.
- Respect local customs and formalities and always be polite. Find out early on what is acceptable for a team in the data collection site. For example, will it be acceptable for women to interview men or *vice versa*.
- Note taking is the best way of recording data, but it should be done discreetly with the consent of the person/group being interviewed. It may be best to start taking notes a little way into the interview when the interviewee is more at ease rather then introduce the notebook at the beginning. In some situations it may not be practical to take written notes, either because of the situation or because the person does not want notes taken. If this is the case then as soon as possible after the interview make sure as much information is written down as possible. A dictaphone or small tape recorder can be useful for recording observations and key points quickly in situations where writing is difficult.
- Bias is an important issue which is discussed in more detail in the principles section on page 57. However, in a fishing community there will be different sub-groups characterized by such things as age, wealth, ethnic group or sex. Each sub-group may have particular circumstances and may be affected by fish losses in different ways. Therefore, it is important to be aware of the different groups that may exist in a community and to try and include them in a study.
- Always finish an interview politely, thanking the respondent or group for their time and assistance. Allow time for the people interviewed to pose questions to the study team.

Loss Avoidance

In some fishery sectors people may be using coping strategies to avoid losses. In other words, people perceive losses as a problem and are trying to do something to reduce or avoid losses.

To understand existing loss reduction strategies will be useful for planning any future loss reduction programmes. So while conducting fieldwork and especially SSIs try to establish whether loss reduction strategies are already being used, or whether they have been used in the past. Typical examples are the introduction of new and or improved technologies and processing methods. Box 7 shows some findings from a study of fresh fish retailing.

BOX 7

Fresh Fish Retailing

All spoilt fresh fish are usually thrown away (burying). However, fresh fish retailers tend to be more careful in ensuring that they do not purchase early night catches to avoid losses. Another strategy employed to curb losses in the fresh fish retail line is product promotion which allows for quick clearing of the lot. Retailers, on noticing the possibility of loss would reduce the selling price early to ensure that the entire lot is sold before fish go stale.

Observation

Direct observation of activities, the environment and behaviour of people is a useful tool in fish loss assessments. Observations can generate data for the study or can be used to formulate questions for SSIs. Observation can also be used to cross-check data from SSIs. Observation of the following activities can indicate to the team where losses may be occurring:

- *fishing*
- *landing of fish*
- *sorting and grading*
- *selling/auction*
- *condition or quality of fish at any stage*
- *fish handling and processing*
- *storage*
- *buying selling and distribution.*

Below are some examples of how observation can be used in fish loss assessments.

- "It was observed that prawns were being handled in a way that was causing some quality deterioration. Only by observing every stage in the supply chain from fishing to factory gate was it possible to gain a full understanding of the reasons why losses were occurring."
- "At landings the fish is usually kept at the lake shore. Traders will arrive and normally sort through to check the quality of the perch before buying. The main quality indicator used by buyers is gill colour. Only fish with blood red gills is bought. Any fish with pale or pinkish gills is singled out as not acceptable and will usually be rejected and sold to salters."
- Observations made indicate that before freezing the fish is exposed to high ambient temperatures for many hours. The fish is not washed before freezing which is likely to speed up microbial spoilage. The quality problems caused are likely to be noticed further down the marketing chain when some fish is unfit for selling fresh.
- A key indicator of dried fish quality is its colour. Dried fish stored for 3 days during the rainy season can change in colour from shiny silver to dull reddish-brown. The latter is associated with a bitter taste and is probably a result of fat oxidation catalysed by a high moisture content. Dried fish that has changed colour will be sold for a reduced price. Even well-dried fatty fish will change colour fairly quickly compared to well-dried lean fish. Lean fish can be stored for 3 months without changing colour.

* Mr X had just arrived by dug-out canoe with two polystyrene boxes containing around 45 kg of prawns. Mr X had run out of ice while collecting and had returned to re-ice and then wait for transport. It had taken 4 days to collect these prawns and it would be another 24 hours before they would reach market and be sorted. The prawns had already begun to produce off odours and the melt water that was drained off them was black. Some of the larger prawns were washed but the smaller prawns, which were in the majority, were taken from one box to another without washing. It later transpired that of the 45 kg of prawns, 20% was rejected by the buyer because of poor quality.

Certain simple equipment can be used to assist in making observations. For example, a thermometer can be used to check the temperature of fresh fish. This is a useful way of checking the effectiveness of any chilling methods and of identifying factors that can lead to fish spoilage. Likewise, weighing scales can be used to measure traditional units of measurement or actual fish weights.

During a study it was observed that fish was sorted after landing according to quality. Poor quality fish was sold for a reduced price to fish processors. A sample of the fish was weighed and fishermen were asked the approximate number of fish. It was then possible to calculate the percentage of fish that was sold for a reduced price. This indicative quantitiative information could then be cross-checked during SSIs.

Mapping

Mapping can be used to stimulate discussion during an SSI and is an effective method to use at the start of such an interview.

Maps of the locality or fishing areas are best drawn by key informants and groups. They should be drawn on the ground, on paper or any medium appropriate in the interview situation. Materials and objects can be used to symbolize key features. Finished maps drawn on the ground should be copied on to paper by a member of the study team.

BOX 8

Extract from an Exploratory Study

As well as generating useful general information on the fishery, particularly on the seasonal switch between fishing grounds, the important point about this exercise was that it 'broke the ice' and stimulated open discussion. It did not generate specific information on fish losses, but provided leads to follow and information that might help understand losses better.

It is felt that in future more could be made of this technique. Fishing grounds should be discussed in relation to the types of fishing gears used on them. More could be learnt of indigenous management of resources by villagers. For example, at the end of the session it came out during discussion that there were rivalries between different villages over access to fishing grounds which showed there are local access boundaries for fishing grounds. Such sensitive issues may be difficult to talk about in a semi-structured group interview and will be better discussed with individuals.

Mapping of resources and a locality with key informants and groups is a good way to generate information quickly about:

- *fishing grounds*
- *fishing gears used*
- *seasonal patterns*
- *processing sites*
- *social groupings.*

In terms of learning about losses, mapping can be used to highlight general issues such as fishing gear type, processing methods and fish species. Once these general issues are known then either during the mapping process or during subsequent SSIs, the general issues can be explored (probed) to find out if losses are occurring.

Fishing Cycle Calendar

Calendars are a type of diagram tool often used during SSIs. Two calendar methods that are useful in fish loss assessments are the **fishing cycle calendar** and the **seasonal calendar.**

Figure 3 shows a fishing cycle calendar for a marine inshore reef fishery which has four distinct stages in a cycle. However, the calendar is drawn to suit the particular cycle of a fishery being assessed which may have different stages.

This technique proved to have promise as a way of understanding catch fluctuations and fishing activity. It is possible that similar methods, without tides, based on the phases of the moon, could be developed for freshwater fisheries as the state of the moon can often be associated with differences in catch levels and fishing activity.

Phase 1 Spring Tide	Phase 2 Neap Tide
Phase 3 Spring Tide	Phase 4 Neap Tide

Figure 3 Fishing cycle calendar.

The outline of the calendar should be drawn on the ground and used as a focal point for discussion. Typically each stage of a cycle is discussed with an individual or group of fishermen. Fishermen are asked to describe the key activities or features associated with each stage of the cycle. Typical topics to discuss are:

- *catch levels*
- *species caught*
- *fishing gears used*
- *losses.*

Once a discussion on losses has started efforts should be made to probe for information on the reasons why losses occur and indicative data on the magnitude of them.

Figure 4 summarizes the results of using the fishing cycle calendar with a group of fisherfolk. The calendar was used to define the active fishing periods during a fishing cycle. Then semi-structured interviewing was used to define the key activities or features of each stage in the cycle.

Seasonal Calendar

Seasonal calendars can be drawn by local people and are used to show links or patterns of activities according to seasons or time of year. They can be used to identify seasonal trends in:

- *fish catch/production, trading*
- *post-harvest losses*
- *fishing activity*
- *weather*
- *alternative employment and other relevant activities.*

Data on any trends or patterns can help the team in their understanding of fish losses.

Seasonal calendars are normally drawn on the ground, the first step is to mark out a time-scale axis. The time-scale used will depend on what local people use; this may not always be the standard western style calendar.

Once established that losses are occurring, the following questions should be asked to build up a picture of the circumstances, frequency and seasonality of loss:

- *when is the fish catch highest, second highest, lowest, second lowest?*
- *when do post-harvest losses occur?*
- *when are losses highest, lowest?*
- *when and what are the different seasons?*

> "Seasonal calendars can be prepared for the village or area as a whole or for the activities of individuals or households" (Townsley, 1993b).

Ranking

Ranking is a non-diagram method which is used by researchers to explore a key informant's or a group's perceptions and preferences for particular issues or aspects of a study, such as:

- *fishing gear used*
- *processing methods*
- *problems*

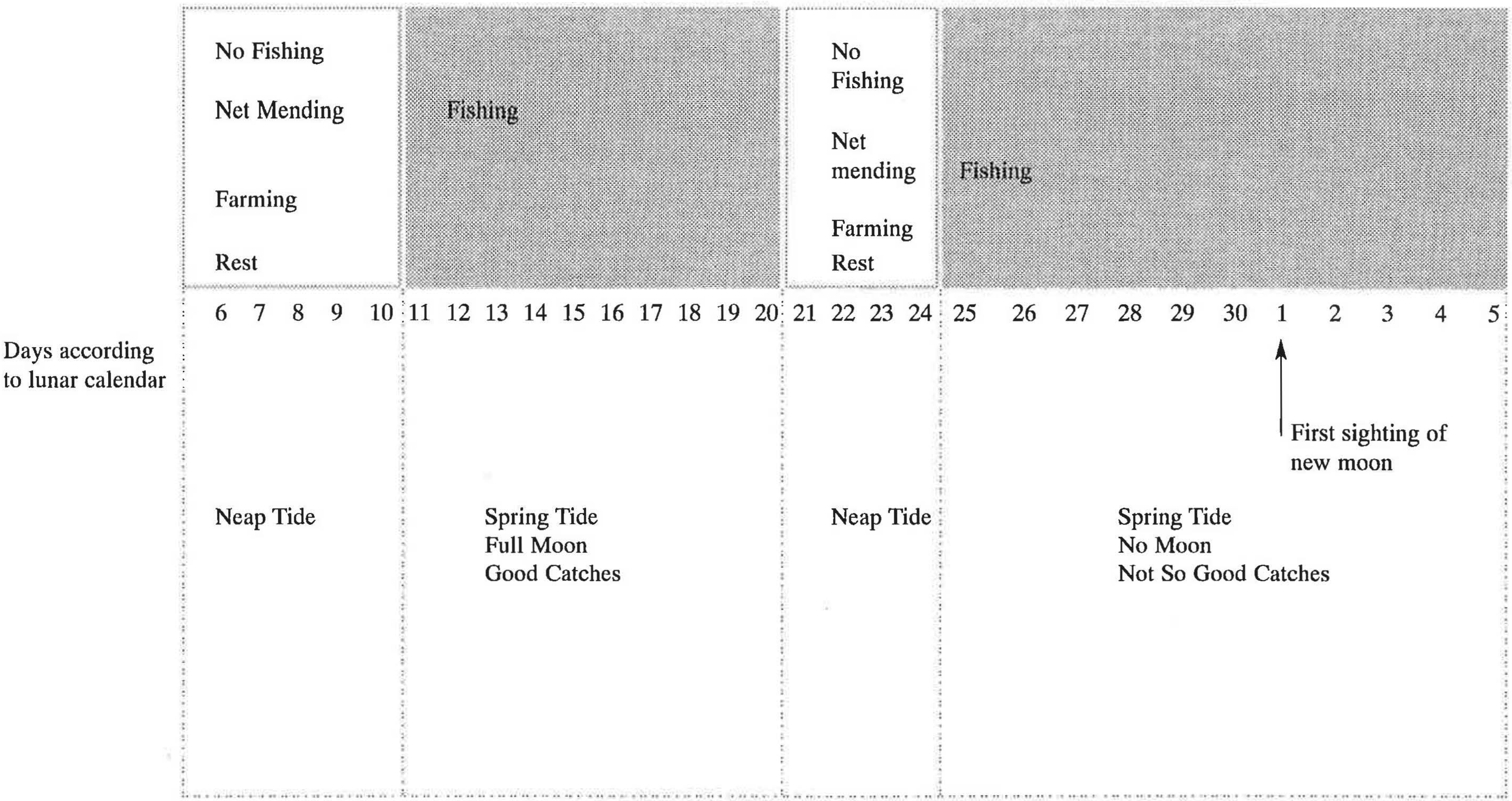

Figure 4 Activity chart for fishermen.

* *reasons for post-harvest losses*
* *importance of post-harvest losses*
* *cost of production*
* *important fish species.*

There are three types of ranking: wealth, preference or pairwise and matrix.

> "Analytical tools, such as ranking, complement semi-structured interviewing by generating basic information which leads to more direct questioning" (Theis and Grady, 1991).

Ranking is done once the alternatives to rank are known, i.e. types of fishing gear, important fish species, and reasons for losses. These can be identified using SSIs and the other methods mentioned in this section.

Preference Ranking

Once a list of the alternatives has been identified the key informant or group are asked to choose which is more important, second most important and so on.

> "Preference ranking allows the team to determine quickly the main problems or preferences of individual villagers and enables priorities of different individuals to be easily compared" (Theis and Grady, 1991).

Once the main reasons for post-harvest fish losses are known then ranking can be used to determine which is the most important in terms of causing the highest losses and which is the least important.

Table 8 shows the ranking of the constraints, in descending order of importance to business as perceived by a frozen fish wholesaler. Although post-harvest losses were one of the constraints, there were a number of other issues which were found to be more important, i.e. the losses due to non-payment of credit by small-scale fish retailers.

Table 8 – Ranking of Major Constraints by a Fish Trader

Losses due to Non-payment of Credit Loans	1
Lack of Adequate Storage	2
Poor and Unreliable Transport	3
Stale Fish Losses	4
Electricity Supply	5

Table 9 shows a relationship between capital cost, catch level and level of losses according to different types of fishing gear as perceived by a group of fishermen.

The % loss figures were derived using the % loss method described on page 48. Table 9 shows that handlines are relatively cheap to buy compared with the other gear types yet they are associated with the highest levels of post-harvest loss, up to 25% of the catch. Beach seines account for the highest catches and the least losses. During discussions as the ranking exercise was taking place, it was discovered that the reason for high losses with handlines was due to the fact that handline fishermen used sail-powered boats which sometimes took a long time to reach shore if the wind was poor or from the wrong direction. As no ice was used on board this delay caused fish to spoil in the high ambient temperatures.

Table 9 – Matrix Ranking of Fishing Gears by Fisherfolk

Gear	Cost	Losses	Catch	Indicative % Loss
Beach Seine	2	4	1	>5
Shark Net	1	3	2	5
Trap	4	2	3	15
Handline	3	1	4	25

1 = highest; 4 = lowest.

Ranking Fish Species

Ranking can be used to identify which species to target in Load Tracking or Questionnaire Loss Assessment. As with all ranking exercises, it is important to first set the criteria which governs the ranking exercise. If the most important species in the fishery are to be identified by ranking then it must be clear what the definition of importance is and who decides this – the survey team or the fisherfolk. One species may be important to fishermen, but another species may be important to retailers.

Retailers may not think a species is important because its shelf-life is short and it tends to spoil quickly. Similarly the species that are important to the export sector may be very different from those of importance to indigenous consumers of fish.

Once a list of the main species in a fishery is known then the species should be ranked according to the criteria with as many key informants and/or groups as possible. A matrix is used to record the data.

The following is a general guide to ranking fish species.

- The first step is to determine the criteria of the species that are to be the focus of the survey. For example, 'the most commercially important', and this is determined from discussions with the client.
- Next, gain a broad understanding of the reasons why some fish species are more important than others, and the species involved. This is best done by SSIs with key informants and groups.

- Ranking with as many key informants and/or groups as possible can then be done to determine the type of species required. If the species are not to change each season during the survey, then ask respondents about the most commercially important species based on the 'whole year'. To help with recording the results *in situ* it may be useful to have ready a table drawn up on a piece of paper.
- Ranking of species by price, keeping quality, seasonality and abundance can also be used to determine the focus of the study, as these are some of the attributes associated with important fish species and inherently linked to why the fish were important. Table 10 shows an example of a ranking exercise done using several topics.
- If ranking is done on just one criteria such as the 'most commercially important' species then as the ranking is done the respondent should be asked why the species are ranked in the order they are and why one species is more important than another.
- Tabulate the results of the ranking exercise according to sub-sector, if appropriate. Use the highest score (4) to represent the most important species and the lowest (1) to represent the least important of the number of species required. Total the scores for each species to determine the overall rank of the species.

The species were ranked in descending order according to: best fish to sell, the most abundant fish species in the fishery and the species which had the longest shelf-life on ice. Another criteria not included here but which can be ranked is the highest price. According to this exercise the total shows that snapper scored highest and was, therefore, the most important species and mackerel the least important.

Table 10 – Ranking Exercise Done with a Fisherman

	Snapper	Trevally	Barracuda	Barracuda (small)	Mackerel
Preferred	5	4	3	2	1
Abundance	1	3	2	5	4
Keeping Quality	5	3	4	2	1
Total	11	10	9	9	6

TIP 11

To ease analysis, the results from a number of interviews should be tabulated, see Table 11. The ranked order is then totalled for each species to give the overall rank. To help with recording the results in the field it may be useful to use a ready drawn matrix.

Table 11 – Tabulation of Results from Interviews

Criteria	Species A	Species B	Species C	Species D	Species E	Species F
Interview 1						
1	2	4	3	1	5	6
2	1	2	3	5	6	4
3	4	5	6	2	1	3
Interview 2						
1	3	5	6	2	1	4
2	6	5	4	3	2	1
3	3	4	5	1	2	3
Interview 3						
1	3	2	1	5	4	6
2	6	5	4	3	2	1
3	4	2	1	3	5	6
Total	**32**	**34**	**33**	**25**	**28**	**34**

From Table 11 it can be seen that species B and species F are the most important species according to criteria 1, 2 and 3.

> "What counts is not so much the final scores but the process of discussion and debate that occurs as the matrix is being created" (Pretty *et al.*, 1995).

Pairwise Ranking

Table 12 shows the results of a pairwise ranking exercise conducted with a group of fishermen.

Table 12 – Pairwise Ranking of Five Different Fish Species According to 'Total Value to Community'

	Sail fish	Seer fish	Tuna	Sardines	Total Score
Mackerel	Mackerel	Seer	Mackerel	Mackerel	3
Sardines	Sardines	Seer	Sardines	-	2
Tuna	Sail / tuna	Seer	-	-	0.5
Seer fish	Seer	-	-	-	4
Sail fish	-	-	-	-	0.5

'Total value to the community' was determined by the fishermen interviewed and was a function of fish unit price, length of season, and size and frequency of catch. Seer fish was ranked highest with a total score of 4. It was established during the ranking exercise that seer fish commands a relatively high selling price and can also be processed and sold for a good price if it is not sold fresh. Whereas sail fish was ranked low because few are caught, although the price is high. Alternatively, tuna is caught frequently but fetches a low selling price.

Scoring

An extension of ranking is to score criteria rather than simply rank then. In matrix ranking, scoring criteria can show more clearly the relative importance of one alternative over another. So rather than having a 1 to 6 value as in Table 10 the respondent would be asked to give the species a score out of 10 for the different criteria.

Locally available materials such as pebbles, seeds, etc., can be used to score if the matrix is drawn on the ground.

The Use of Scoring in Post-harvest Fish Loss Assessment

Scoring is an appropriate tool for loss assessment and can be facilitated by team members who are either literate and numerate or who have difficulties in reading and writing. Scoring can also be used to assess loss levels and is used during SSIs with groups or individuals to focus on fish quality and losses in relation to:

- *fishing gear type*
- *seasonality*
- *fish species.*

Once scoring has been done and a matrix can be seen by a group or individuals it is then easy to probe and ask questions about key issues. For example, once a seasonal scoring exercise has been completed, it is possible to ask about and discuss the reasons for loss at certain times of year. Once peak and low loss seasons have been discussed it is then relatively easy to follow on with a scoring exercise which can estimate the level and value of losses during each season.

The following is an example of how scoring has been used with a group of fishermen to identify if there is any variability in loss levels according to fishing gear type in a fishing community where a diverse range of gears are used. You should aim to use scoring in a similar way for other variables which affect loss, such as different processing methods, fish species and methods of packaging. The exercise begins by marking out a table or matrix on a suitable medium such as the ground, or in sand or on a large piece of paper, identify the fishing gears used by fishermen and mark these along one side of the matrix. A bag of stones, shells or beans should have been arranged beforehand.

The group is then asked a series of questions such as which gear produces the best catch, which gear produces best quality catches and which gear is associated with physical loss. The answers are given a score out of 10. The counters are placed in the appropriate box. Table 13 shows the results of a similar exercise.

Table 13 – Scoring with Fishermen Group

	Trap	Surround Gill Net	Beach Seine	Line	Octopus Jig	Surround Net	Deep Gill Net	Long Line (100 hooks +)	Drift Net
Quantity of Fish Caught per Trip (10=most)	3	2	1	3	5	10	5	5	1
Quality of Fish (1=poor, 10=best)	14	2	7	10	8	5	1	7	1
Physical Losses (0=lowest)	0	6	8	1	0	10	8	1	5
Number of Gears in Village (1=lowest)	5	1	2	10	6	7	4	8	1
Cost of Gear (1=cheapest)	2	6	8	2	3	20	6	6	3

The results in Table 13 show that surround nets are associated with high catches and high physical losses. Along with deep gill nets and drift nets they are also associated with poor quality landings. Such information can help a team learn quickly and prioritize for follow-on discussions and dialogue.

For example, the team may now wish to focus on the surround net fishermen and their losses since high losses were associated with this gear and catches were also high. Table 14 shows the results of a seasonal scoring exercise, which has focused on one particular type of gear. Note that the traditionally recognized seasons were used and the corresponding months were added later when the matrix was recorded by the team. It shows that August is a month when high physical loss is expected.

Discussion during the scoring exercises revealed that high losses in June, July and August are due to the high temperatures leading to rapid spoilage. In addition, this is also the rainy season and if fish is rained on between capture and landing it also spoils more rapidly and buyers are more likely to reject the fish.

Table 14 – Seasonal Scoring with Fishermen for Surround Net Fishery

	Jan	Nor Feb	Mar	Apr	Tioron May	June	July	Nawet Aug	Sept	Oct	Loly Nov	Dec
Quantity per Trip	••••••	•••••	••••••••	••••••••••	•••••••••	•••••••••	•••••••	•••••••	•••••	••••	•••	•
Price per Basket	•••••••	•••••••	•••••	•	•••	•••	••••••	••••••	•••••••	••••••	•••••	••••••••••
Physical Loss	•	••	••••	••••••	••••••	•••••	•••••••	••••••••••	••••	•••	•	•
Quality of Fish	••••••••	••••••••••	•••••••••	••••••	••••	•••	••	•	•••	••	•••	••••••••

• = lowest or poorest; •••••••••• = highest or best.

Quantifying Losses

After identifying when peak and low losses occur, a further scoring exercise can be carried out to provide indicative loss level and value data. The percentage loss tool is used to achieve this (page 48).

A hundred stones are used to symbolize a theoretical amount of fish. The group or individual is then asked to assume that this was a catch in the time of peak and low losses and to divide the 100 stones according to the amount of good quality fish, poor quality fish and fish thrown away accordingly. This will establish indicative percentages, which can then be used in calculations. However, a number of questions must also be asked during this exercise to provide additional data to enable calculations of loss levels to be made. The questions are:

- *on average how many baskets of fish do you land per trip in the month of peak losses?*
- *how many fishing trips do you make on average in the month of peak losses?*
- *what was the price of a basket of good quality fish during the month of peak losses?*

And they are asked referring to the time of high and low losses.

- *what is the weight of the traditional unit of measurement (basket)?*
- *how often do you experience losses during the month of peak/low losses?*

The answers will make it possible to calculate the value of physical losses during the peak and low loss times. Table 15 gives an actual example of a calculation.

Table 15 – Scoring to Assess Level of Loss

		High Loss	Low Loss
•	No. Baskets Sold for Good Price	50	80
•	No. Baskets Sold for Low Price because of Quality	20	15
•	No. Baskets of Fish Thrown Away	30	5
1	No. Fishing Days	30	30
1	Average No. Baskets per Trip	150	42
1	Average Weight of Basket	60	60
a	Weight of Fish Landed per Trip (kg)	9000	2520
1	Price of Good Quality Fish per Basket (CFA)	2500–3000	2000
a	Good Quality Price (kg)	46	33
1	Price of Poor Quality per Basket	500–1000	800–1000
a	Poor Quality Price (kg)	12.5	15
a	Weight of Physical Loss per Trip (kg)	2700	126
a	Max Value of Physical Loss per Trip (CFA)	124200	4–158

(NB: CFA Franc is the currency used in West and Central Africa.)

- • results of scoring exercise
- 1 data from questions posed during the scoring exercise
- a calculated after exercise completed

Percentage Loss

Percentage loss is a quick method to get indicative quantitative data on levels of fish loss. It can be used during an SSI and is a simple estimate of how much fish is wasted or sold for a reduced price according to seasons or variables.

The most straightforward way to calculate percentage loss is to ask the question "if you landed or sold 100 fish, how many on average would be thrown away (or sold for a reduced price)?" The calculation could be done in conjunction with a seasonal calendar to build up a picture of the relative loss levels over a set time period or according to seasons of the year.

Flow Diagrams

Flow diagrams are used to show the key activities and variables of a particular process or distribution chain. The process of constructing a flow diagram will often stimulate useful discussion.

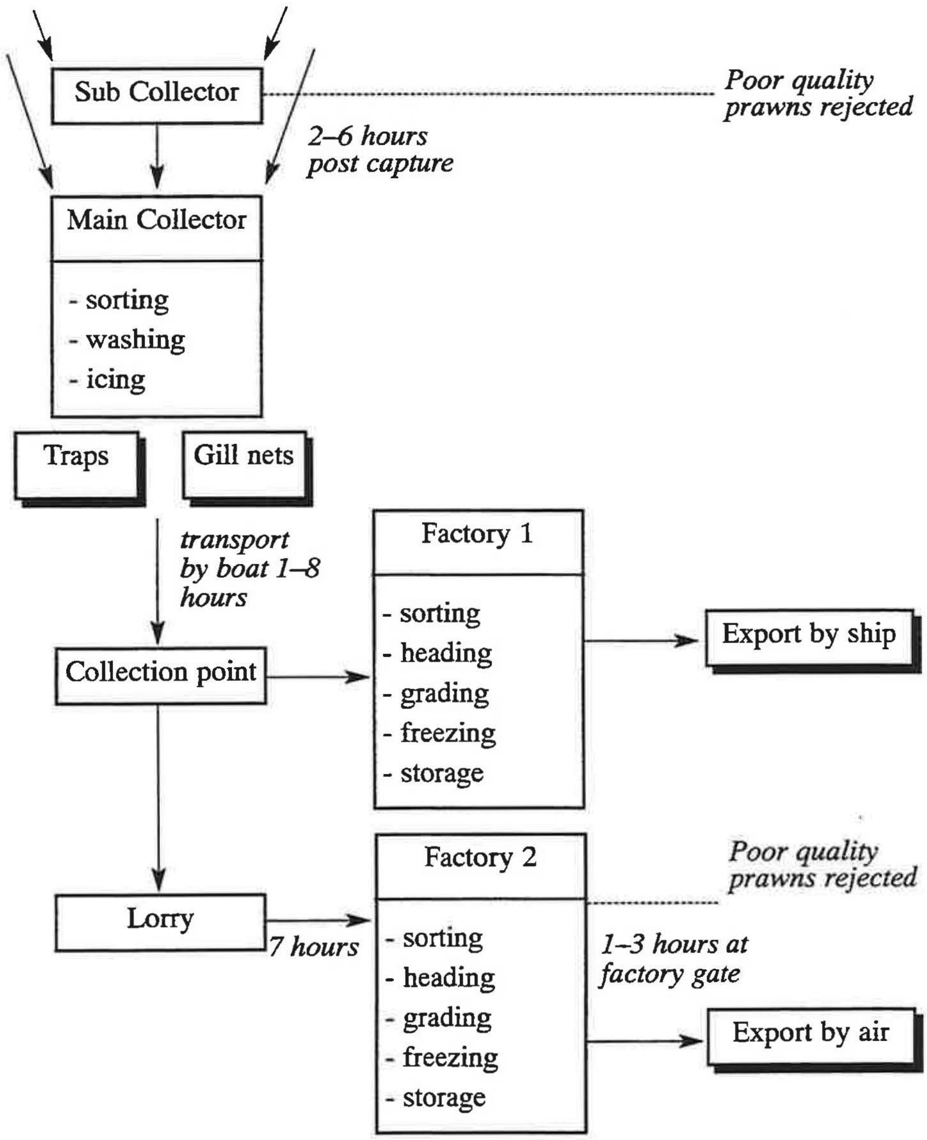

Figure 5 Artisanal prawn fishery – flow diagram.

Flow diagrams can be useful tools for planning and analysing distribution chains. They can show where losses occur and help in determining why they are occurring. A good way to construct flow diagrams is to ask the respondents to set out the stages of a distribution chain or process; these can be determined from SSIs and observation. Once the stages are clear, then time and temperature data (if available) can be added to each stage. Such data can be obtained using semi-structured interviewing, observation and Load Tracking.

Figure 5 shows a typical flow diagram from a loss assessment study. Flow diagrams can show where bottlenecks in fish distribution chains occur. For example, it can be seen in this diagram that prawns can spend up to 120 hours in ice with the main collector and that prawns are rejected at this stage. Any effort to reduce losses may do well to focus on this stage of the chain.

Using Tools to Generate Indicative Quantitative Data on Losses

In order to be able to estimate accurately the levels of post-harvest fish loss in a given fishery the following basic data are required:

- *types of loss*
- *loss percentages according to seasonality*
- *quantities of fish according to seasons*
- *frequency of loss*
- *frequency of operation, i.e. number of fishing days per year*
- *average selling price for good quality fish/product*
- *average selling price of poor quality fish/product.*

Once the data are available it will be possible to calculate average annual percentage and monetary values of losses in given fishery sectors.

The most practical way to measure loss is either as a percentage or as a monetary value. Percentage figures show how significant a loss maybe and are useful when comparing losses in different sectors. Monetary values of loss can also be used to do this, in addition, they add a value and can be useful in decision-making.

Defining the Type of Loss

At the beginning of the data collection process it is necessary to explore and define the type of losses occurring in a system. There are three types of primary loss to consider. These are:

- *physical*
- *quality*
- *market force.*

The list of topics on the checklist should include these three types of loss.

It is possible that more than one type of loss occurs at the same time. A fisherman may throw away fish due to spoilage and sell some for a reduced price. These two types of loss can be combined to give a **total financial loss**. This is the monetary value of both losses expressed as a percentage of the maximum value of the catch or batch of fish and is recommended as a standard measure of post-harvest fish loss.

There are a number of informal data collection tools that can be used to define the type of losses in a sector under study. The most widely used is the **Semi-Structured Interview** (SSI).

The subject of 'loss' can be a sensitive one and may need to be broached indirectly. For example, people may be reluctant to discuss losses, even though they occur, because there are by-laws or regulations that control fish wastage, i.e. physical losses. Misunderstandings about the reasons why data on losses are being collected can usually be reduced by a clear explanation of the reasons for the study.

A way to overcome the stigma that can be associated with losses is to use certain phraseology (and hope this translates into a local language accurately). For example, instead of discussing losses it is better to discuss grades of fish. The following are examples of the sort of question that can be asked in an SSI:

- *how many grades of fish do you buy or sell?*
- *can you tell us about the different grades?*
- *do you ever not sell any fish for any reasons?*
- *do you ever have any difficulty selling your fish/product?*

The answers to these sorts of question will give the researcher strong clues as to the type of losses and, to an extent, how significant are the losses. Observing how a respondent talks about loss will also give some insight into the significance of the losses.

Another tool that can assist the researcher identify the types of losses in a system is **observation**. Typical activities to observe for clues of losses are:

- *landing of fish*
- *sorting and grading*
- *quality of fish*
- *handling and processing*
- *selling and distribution.*

Any observations that indicate losses occurr should be followed up by questioning in an SSI. The observations can assist in framing questions to be asked during the interview. If the quality is poor at an early distribution stage, then losses will often occur further down the marketing chain. Observation of processing and storage can disclose whether insect infestation is a problem, which can be a cause of both physical and quality losses.

Seasonality

Once a loss has been identified then data are required on its seasonality and its size. This information and data on the quantities of fish that are being traded will be used in a simple calculation to give indicative loss levels.

Seasonality can be borne out during interviews. For example:

> "Losses are highest during the SE monsoon when there can be a strong continuous wind for 3–7 days. During the the NE monsoons there are usually only strong winds at night over a 2–3 day period. Rock cod, a fish that can grow to a large size, can sometimes break traps. Once a year traps are broken by net fishermen and the whole catch is then often lost".

The seasonality of losses can be explored using **calendars** and **scoring**. Typically respondents identify when the maximum and minimum losses occur, according to seasons, over a time period which is typically 12 months (the calendar used should be that used and best understood by the fisherfolk). Data are then added for the times in between, giving a full picture of how loss levels can change over time. Calendars can be built up to show trends in fish catch and other related issues such as weather patterns, income levels and activities.

If fishing, processing or trading, etc., are done according to a pattern or cycle, then loss levels can be discussed in relation to this. For example, in some fisheries fishing is done according to the phases of the moon or tides. The different phases or tides together represent a cycle which can be diagramatically represented and then used as a focus for an SSI.

Loss Levels

Once seasonal trends have been clarified then data on loss levels should be sought. This can be done by using proxy examples or questions in **SSIs** and can be done at the same time as **seasonal calendars** are developed or matrix scoring undertaken. The **% loss** approach is a proxy method which involves asking the fisherman that if he landed/sold 100 fish then how many on average did he:

- *sell for a reduced price?*
- *physically lose?*

The exercise is done according to seasons and it may be more practical to lower the number to 10. The exercise can be done as a diagram where the numbers are written out on the earth or sand by the researcher.

Data on levels of loss can also be generated from observation. It may be possible to count, or quantify, fish that are sold for a reduced price (different grades) or fish that are physically lost. A set of pocket-size weighing scales can be useful for weighing samples of fish and quantifying loss levels.

Quantities of Fish and Number of Operators

Information on the quantities of fish that are being caught, processed or traded is also needed so that meaningful monetary values of losses can be determined. The quantities may also vary according to season and so data on quantities can be best generated using **calendar techniques** as well as **SSIs**. Often quantities of fish will be measured using local (traditional) units. It is important to get data on these units, especially if more than one traditional unit is used for buying or selling the fish, so that values can be converted to standard units such as kilograms. It may be possible to physically weigh fish to get data on traditional units.

If conclusions on losses are to be used as representative of a given sector or area then data will be required on the number of operators in that sector. This data may be available from secondary sources, such as reports and government statistics. It is often impossible to collect data on an entire population, unless the sector is small. By assuming that the sample frame from which the data were sourced is representative of a population will often be an assumption based on faith, which may be difficult to justify. It is recommended that care should be taken to make sure the results and conclusions on losses are presented in light of the assumptions made and that data are not extrapolated beyond reason.

Frequency of Losses and Operations

Losses may occur in a particular fishery, but they may not occur every time an activity is carried out. So it is important to find out the frequency with which a loss occurs. This is best done using an **SSI**.

The frequency of a loss or an operation, i.e. fishing or transportation, may also vary according to weather conditions or other variables such as fishing gear type, so it is important that these issues are also explored and for this tools such as **seasonal calendars** and **scoring** are useful.

In order to apply realistic data on the volumes of fish moving in particular sectors data are also required on the frequency with which fishing, trading and processing of fish is carried out. Some data may be available from **secondary sources**, such as statistical reports. This data will be used with the data on quantities of fish to determine volumes of fish over a period of time, such as a year. Frequency data are usually obtained from SSIs, by asking simple questions like:

- *how often do you fish?*
- *do you ever stop processing?*

Cycle diagrams such as those associated with fishing activities are also useful ways of finding out how often an activity is carried out. For example, fishing may be carried out according to a predictable cycle, which may be linked to the lunar cycle. Consequently there are times of fishing activity and times of rest.

Prices

Price data are required for the calculation of monetary losses. Prices are another sensitive topic and it can be difficult to get data on them, particularly as some business people are secretive about prices. People will often become suspicious when asked about prices, especially if you have no intention of buying the product. Misunderstandings about the nature of the research will only exacerbate this problem. So it is important that the research team provides a clear explanation of the research to respondents before interviewing them.

There are three main sources of price data. It can be derived from questioning during SSIs. It can also be gleaned from secondary sources of data, such as market records or buyers records. Otherwise, observation during fieldwork can be used to pick out price data by listening to transactions. Prices may also be on display (see Appendix 1).

If price data are not easy to get directly from respondents then it may be worth talking to people with indirect involvement in the activity. For example, a fisherman may sell fish through an auctioneer. The auctioneer will be less impartial than the fisherman about prices and may disclose the data more easily. Consumers will also be able to give price information, as will market officials and traders of other fish products in the same site. If all else fails, then buy a fish!

Data are only required on two prices. These are:

- *price at which the best quality fish was sold*
- *price at which the poorer quality fish was sold.*

The best price is used as a bench mark to work out the maximum value of the fish, under local conditions. Then if fish is sold for a lower price, perhaps because of quality reasons, then the loss in value can be easily worked out. The 'best price' is also used to calculate the economic value of physical losses. If 10 kg of fish are physically lost then the value would be simply 10 multiplied by the best price per kilogram.

If fish are graded for selling according to quality then there will automatically be several different prices. In which case it is important that a practical approach is taken and that average prices are derived and then used to calculate the value of losses.

Another factor which can complicate determining the right price to use in calculations is the fact that the selling price of fish may fluctuate over a short space of time. Furthermore, the price of fish may be lowered towards the end of a selling session simply to sell the fish off because the costs of keeping the fish until the next session are prohibitive. One option in circumstances like this is to determine the average price of best and poor quality fish over the selling period.

To make price data user friendly it should be in standard units such as kilograms. To achieve this in situations where traditional units are used for fish measurement, samples of fish may have to be weighed, in which case a set of small weighing scales is a useful tool to have at hand.

Basic Financial Loss Calculations

The following are two examples of how financial loss can be calculated. Further examples are to be found in the section on extracts from loss assessment reports later in this chapter and a more detailed example is given in the introduction to the manual.

A fisherman indicated that out of 15 bags of fish caught, only 12 bags were actually landed. Two of the bags landed were of poor quality. The prices charged for good quality and poor quality fish were 500 and 250 respectively. The fishermen's financial loss is calculated as follows:

Potential income: 15 sacks x 500 = 7500

Actual income: (10 sacks x 500 = 5000) + (2 sacks x 250 = 500) = 5500

Monetary loss: Potential income - Actual income

7500 - 5500 = 2000

A processor purchased 10 sacks of fish. After processing, two sacks were of poor quality and two were lost during processing. The prices at which she sold good quality and poor quality product were 3000 and 1500 respectively.

Potential income: 10 sacks x 3000 = 30 000

Actual income: (6 sacks x 3000 = 18 000) + (2 sacks x 1500 = 3000) = 21 000

Monetary loss = Potential income - Actual income

30 000 - 21 000 = 9000

Case Studies

Case studies are a detailed account of an important activity or subject related to the objectives of the study. A case study will help to highlight or support important issues identified by the study team. Below is an example of a case study included in a report of an informal fish loss assessment. It is derived from an SSI with fisherfolk and highlights some of the key issues in this sector, i.e. the migration of fisherfolk and the seasonal nature of fish loss.

BOX 9

Case Study: *Dagaa* Fishermen and Processors

Juma Hussein, Amri Kassim and Gideon Papa are three fishermen who fish for *dagaa*, a small anchovy-like fish. One reason why they are now fishing on the Lake, they say, is because it is easier to fish here, particularly because they do not need to use an engine.

There are 75 fishing units (households) in this village. During a good season each can produce 80–100 35 kg sacks of dried *dagaa* per month. Buyers from all over come to buy *dagaa* here.

At the time of this study a 35 kg sack of good quality *dagaa* was selling here for 6500 Tsh; this is about 185 Tsh per kg. But price varies according to supply and demand.

In a month the running costs for fishing are 20 000–30 000 Tsh. In a peak season when 100 sacks could be sold then, assuming a price of 6500 Tsh per sack, the owner of the fish could realize a profit of 300 000 Tsh and the fishermen could earn roughly 70 000 Tsh each.

When fishing stops some fishermen will leave the camp for nearby towns and others will remain to look after things. The fishing gear is normally owned by someone who does not actually fish.

The rainy season (October to May) is a difficult time to fish and process and this deters people from fishing then. Some fishermen stop fishing during the rainy season and go to farm instead. As for losses, up to 60–70% of a catch can be discarded during the rainy season because it is not possible to dry the catch properly.

The fishermen are usually involved in the processing of the *dagaa*. The women, who are resident in the camp, cook and assist in unloading the *dagaa* from canoes and in the drying. The *dagaa* can take from 8 hours to 2 days to dry depending on the weather conditions.

Principles

There are several principles that should be used in association with the tools. The principles are intended to assist in validating information, reducing bias and improve the quality of the study findings, i.e. in general terms to enhance the trustworthiness of the data.

> "Use of participatory methods without, for example, triangulation of sources, methods and investigators and participant checking of the constructed outputs should be judged as untrustworthy" (Pretty *et al.*, 1995).

The common principles are triangulation, flexibility, serendipity, avoiding bias, participation and data analysis. In addition to a description of the principles a more detailed analysis of the criteria for trustworthiness is given in Pretty (1995). A framework for judging trustworthiness is shown opposite.

A FRAMEWORK FOR JUDGING TRUSTWORTHINESS

1. *Prolonged and/or Intense Engagement Between the Various (Groups of) People.* For building trust and rapport, learning the particulars of the context, and to keep the investigator(s) open to multiple influences.

2. *Persistent and Parallel Observation.* For understanding both a phenomenon and its context.

3. *Triangulation by Multiple Sources, Methods and Investigators.* For cross checking information and increasing the range of different peoples' realities encountered, including multiple copies of sources of information, comparing the results from a range of methods, and having teams with a diversity of personal, professional and disciplinary backgrounds.

4. *Expression and Analysis of Difference.* For ensuring that a wide range of different actors are involved in the analysis and that their perspectives and realities are accurately represented, including differences according to gender, age, ethnicity, religion and class.

5. *Negative Case Analysis.* For sequential revision of hypotheses as insight grows, until one hypothesis accounts for all known cases without exception.

6. *Peer or Colleague Checking.* Periodical review meetings with peers not directly involved in the inquiry process.

7. *Participant Checking.* For testing the data, interpretations and conclusions with people with whom the original information was constructed and analysed. Without participant checks, investigators cannot claim that they are representing participants' views.

8. *Reports with Working Hypotheses, Contextual Descriptions and Visualizations.* These are 'thick' descriptions of complex reality, with working hypotheses, visualizations and quotations capturing people's personal perspectives and experiences.

9. *Parallel Investigations and Team Communications.* If sub-groups of the same team proceed with investigations in parallel using the same approach, and come up with the same or similar findings, then these findings are more trustworthy.

10. *Reflexive Journals.* These are diaries that individuals keep on a daily basis to record a variety of information about themselves.

11. *Inquiry Audit.* The inquiry team should be able to provide sufficient information for an external person to examine the processes and product in such a way as to confirm that the findings are not a figment of their imaginations.

12. *Impact on Stakeholders' Capacity to Know and Act.* For demonstrating that the investigation or study has had an impact, for example, if participants are more aware of their own realities, as well as those of other people. The report itself could also prompt action on the part of readers who have not been directly involved.

Source: Pretty *et al.* (1995).

Triangulation

Triangulation is used to validate data and improve the quality of the study in the absence of systematic sampling for key informants and groups. There are three types of triangulation that should be applied during fieldwork.

1. The individuals of the study team will have their own specialist background and knowledge and should each be able to approach a topic from a different angle and so the research topic will be explored and covered more fully.

TIP 12

A team consisting of a fish technologist, a socio-economist and a marketing specialist will be able to produce a more comprehensive study than a team consisting of only fish technologists.

2. It is important to interview more than one key respondent or group about a subject as then the data will be cross-checked and validated. Likewise it is important to interview different types of key informants and groups to get a more overall picture of the key issues. Asking the same person or group the same question in different ways is also a way of triangulating.

TIP 13

Wealthy fisherfolk may have a different view of fish losses from poor fisherfolk. Women processors may have different views and constraints compared with male processors.

In a study a number of key respondents were asked about the same issues which led to the following conclusions.

> "It was recognized by traders and processors that seer fish landed in certain villages were more likely to be of poor quality than fish from nearer villages. Poor quality fish, which is termed 'soft' fish because of the firmness of the flesh, is downgraded on arrival in the auction market and is bought by small-scale processors for salting and drying. This downgrading of fish is much more acute during the summer months, when ambient temperatures are higher and catches larger".

3. The third type of triangulation is to use different tools to find out about the same piece of information. For example, a fisherman may talk about the general quality of his catch, but observation can also be used to validate what is said verbally.

Flexibility

One of the principles of the methodology is flexibility, especially during fieldwork. The study team should choose and change data collection methods as they see fit according to situation or circumstances. There may be scope for the research team to develop new methods to aid data collection. Similarly as the team learn about a sector the new knowledge should be incorporated and if necessary, used to shape further fieldwork activity.

The research team's approach to data collection should also be flexible. It will be difficult to work to set hours in the field. When data collection and interviews take place should be determined by the respondents and their activities. For example, the best time to interview fish traders may be while they are waiting for fish to arrive at the market. This will mean the team are at the market at the appropriate time.

Another form of flexibility in serendipity – taking advantage of chance, being aware of chance opportunities and taking advantage of meetings with people or groups who may be able to provide useful information, but were not thought of as an obvious source of information in the first place. It may be tempting to stick to a pre-determined plan of action during fieldwork, but this can often exclude the opportunity to tap into new and different sources of data.

TIP 14

During fieldwork be prepared to interview someone met by chance and who may have interesting or useful information to offer.

Avoidance of Bias

Bias can distort the focus and conclusions of a study. It is important that the major types of bias are recognized by the study team and are eliminated as much as possible from a study. Some examples of bias are presented here and more information can be found in Chambers (1994a, 1994b).

Seasonal Bias

Try to avoid conducting fieldwork on the premise that the conditions in the field will be the most comfortable for the team to work. Conduct fieldwork at times that are likely to yield interesting data.

It may be tempting to carry out fieldwork during a certain time of year, for example, during the dry season, when conditions in the field will be relatively comfortable. However, it may be more appropriate to conduct fieldwork at times of year when the weather conditions are not so favourable.

Wealth and Influence

When a study team arrives at a site, especially a fishing village, they may be received by the more influential villagers and leaders. These people are usually good at articulating the community's interests and concerns and are a very useful point of entry into a community. It is good protocol to accept their hospitality and to learn from their knowledge. However, the team should be careful to avoid being side-tracked too much by initial contacts. They should make sure that the fieldwork also involves other people from different backgrounds and levels in the community.

Male Bias

Most local-level researchers tend to be men. Once in the field it will often be easier for them to establish contact with male key informants and groups. This has the effect of excluding women from the study and gives the study a male bias. Bearing in mind that women sometimes dominate the processing and trading sectors in certain fisheries, it would be wrong to exclude their views and knowledge from a study. This bias can be overcome to an extent if the study team comprises both men and women. Certainly a topical study to investigate how losses affect women in a fishery should be done by a study team of mixed sex or an all-female team.

Expectations

Visitors to a village or fish landing will normally raise some level of interest or perhaps suspicion within the local population. Strangers are sometimes associated with revenue collection and taxation. The people may think that there is a project or some development about to start. It is, therefore, very important that the team explain clearly why they are at a site and what they will be doing, otherwise people may get false expectations, which may distort the data they provide.

Participation

What do we mean by participation? There are a number of definitions of participation, but generally it refers to the level of involvement of people in the research or development process. There are various degrees with which people participate, the two extremes are:

- *people being informed of what will happen or has happened*
- *people taking initiatives to create change independently of any institutions.*

Outside professionals going to villages to collect information and take it away for processing and analysis without feeding back to those who provided the data is an extractive-type process which is relatively easy and quick to do. However, this approach restricts the role the target population plays in the information exercise.

So often it is relatively easy to extract data and then not inform those who provided the data of the overall results and conclusions. Also the degree of participation will be related to the objectives of the assessment. If the assessment is to be extractive in that the data are taken and used for macro planning then this should be stated at the outset so that people are aware of the aim of the research. If people are to be involved in taking decisions about reducing losses then a greater degree of participation should be encouraged. This can be done by:

- *stimulating more discussions with the target population*
- *research team sharing ideas with the target population*
- *research team spending as much time as possible with the target population*
- *target population encouraged to take an active part in data collection and analysis.*

> "In a growing number of government and non-government institutions, extractive research is being complemented, and even replaced by investigation and analysis by local people themselves. Methods are being used not just for local people to inform outsiders, but also for people's own analysis of their conditions" (Pretty *et al.*, 1995).

Certain data collection methods, such as mapping and seasonal calendars are inherently participatory in that they involve local people in presenting and discussing information.

For more information on participation see Pretty *et al.* (1995).

Data Analysis

Informal studies can generate a lot of data in a short space of time. The data will have often been collected in a random order in note form. Analysing the data and organizing it can be a daunting task to a team using IFLAM for the first time.

TIP 15

It is worth deciding how data will be analysed ahead of time or field test analysis.

There are two sets of analysts for an assessment: the external researchers and the local people. It is important to establish at the planning stage of an assessment who is to analyse the data. If the assessment is extractive in that data are collected by researchers and then taken away without the need of participation of the local people, then the external researchers will be the ones concerned with analysis. If participatory planning is an objective of an assessment then the local people should be heavily involved in analysis and discussion.

If the research team is to analyse the data then one of the best ways of maintaining the focus of a study and ensuring its clarity is to hold regular team meetings during the fieldwork period – one a day is recommended. Sometimes it is a good idea to set aside a whole day for such an exercise. These meetings will provide an opportunity to go over and discuss and analyse the data that have been collected and to plan further fieldwork, deciding which issues are no longer of importance and which issues should receive more focus.

TIP 16

It is better to take a day off from fieldwork in the middle of a survey if notes are not being compiled regularly than to leave it all to the end when salient points will have been missed.

Large pieces of paper and a marker pen can be used to summarize the results of these meetings. Issues that need further research can be easily identified as can issues which need no further research. The papers should be kept and used when writing the study report.

Reporting

The results of an IFLAM should be recorded in a form which can be used by the team and others to plan loss reduction measures or Load Tracking and Questionnaire Loss Assessments.

It is important that a report is produced jointly by the team and ideally a draft of the final report should be produced before the team disperses. The report should be concise and should only include the data that are relevant to the objectives of the study. Where necessary, data should be analysed and turned into information. This is especially important for indicative loss data. For example, different data from different sources may have been collected from primary and secondary sources and in this fragmented form an overall conclusion may not be clear. However, by assimilating the different sets of data it may be possible to form clearer conclusions.

Unlike a statistical survey it is less common to apply mathematical principles to the analysis of data generated from an informal fish loss assessment. Instead the field team will have a series of facts, opinions, observations, statements and data in the form of diagrams which has to be sifted, edited, assimilated and compiled in a clear and logical way so it can be readily understood by the intended recipient of the study data. The following are key points to bear in mind when producing a report:

* *a member of the team should write fieldwork notes up clearly and on a regular basis, probably the best time for writing up is either at the end of the fieldwork day or after a fieldwork meeting*
* *use data on quantities of fish, prices and losses to calculate indicative quantitative information on fish losses*
* *use case studies to highlight key issues*
* *try to use raw data to show trends in losses and indirect issues such as fish catches*
* *compare data from secondary sources with study data*
* *discard data that are suspected to be false*
* *be objective about data*
* *only use data relevant to the objectives of the study unless there are good reasons to do otherwise.*

IFLAM Report Template

Reporting or writing up the results of an IFLA should be done so that the reader or the person to be informed has a clear understanding of what has been done, what the key findings are and what tools and principles have been used and by whom. The latter will give the reader an indication of how reliable the results of the assessment are. In order to assist the team to write up the results of an IFLA the following report template has been produced (Table 16). This represents the essential issues and topics which should be included in a report. Use of this template will also assist in standardizing the reporting and presentation of post-harvest fish loss data, making comparison of data across communities, regions and countries more meaningful in future.

Table 16 – Template for Reporting an IFLA

Summary (ideally on no more than of 2 sides of A4 size paper)	who, what, where, how, why loss level data reasons for loss key conclusions key recommendations
Introduction	objective reason for the IFLAM sites and communities involved products, species, distribution chain dates of fieldwork and duration team composition and roles training and orientation description of planning
Tools and Principles	description of how they were used or applied who used what tools who were the key informants and others involved

Table 16 cont.

Loss Assessment	indicative quantitative data on losses showing price data calculations describe how the indicative quantitative data were derived and from what sources reasons for loss frequency of loss who is affected by loss seasonality of loss variables which affect loss perceptions of loss by communities, individuals, team coping strategies already used to overcome loss biases noted include copies of diagrams
Profile of Those Affected by Loss	income sources expenditure population size seasonal livelihood patterns trade and business links access to credit
Conclusions	are losses significant? are loss reduction initiatives worthwhile? describe any need for Load Tracking or Questionnaire Loss Assessment? are there coping strategies which could be developed further or disseminated?

Extracts From Loss Assessment Studies

This section shows how data from informal fish loss assessment studies can be presented in reports.

The following is an example of the content of an IFLA report summary. It tells the reader who was involved, what the focus of the study was, key data on losses including the perceptions of fishermen and observations by researchers.

Extract From A General Summary of Losses

An informal fish loss assessment (IFLA) study was carried out on the Lake...... fishing sector by a team which comprised a researcher from a national research institute, a fisheries department extension officer and two local fishermen/traders. The study was carried out in May and June 1999 in conjunction with fishermen from D..., B.... and M... villages. The IFLA was conducted as part of an exploratory survey of the fishery. The team used semi-structured interviews and seasonal calendars with fishermen and traders.

The five main species landed were *Clarias angularis*, *Tilapia* spp., *Heterotis*, *Gymnarchus* and *Lates niloticus*. Catches were generally higher during the rainy season (July to November) and when there is a full moon. Of the five main types of fishing method, gill nets are synonymous with higher post-harvest losses and loss is seasonal, being highest during the dry season from February to June. Both physical and quality loss occurs as a result of spoilage influenced by: the length of time the fish remains in nets prior to hauling, high ambient temperatures and length of transport time from fishing ground to landing. Indicative quantitative data suggests that it is common for 20–30% of fish to be downgraded and 10% to be discarded per trip during the dry season. Physical loss is increased during times of high catches as low quality fish is discarded before landing to make room for better quality fish. Low quality fish are sold for fish smoking as are those of better quality. Of the five species of fish commonly landed, *Tilapia* are understood to spoil the quickest and *Heterotis* sp. the slowest.

Fishermen are aware of losses and are of the opinion that their fish gets a low price when the distance to the fishing ground is long and they fish using a non-engine powered vessel.

Observations on landing and post-landing activities and facilities indicates that temperature, handling and hygiene problems increase the rate of spoilage and physical damage to the fish between landing and processing.

Summarizing Post-harvest Fish Loss Levels

One of the most important aspects of a loss assessment study is to produce indicative quantitative data on losses.

Example 1

Table 17 shows how loss data, mainly derived from SSIs with groups of fishermen, can be summarized.

Table 17 – Summary of Post-harvest Fish Losses

Sub-sector	Total Loss (%)	Number of Operators	Annual Sector Monetary Loss (Tsh)
Octopus Fishing	0	unknown	0
Surround Net	0	3	0
Box Trap	6	13	93 600
Collector Boat	40	1	4 100 000
Octopus Collection	23	1	322 800
Sharknetters	6	17	435 200
Processors	5	8	432 000

The losses affect fishermen and collectors. The total loss refers to the combination of physical losses with losses due to the fish being sold for a reduced price.

To show how the figures in the table are calculated let us look at the collector boat operator who on average loses 40% of his potential income every year.

Box 10 is taken from the study report. It shows the sort of data that are needed to estimate losses and it shows the assumptions that have to be made at the same time.

TIP 17

A point to make here is that prices are sometimes a sensitive issue. In some cases it may be practical to get price information from indirect sources, at the very least make sure price data are cross-checked.

The first example is taken from fieldwork in an artisanal marine fishery. It draws on data on the:

- *seasonal losses*
- *levels of loss*
- *frequencies of activity*
- *prices*
- *traditional units.*

BOX 10

Fish Collection
Season 1
During the SE monsoon the trader makes 14 trips, one every spring tide. During each trip 22 baskets of fish are collected. Of these 4 are discarded and 11 are sold for a price which is 50% of the best price, because of quality deterioration. These losses are an average per trip. The other 7 baskets are sold for a good price. The average selling price for a small basket of fish in the market is 3250 Tsh. (6 small baskets = 1 basket)

The theoretical maximum return for this fish for this season, which assumes they are sold for the best price, is:

basket x small basket x price per small basket x no. of trips

22 x 6 x 3250 x 14 = 6 006 000 Tsh

The total loss in monetary terms is the physical loss plus the loss in revenue due to fish being sold for 50% of the best price.

The physical loss is calculated by:

baskets discarded x small baskets x best price x no. trips

4 x 6 x 3250 x14 = 1 092 000

The reduced price is calculated by:

baskets x small baskets x best price x reduced price percentage x no. of trips

11 x 6 x 3250 x 50/100 x 14 = 1 501 500

The total monetary loss for the SE monsoon is:

1 092 000 + 1 501 500 = 2 593 500 Tsh

continued overleaf

Box 10 cont.

Season 2
During the NE monsoon 22 baskets of fish are transported and 10 trips are made on average per trip, only 0.5 of a baskets is discarded, but 14.5 are sold for a price 50% that of the best price.

The potential maximum revenue for this season is:

22 x 6 x 3250 x 10 = 4 290 000 Tsh

The physical loss is:

0.5 x 6 x 3250 x 10 = 97 500 Tsh

The reduced price loss is:

14.5 x 6 x 3250 x 50/100 x 10 = 1 413 750 Tsh

The total monetary loss is 97 500 + 1 413 750 = 1 511 250 Tsh

Annual Losses

Annually, the maximum potential revenue to the trader is:

SE monsoon + NE monsoon

6 006 000 + 4 290 000 = 10 296 000 Tsh

Annually, the total loss is:

2 593 500 + 1 511 250 = 4 104 750

Annually the average **total financial loss** in percentage terms is:

4 104 750/10 296 000 x 100 = 40%

Annually, the **physical loss** is:

monetary value of physical loss/maximum potential value of fish x 100

(1 092 000 + 97 500)/ 10 296 000 x 100 = 11.5%

It is assumed the data on losses are accurate and that the selling price remains constant all year round regardless of quantity supplied. However, this is indicative data and in the context of this study it showed that in terms of percentage and monetary significance the collector boat operator is suffering high losses.

Example 2
In another example for fish wholesalers who were dealing in frozen fish transported by train, where the data on losses are again taken from SSIs, the seasonal loss data are used to calculate indicative annual monetary losses. This example shows the importance of

SSIs and the data required to produce indicative quantitative information on fish losses. Table 18 shows the average sizes of a consignment during the hot and cool seasons, the average amount of fish sold for the best price available and fish that is sold for a reduced price and discarded. Once again the total loss is calculated, which is the combination of reduced price losses and physical loss. The reduced price is on average half of the best price. The loss is the loss in revenue to the wholesalers.

The consignment size varies so the overall average loss for the two seasons is 11% and is calculated by dividing the equivalent total weight of fish lost by the total weight of consignments multiplied by 100:

714/6447.5 x 100 = 11%

Table 18 – Average Sizes of a Consignment during the Hot and Cool Seasons

Season	Consignment Weight (kg)	Best Price (kg)	Reduced Price (kg)	Physical Loss (kg)	Total Loss (%) and (kg)
Hot	1000	870	130		6.5 (65 kg)
Cool	600	570	30		2.5 (15 kg)
Hot	1000	800	200		10 (100 kg)
Cool	1000	950	50		2.5 (25 kg)
Hot	1000	700	270	30	16.5 (165 kg)
Hot	1847.5	1504	343.5		18.6 (344 kg)
Total	6447.5		**Weighted Average Loss**		**11 % (714 kg)**

Table 18 shows the difference in loss level according to season and that the most common loss is due to selling fish for a reduced price.

Taking the data for each season the weighted average total loss for the 'hot' season is 7% and 4% for the 'cool' season.

Example 3

In a third example the loss due to rejection of prawns by a processing factory is calculated in terms of gross income lost to the factory. The study was for the manager of a factory who was concerned about the poor quality of prawns arriving at the factory gate (box 11).

BOX 11

Loss Due to Rejection of Prawns in a Processing Plant

On average 3% of a consignment of prawns arriving at the factory is rejected. Observations suggest that these are a mixture of 50% small and 50% poor quality. Therefore 15 kg of prawns are rejected for every 1000 kg accepted because of poor quality rather than size. Multiplying up, if the factory receives on average 3 tonnes of prawns per week, this equates to 45 kg of rejected prawns. In a year, therefore, as much as 2340 kg of prawns are rejected. If these prawns could have been sold headless at 10 US$/kg (the export market price) then, taking in to consideration the 40% weight loss due to processing, the gross income to the factory could be

2340 x 60/100 x 10 = US$ 14 000

From the text it can be seen that observations were used to calculate the proportion of prawns rejected by the factory because of size and quality. Data on the average size of consignment of prawns and the number of consignments per week were taken from SSIs. Price information was from secondary sources. Again there are some assumptions, i.e. the factory receives a steady supply of raw material all year round and that there is no seasonal variation in the proportion of prawns rejected.

Reasons For Losses

An important part of a loss assessment is to find out why the losses occur.

Example 1

Table 19 shows how the key findings of a study can be summarized in table form. The data in the 'Findings' column are derived from actual direct observations by the study team and from SSIs with fisherfolk, collectors and factory management.

Table 19 – Artisanal Prawn Fishing and Collection – Key Findings

	Findings	Effect	Comments*
Fishing	No ice used by fisherfolk but some shading of the prawns before landing. Prawns kept at high ambient temperatures in canoes for several hours.	Onset of spoliage rapid with up to 20% of the prawns rejected by buyers.	Fisherfolk should be encouraged to use better evaporative cooling methods and possibly ice.
Collection	Prawns not washed or poorly washed before icing.	Maintenance of a potentially high bacterial load and hence acceleration of the spoilage rate.	Prawns should be washed in clean water before icing.
	Large chunks of block ice used for chilling.	Poor icing of prawns and mechanical damage causing general quality deterioration.	Better icing practice employed, possible use of block ice crushers.
	Prawn to ice ratio 3:1 to 5:1.	Ineffective chilling enhancing spoilage.	Use 1:1 prawn to ice ratio.
	Not enough ice available.	Rejection of good quality prawns during periods of high landings.	Make more ice available.
	Collection time:		
	2 days	8% of prawns sold for a reduced price to factory.	

Table 19 cont.

	Findings	Effect	Comments*
Factory	4 days	15% sold for a reduced price to factory.	
	4 days +	30% sold for a reduced price to factory.	
	General quality deterioration	1.5% of prawns totally rejected by factory.	
	Prawns downgraded – headed and frozen.	40% weight loss and a loss in value of 20%.	
	Prawns downgraded – peeled and frozen.	50–60% weight loss and a loss in value.	

* Basis for recommendations from the study.

Table 19 shows there is a relationship between the time spent collecting prawns and the proportion of prawns bought by the factory for a reduced price. It also highlights some of the handling practices that are contributing to poor quality prawns.

Example 2

In a second example, SSIs with traders and fisherfolk combined with observations have been used to show the reasons why fish is subjected to high ambient temperatures and hence why higher fish losses occur during the warmer months of the year (Box 12).

The reasons for loss may be linked to other variables such as the biological nature of the fish species. Exporters indicated that rejections vary according to fish species and the time of year. Seer fish, for example, are more prone to belly bursting, while smaller fish like pomfret are more prone to bruising and crushing (Digges and Clucas, 1995).

BOX 12

Case Study: Warm Weather Losses

The onset of organoleptic changes (gill colour) associated with spoilage is facilitated by the time the caught fish spends at high ambient temperatures. Fish caught early in gill nets (set at 6 pm (18.00 hours) for anything from 8 to 24 hours) will spend several hours after death in relatively warm water before being hauled into a canoe and then transported, possibly for several more hours without ice to the buyer. The buyer in turn may then spend a couple of hours deliberating before actually buying the fish. In the case of traders who air-freight frozen fish it can take anything from 5 to 16 hours between the time the fish has been caught until it enters a freezer. During this period the fish will be left at ambient temperatures. It is not surprising then that the warmer months of the year tend to be associated with higher levels of loss.

Perceptions

What people think about fish losses is one of the most important issues to be addressed in loss assessment studies if a real understanding of losses is to be established. If people are concerned about losses they are more likely to be interested in reducing them. In essence this involves asking people what they think.

One method of putting losses into perspective is to carry out a ranking exercise in which losses are ranked alongside other problems.

> "As for the perception of losses by fishermen and traders, most seemed to accept losses as a normal part of the business and work. Some of the more fatalistic described losses as Gods work".

Some Common Problems Associated With IFLA

This section highlights some problems with IFLAM.

- One of the reasons why it is open to criticism is that it is seen as being less scientific than formal approaches to data collection, especially since it lacks a statistical sampling component, although this problem is addressed by the trustworthiness criteria (see page 55).
- One of the main reasons for weak studies is the failure to address the objectives set during planning. Generally, if planning has been weak, or data collection during fieldwork has not been rigorous, then the results of a study will be weak, there will be gaps in the data, the study will be inconclusive, and at worst it will provide misleading information.
- The data collection tools may be used as a means to an end rather than to collect data that will fulfil the objectives of the study.
- The method is demanding in terms of commitment from the team. The quality of the study is just as much reliant on the commitment and human relationships within the team as it is on the application of good planning, and the tools and techniques of data collection.
- The checklist can be wrongly used as a questionnaire rather than as a guide. Similarly the checklist is sometimes used as a means to an end so topics that arise during an interview or study that are relevant, but because they are not on the checklist, are ignored.
- If probing is neglected the study will probably have gaps and be weak. Once a group or person starts to talk about an issue that is important to the study the issue should be thoroughly explored by probing.
- During analysis and report compilation, a lack of discussion between team members, will often lead to a weak report.

Other reasons why studies may produce poor quality results are:

- *an inadequate use of secondary sources of information*
- *too rigid a schedule for fieldwork*
- *poorly defined objectives*
- *the team did not understand the objectives*
- *bias has not been tackled well*
- *wrong team was used*
- *non-multi-disciplinary team used*
- *team members chosen had been involved in law enforcement and or revenue collection so people were suspicious of them*
- *the team was inadequately trained in the use of data collection tools and techniques*
- *conducting fieldwork too quickly*
- *lack of communication between the team members*
- *not interviewing a representative cross-section of people*
- *raising expectations and not explaining reasons for the study*
- *lack of interest in the work*
- *poor analysis of data*
- *having insufficient time for analysis of data and report writing.*

Chapter 3 *Load Tracking*

Introduction

This chapter describes how the Load Tracking (LT) Method can be used to obtain statistically valid and meaningful results for the assessment of loss between two stages in a distribution chain. Appropriate experimental designs and a number of realistic scenarios are considered. This requires the use of some statistical terminology, which is explained in a glossary of definitions in Appendix 3.

The biometric requirements for a successful LT are discussed, with particular reference to sampling, replication and design. Smaller LT experiments with limited replication can be used to obtain quick and rough estimates of loss and to give a quick indication of where the largest losses occur in a distribution chain and this can be a useful precursor to a full LT.

However, this type of empirical LT does not provide statistically valid results and is similar to the Informal Fish Loss Assessment Method (Chapter 2).

There are a number of types of loss and typical examples which might be recorded during LT are:

- *physical loss, defined as actual weight loss of fish*
- *increase in broken fish, measured by weight or count*
- *any continuous measurement that quantifies loss.*

LT gives the most accurate results when the data take one of the forms above. If scores, grades or ranks are used to quantify loss then it is more difficult to get a meaningful loss assessment. These discrete types of measurements are more appropriate for empirical LT, which is discussed in page 98.

The sampling necessary for LT is non-destructive and has a minimal impact on the distribution chain under investigation. Good co-operation between local communities and researchers will mean that researchers may be able to sell their fish at the end of a LT to recoup costs. If the local communities are well informed and supportive of the LT, it might not even be necessary for researchers to purchase the fish.

The key components of a LT exercise are shown in the following table.

Table 20 – Key Components of LT

Planning	objectives – a clear statement of the purpose of the experiment, assists all subsequent stages experimental design
Fieldwork	equipment – appropriate equipment should be identified as the fieldwork may take place in locations distant from the researchers base co-operation – LT is a field-based assessment technique and requires trust and assistance from the fisherfolk involved data recording – a vital part of LT, as poor data management can result in a wasted experiment
Reporting	data analysis – allow time for an accurate analysis of the data report writing – prompt writing up and appropriate dissemination is required

Pages 90–97 give a full report of an actual LT experiment to assess the losses incurred by transportation between two markets. This gives a good indication of how the stages shown in Table 20 are implemented in practice.

The remaining sections of this chapter give a detailed description of LT, divided into the following topics:

- *uses*
- *resources required*
- *planning*
- *case studies*
- *fieldwork*
- *reporting*
- *empirical LT*
- *problems.*

Uses

LT is used by researchers to assess post-harvest fish losses with communities and people working in small-scale and industrialized fisheries. Losses can be quantified at most parts of the processing or distribution chain and typical examples are:

- *losses incurred between hauling time and landing*
- *handling and packaging losses*
- *physical and quality loss during processing and transport.*

LT focuses on obtaining data that can:

- *assess how fish quality can change within a distribution chain*
- *identify why and where losses occur*
- *estimate the value of losses in monetary terms*
- *measure the effect of interventions to reduce losses.*

A successful LT experiment should:

- *use an appropriate measure for loss*
- *obtain good estimates of loss*
- *quantify the accuracy of the estimates*
- *give results that are valid for whole communities.*

Using LT can identify opportunities for loss reduction and be used to test the impact of any interventions. The data generated by LT can be used in the Predictive Loss Model, which is a Fish Loss Assessment and Control (FLAC) tool designed to model the effects of loss reduction interventions. LT can be used as a rapid way of troubleshooting for businesses that are having problems with poor quality raw material supplied externally or to analyse losses internally within a factory environment.

Resources Required

Before performing a LT experiment, the availability of resources should be considered, where 'resources' has a wider interpretation than financial restrictions. **If in doubt do not start a LT exercise with limited resources. Once started the experiment must be completed in as short a time as possible**. The equipment resources required for fieldwork are discussed on page 86.

The Team

The implementation of a LT experiment requires at least two field-based staff to undertake and co-ordinate the whole process. These staff would be expected to have a basic scientific training and key skills are:

- *good numeracy level*
- *good communication skills*
- *be able to co-operate with the relevant communities*
- *basic knowledge of experimental design*
- *implementation of random sampling*
- *be able to accurately read quantitative measurements, such as weights*
- *training in data management.*

In addition, the team could include members of the community or communities with which the loss assessment is to be conducted. The inclusion of such people in the assessment not only gives a sense of ownership of the research to communities, but it also encourages co-operation between the researchers and the community. This will improve the quality and efficiency of the research.

Biometric support

The successful outcome of LT depends on an appropriate design and a satisfactory level of replication. It is far more important to seek biometric assistance during the initial design stage than the final analysis and reporting process. This chapter attempts to give guidance on design replication and analysis, which should assist researchers in undertaking their own LT exercises. It is not possible to provide an entirely prescriptive guide, due to the large range of possible LT experiments.

If in doubt allow resources (time and consultancy fees) for biometric support.

Finance

This section on finance does not provide any specific cost figure but outlines the activities and costs which should be budgeted so that those intending to use LT can calculate their own costs. Typical expenditure associated with the use of LT will be:

- *buying fish (replication is discussed in the experimental design section)*
- *recruiting local key informants on a consultancy basis*
- *compensation for inconvenienced collaborating operators*
- *local labour*
- *packaging materials*
- *transport for fish*
- *transport and accommodation costs for research team*
- *scientific instruments (for e.g. weighing scales)*
- *stationery*
- *running training courses.*

Fee rates may or may not apply and will vary from country to country and different organizations. Training costs, if training is required, will depend on who conducts the training and where they travel from. The fieldwork cost will depend on the size of the team, how much travel will be involved and whether air travel will be necessary. It will also depend on the number of sites or communities to be involved and the length of time the team stays in the field. Accommodation costs will also vary from place to place.

During the analysis and reporting stage, general office facilities will be required, particularly the availability of computing facilities. Dissemination is an important part of LT and resources should be reserved for this also.

Training

The training needs should be assessed using the list of key skills described in the previous section. Even if suitably trained scientific staff are available it would be advisable to reinforce their knowledge with a short 1 or 2-day course on the specific skills necessary for LT. If the core team includes fishermen, processors or traders, representatives from NGOs and fisheries departments then a more general course would be appropriate.

The information in this chapter should provide the basis for a short training/orientation course. Nevertheless, it might also be appropriate for the team to discuss any outstanding issues with someone who has conducted loss assessments before. A list of resource organizations to contact is given as Appendix 2.

Planning

Two major areas, objectives and experimental design, have been highlighted as planning stages in Table 20. This section expands on these themes and although presented sequentially, they should be considered simultaneously as they are all inter-linked.

Objectives

In common with any experiment the first consideration should be a list of realistic objectives. These objectives do not need to be quoted as hypotheses and simple statements are perfectly acceptable. Typical objectives of LT experiments are:

- *what is the physical loss during packaging?*
- *how much quality loss is there during the smoking stage?*
- *what is the financial loss during the transport stage?*

Experimental Design

Although the stages in a LT experiment cannot be considered in isolation, the fact that a major purpose of LT is to obtain accurate loss assessments makes experimental design a key component. Although there are many different situations where LT is applicable the design, sampling and analysis approaches are similar. The main issues involved are described here and four possible load-tracking scenarios are considered.

Experimental Unit

In common with any experiment the first consideration should be the definition of the experimental unit. It would be unwise to use one fish as an experimental unit as any differences detected are likely to be caused by differences between the individual fish. For many load-tracking experiments a container of fish makes a natural choice for the experimental unit. However, there are situations where this is not feasible or practical and the experimental unit will consist of a randomly sampled group of fish. Each group should have at least 5 fish, to try and avoid the experiment measuring differences between fish.

LT records changes between two stages in the processing chain. In order to obtain valid estimates of the losses it is vital to use designs that track the experimental units through the processing chain. The most common designs incorporating this element are paired t-tests and the designs used for LT are based on this procedure. Rather than consider the theoretical implications of such designs, four case studies of LT designs are presented from page 78 onwards.

Random Sampling

The purpose of a designed experiment is to provide data suitable for statistical analysis from which information about a larger population can be inferred. This wider inference relies on the fact that the data have been obtained from random sampling. It is often necessary for practical reasons to use a two-stage sampling process with a systematic selection followed by random sampling. Common sense should prevail in the choice of a sampling scheme, as there is no definitive method.

Replication

The purpose of LT is to obtain an accurate estimate of losses. The precision of an experiment is governed by the amount of replication of the experimental unit. Although there is no prescriptive rule for determining the correct level of replication a number of guidelines can be given. The major issues are:

- *too little replication – poor precision, i.e. only large differences will be detected; it must also be considered whether a small number of replicates is representative*
- *too much replication – waste of resources.*

A sensible estimate for the amount of replication is design dependent and is shown in the four case studies later in the chapter.

Response

The response is the quantity measured by an experiment. Loss data is often quantified using scoring, which can give a good qualitative indication of the loss. However, for LT the most appropriate measurement is a non-subjective quantitative measurement, such as weight. This gives a more accurate estimate of loss, although it is often necessary to convert this loss to percentage or financial terms.

It is also important to record covariate variables which might affect the before and after differences, such as temperature. Ideally a researcher should stay with the sampled units throughout the experiment to record a full post-harvest history. This will strengthen the inference from the experiment, but for practical reasons it might be people working in the distribution chain who record the post-harvest history.

Checklist

During the design of a LT exercise, an experimental protocol can be built up, describing each feature of the design and how it will be applied in the field. This helps researchers to consider all features of the experiment and it can be used as a checklist in the field. Researchers should be prepared to make slight alterations in the protocol to take advantage of local field conditions, but these changes should always be recorded.

Analysis

Although analysis is listed in the final section of Table 20, it can be very useful to consider the mode of analysis during the design phase. The major tools in the analysis of LT experiments are:

- *initial data analysis and summary statistics*
- *graphical methods*
- *analysis of variance.*

These methods are available in a wide range of software packages, but some general guidelines for their use are given below.

(a) Initial data analysis and summary statistics

This is an area that is often overlooked, but a good initial data analysis can give a very good idea of the outcome of the experiment in terms that are easy to convey to non-specialists. The most common summary statistics are the mean and variance. However it should be recognized that these are not appropriate for skewed data. The median and quartiles give the best summary for skewed data. Summary statistics can be calculated by hand or calculator and do not necessarily require a computer.

(b) Graphical methods

The simplest method for visualizing the results of an experiment is a graphical presentation of tables of means and totals, where both bar and line graphs can be used. To examine the distribution of a response, a histogram (not the same as a bar graph) is the most appropriate graphical tool. Again graphical methods are easy to apply without computing facilities.

(c) Analysis of variance

If the techniques in the previous sections have been followed, the researchers should by now have a clear idea of the inference from the experiment. Formal statistical analysis is used to quantify this inference and at this stage the researchers might seek external help from a biometric/statistics department or scientists experienced in the analysis of LT experiments. Although most statistical testing is done at the 5% level, non-significance at this level does not necessarily imply that the differences are not important, as economic impact must be considered. For example, a loss caused during storage might not be significantly different from zero at the 5% level, but in terms of the incomes of local people this loss might be very important.

LT experiments are concerned with comparing before/after effects or control/intervention effects. For this type of data the most appropriate form of analysis is analysis of variance which tests the significance of differences between effects. However, there are three important assumptions that need to be satisfied before a response can be analysed using analysis of variance:

- *data should be continuous (weights for example)*
- *data should be normally distributed (measurements such as lengths or weights, not scores, ranks or counts)*
- *data should have constant variance (the variability over the range of measurements should be constant).*

A typical measurement from a LT experiment is weight of fish (note either total weight or mean weight of an experimental unit can be used), which will generally satisfy these three conditions. If loss is expressed as percentages, the constant variance assumption is not always satisfied and a transformation is often necessary. If scores are used to quantify loss, analysis of variance should not be used and numerical or non-parametric methods should be employed.

Suitable Statistical Packages

The initial data analysis and summary statistics can, if necessary, be performed without any assistance from statistical software. For the formal analysis, it is more convenient to use a statistical package. All packages have analysis of variance options and any of the following packages is adequate: mstat, cstat, systat, stat-graphics, SPSS, genstat, SAS, S-plus and minitab. Excel also has some statistical algorithms and a description of their effectiveness can be found in the *Biometric Guidelines* (University of Reading, 2000).

If in doubt get help from somebody with statistical knowledge.

Reporting Statistical Results

Initial data analysis and summary statistics can be included in the main text of the report as they give a good interpretation of the results, without using complicated statistical terminology. Generally the analysis of variance tables are not included in the main report. They can either be left out of the report completely or relegated to an appendix.

The results of a paired t-test or an analysis of variance are often quoted as 'at the 5% level there is a significant difference'. It is more informative if a confidence interval for the difference between the means is quoted. For example, the statement 'the mean difference of 0.4 kg was significant at the 5% level', could more informatively be written as 'a 95% confidence interval for the mean difference was 0.25 kg to 0.55 kg', (where the interval is calculated using the estimate of the variance). The most common approach is to express significant differences in terms of confidence intervals. The theory and method for calculating such intervals can be found in most elementary text books or help screens from software packages.

The data from most LT experiments are concise enough to report in full in an appendix. This allows readers the opportunity to do additional analysis and preserves the data sets for future reference. Table 21 gives an example of how the results might be presented.

Table 21 – Data from Loss Assessment LT of Smoked Dried Fish

	Before (weight in kg)			After (weight in kg)		
Container	**Weight of container + fish**	**Weight of container**	**Weight of broken fish**	**Weight of container + fish**	**Weight of container**	**Weight of broken fish**
1	12.05	1.15	0.6	11.15	1.2	0.95
2	12.5	1.2	0.65	11.55	1.4	0.75
3	12	1.25	0.6	11	1.4	1
4	12.25	1.3	0.45	11.35	1.2	0.9
5	12.7	1.2	1	12	1.3	1
6	12.15	1.2	0.8	11.5	1.35	0.65
7	10.9	1.15	1	10.1	1.2	0.9
8	11.65	1.45	0.4	10.75	1.5	0.8
9	11.9	1.25	0.95	11.2	1.3	1.05
10	12.65	1.2	0.9	11.55	1.25	0.7

Note how the measurements have been taken to the nearest 50 g representing the accuracy of the dial scale.

Case Studies

The previous sections have given a general introduction to experimental design and analysis. This section considers four case studies to demonstrate how the abstract ideas discussed can be applied to LT problems. There are many possible scenarios for LT and no guide can cover all eventualities. The case studies were selected to cover a wide range of experiments and address the major issues, which are likely to occur in reality.

A key feature of these case studies is determining an appropriate level of replication. This involves some statistical design theory based on calculating degrees of freedom for various analysis of variance structures. Case studies 1 and 4 are basic load-tracking experiments and only limited statistical knowledge is required to follow the procedures. Studies 2 and 3 introduce more complex ideas and require a more in-depth understanding of design issues.

Basic design issues are dealt with in Mead and Curnow (1983), with the more complex ideas required for case studies 2 and 3 covered in Clarke and Kempson (1997) and Mead (1988). A glossary of common design and analysis terms is given in Appendix 3.

Case Study 1 – Before/After Loss Assessment Using Whole Containers

The natural experimental unit for LT is a container of fish. This section considers experiments where this is practical, i.e. for the smaller types of containers. A subsequent case study considers a sub-sampling approach when the use of whole containers is not possible.

(a) Design

An easy way of thinking about experimental design is to think in terms of the structure of the analysis of variance table, i.e. the source of variation and the degrees of freedom. The precision of the experiment is determined by the degrees of freedom of the residual. A general rule is to try and keep the residual degrees of freedom in double figures.

TIP 18

Keep the residual degrees of freedom in double figures.

The analysis of variance removes the effect of the different containers and the containers can be thought of as blocks. The degrees of freedom for containers is one less than the number of containers. The before/after comparison has two levels and one degree of freedom.

The total number of degrees of freedom is the number of data points – 1, which in this case is 2 * (number of containers) –1.

The degrees of freedom for the residual can now be calculated by subtracting the containers and before/after degrees of freedom, from the total degrees of freedom. Different numbers of containers can be tried until the residual degrees of freedom are at least 10.

Table 22 shows the skeleton analysis of variance with 10 containers, giving 10 degrees of freedom for the residual. **Note the degrees of freedom for the residual cannot be calculated directly from the number of containers; 10 containers giving 10 degrees of freedom for the residual as in this case is not a general result.**

Table 22 – Skeleton Analysis of Variance

Source of Variation	Degrees of Freedom	Description
Containers (blocks)	9	Number of containers – 1
Before/After	1	Number of levels – 1
Residual	10	Calculated as total degrees of freedom – (containers + before/after) degrees of freedom
Total	19	Number of data points – 1

The 10 degrees of freedom for the residual gives a compromise between precision and resources, but this amount of replication should be thought of as a minimum. A good guideline is to design experiments with residual degrees of freedom between 10 and 20. Experiments with less than 10 degrees of freedom will have low precision and those with higher than 20 will waste resources.

(b) Sampling

It is often difficult to randomly select the fish for loading in the containers and some systematic selection is often inevitable. However, it is important to load the containers randomly, sticking as closely as possible to 'normal practice'. Extremes such as filling the last container with all the broken pieces of smoked fish left over should be avoided, but otherwise any common sense approach is adequate.

The containers can now be used for a number of LT experiments. They might be loaded on to a lorry or put in storage, but whatever process is being investigated they must be located randomly. It might be appropriate to use a systematic/random approach here. For example, containers could be systematically assigned to areas of a store (east/west) and within each area randomly located.

(c) Analysis

The data is analysed using a one-way analysis of variance where containers are the blocking factor and before/after is the treatment. The significance of the difference between before and after weights can then be read from the analysis of variance output. If the difference is significant it is much more meaningful to quote a confidence interval for the difference between the before and after weights. Many statistical packages (for example, instat, genstat, SPSS, minitab, SAS) will output this, but it is easily calculated by hand and the algorithm is given in Mead, Curnow and Hastead (1983).

The analysis in Table 22 is identical to a **paired** t-test. Note a standard t-test is not appropriate as it ignores the fact that the before and after measurements were made on the same container.

An alternative analysis is to consider the percentage weight loss in each container and test whether this is significantly different from zero. The fact that the data are in the form of percentages and the possible covariate effect of the weight of containers should be considered.

(d) Example

A complete description of an actual LT exercise based on the design outlined in this case study is given in an example report beginning on page 90. The LT used 10 containers of smoked fish to investigate the losses caused by transport between a rural wholesale market and a distant urban retail market. The report describes all aspects of the design and execution of the LT, followed by a detailed analysis and interpretation of the losses.

Case Study 2 – Before/After Loss Assessment from Sub-sampling Containers

Although the experiment in the previous section is ideal, it might not always be possible to have access to enough containers to make the experiment worthwhile. For example, it might only be possible to get enough fish for three large containers.

(a) Design

This experiment depends on obtaining the experimental units by sub-sampling a small number of containers. The first design issue is to prescribe the minimum number of containers. If only one container is used, it may not be representative of the larger population of fish. Also one container may be subjected to unusual conditions on the load-tracked transport or storage. A sensible minimum for the number of containers is 3.

From each of these containers it is now necessary to sub-sample the experimental units. This is a form of pseudo-replication, but if the fish is randomly selected and the containers randomly loaded it is acceptable. As already described it is necessary to have at least five fish in each experimental unit. Each container should contain the same number of experimental units to avoid imbalance in the design.

Exactly the same method as in the previous section can be used to decide how many experimental units should be sampled from each container, except that the sub-sample within container effect should be considered.

Table 23 shows the skeleton analysis of variance for 3 containers with 4 sub-samples from each container, giving 12 before and 12 after measurements. The third column of Table 23 shows how the degrees of freedom are calculated and the usual method of subtraction is used to calculate the residual degrees of freedom.

Table 23 – Skeleton Analysis of Variance

Source of Variation	Degrees of Freedom	Description
Containers (blocks)	2	Number of containers – 1
Experimental Unit Within Container	9	Number of levels – 1 * (Number of experimental units in each container – 1)
Before/After	1	Number of levels – 1
Residual	11	Calculated as total – (2 + 9 + 1) degrees of freedom
Total	23	Number of data points – 1

This gives an acceptable number of degrees of freedom for the residual. The sub-sampling design is physically more difficult to carry out and the sampling procedure is considered in the next section.

(b) Sampling

For this design each container must contain four experimental units. Since the same experimental unit must be measured at the beginning and the end of the experiment it is necessary to tag the fish in each experimental unit. Each fish in the experimental unit must be tagged and the tag should record group membership. The choice of tag material is important and masking tape has been found to be appropriate as it has negligible weight, does not affect breakage/loss and can be written on.

TIP 19 *Masking tape is a good material for tagging samples.*

It is probably more convenient to select the fish for tagging at the same time as loading the containers. The fish should be selected randomly, tagged and then four experimental units stored in each of the three containers. The experimental unit of five fish should not be tied together, but randomly distributed in the container. The selection, tagging and assignment to container are an important aspect of the experiment and should be planned with care prior to the experiment.

(c) Analysis

The analysis is very similar to that of case study 1, except that the sub-sampling within container should be modelled as in Table 23. One further issue that might be of interest in this case is the estimate of the variability of the experimental unit within container. This can be estimated using the mean square of the experimental unit within container effect as demonstrated in Clarke and Kempson (1997).

Case Study 3 – Intervention LT

The results of a LT experiment or an IFLA might suggest an intervention for reducing loss and/or breakage. The experiment differs from the previous loss assessments, as there is now a treatment. This section assumes that whole containers have been used as the experimental unit. Intervention experiments with sub-sampling are possible, but they are unlikely to represent actual practice and will not be considered.

(a) Design

The design of the experiment must consider that the before and after measurements are taken within treatment for each container, which gives a design with two levels of variation. This must be acknowledged in the design and analysis and can be thought of as a split-plot type approach, with containers as blocks, control/intervention as the main plot treatment and before/after as the split-plot treatment. Because of the two levels of variation, split-plot designs are more complicated, but a good description can be found in Mead (1988). The objective of the experiment is to compare the losses for the control and the intervention. This is tested by the interaction effect in the split-level of the analysis of variance and consequently it is the residual degrees of freedom in the split level that are important.

The calculation of the skeleton analysis of variance table is more difficult, but the process is identical to the previous experiments. The experimental design should use the same number of containers for the control (standard practice) and the intervention, with before and after measurements made on each container. The blocking unit in this case is pairs of containers, one intervention and one control. These blocking units should be randomly arranged on the load-tracked transport or perhaps using a systematic/random approach.

Table 24 shows the skeleton analysis of variance for 8 control containers (normal practice) and 8 containers with the intervention, with the blocking unit as pairs of control and intervention. The third column again shows how the degrees of freedom were calculated.

Table 24 – Skeleton Split-plot Analysis

Source of Variation	Degrees of Freedom	Description
Pairs (blocks)	7	Number of pairs – 1
Control vs. Intervention	1	Number of treatments – 1
Main Plot Residual	7	(Number of pairs * 2 – 1) - (1 + 7)
Before vs. After	1	Number of levels – 1
Interaction	1	(Number of treatments – 1) *(Number of levels – 1)
Split-plot Residual	14	Total - (7 + 1 + 7 + 1 + 1)
Total	31	Number of pairs * Number of treats * Number of levels – 1

The split-plot residual has 14 degrees of freedom, which gives adequate precision for assessing the interaction effect. Note the main plot residual is only 7, but the control vs. intervention effect in the main plot is averaged over time and has no relevant interpretation in this experiment.

(b) Sampling

The most important sampling issue in this experiment is the filling of the containers. If all the intervention containers are filled first and then all the control containers, the results of the analysis are likely to be biased. If the containers are filled in random order an unfortunate ordering could occur again, leading to bias. The most appropriate procedure in this case is to consider a systematic alternate filling of control and intervention container.

(c) Analysis

The data is analysed as a split-plot, with the same structure as Table 24. If the interaction is significant the best way of illustrating this is to give a two-way table of means and also plot the mean values for control and intervention at before and after on the same figure as shown in Figure 6.

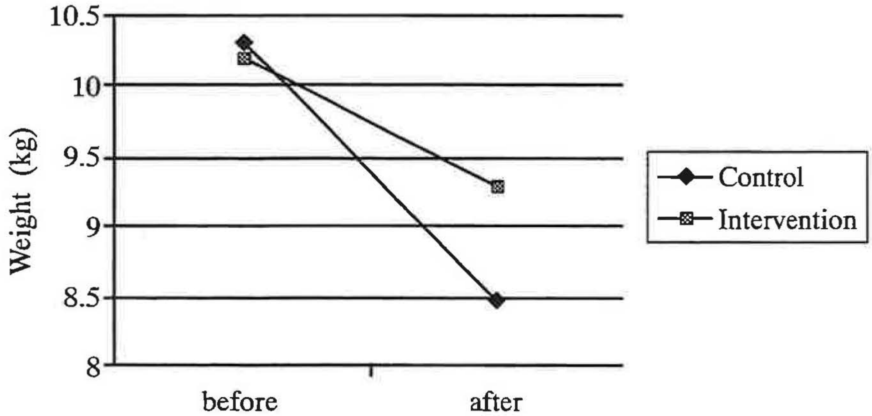

Figure 6 Representation of interaction.

This shows a much larger weight loss for the control and the interaction was significant.

If in doubt obtain biometric help with the design and analysis of experiments of this type.

(d) Example

The LT experiment given later in the chapter as an example report shows that the transport between two markets, plus the packing and unpacking, caused a significant amount of physical loss and an increase in the amount of broken fish (although not significant). The physical loss could have been caused by pieces of fish falling from the containers. An appropriate intervention was the lining of the cartons with plastic sacks, which could also help reduce breakage.

Using the design from this case study enough fish to fill 16 containers was purchased. Eight containers were lined with plastic sacks and the remaining containers served as a control. To ensure that control and intervention containers were subjected to similar conditions during the journey between markets, the containers were arranged as eight pairs. Each pair consisting of one control and one intervention container.

The pairs were systematically assigned to separate levels in the lorry, but within each level a pair was randomly located. This reduces the chance of bias, which might be caused by locating all experimental containers in a localized area on the lorry. The containers were loaded in the usual manner with minimum input from the researchers.

Case Study 4 – LT Assessment of Losses after Processing

This LT considers post-processing loss assessment. The case study considers a specific example to quantify losses that occur during the transport and storage of fish to market immediately after smoking. The design can be modified for other types of post-processing activity such as salting.

(a) Design

Loss caused by storage and transport to market after smoking can be assessed using a sub-sampling design. Ideally a smoking kiln (or any convenient unit in a processing operation) would be the experimental unit, however in most cases this is impractical and an alternative approach is required.

This design considers the situation when there is only one kiln. The idea of the design is very similar to the experiment in case study 2, with sub-samples from the kiln being used as experimental units. If only one kiln is used for the experiment it should be considered whether it is representative of a typical smoking process.

At least 10 experimental units should be randomly sampled from the kiln with at least five fish in each experimental unit. The experimental units then provide the replication to compare the before and after losses. Table 25 shows the analysis of variance for 12 experimental units, which is identical in form to the analysis used in case study 1.

Table 25 – Skeleton Analysis of Variance

Source of Variation	Degrees of Freedom	Description
Experimental Units	11	Number of experimental units – 1
Before/After	1	Number of levels – 1
Residual	11	Calculated as total – (experimental units + before/after) degrees of freedom
Total	23	Number of data points – 1

With this design there are 11 degrees of freedom for the residual which should ensure adequate precision.

(b) Sampling

The most difficult feature of this experiment is the random sampling from the surface of the smoking kiln. One simple method is to divide the surface up into at least five approximately equal regions. This can be achieved by laying sticks across the kiln or using some other convenient marker. One fish can now be randomly sampled from each rectangle and these five fish now form an experimental unit. This would be repeated at least 10 times to give 10 experimental units each of which are representative of the fish in the smoking kiln. As in the sub-sampling experiment in case study 2, the fish in each experimental unit would be tagged and then processed in the normal manner.

(c) Analysis

The analysis is straightforward and is carried out using the analysis of variance approach of Table 25, exactly as described in case study 1.

Summary of Case Studies

Four types of load-tracking experiments have been described. The designs are all based on taking before and after measurements on an experimental unit to assess loss. A number of sampling issues have been raised and similar techniques are likely to be applicable to any modification of the ideas given here. Formal analysis is based on the analysis of variance, although much can be achieved using summary statistics and graphical techniques.

Many of the design, sampling and analysis issues raised here are described in more detail in a set of guides produced by the University of Reading and freely available on the internet or as hard copy.

Fieldwork

Some fieldwork issues have been considered in the case studies and it is clear that an appropriate application of the design is vital. Table 26 shows an example itinerary for a LT experiment, which measured physical loss of smoked fish and the increase in the amount of broken and downgraded fish.

Table 26 – Itinerary for LT Experiment

Date	Activity	Time	Duration
15/03/00	smoked fish bought	9.00	45 minutes
	mixing and packing	9.45	15 minutes
	containers unpacked and fish graded into broken and unbroken, loss measured	10.30	1 hour 15 minutes
	containers repacked		
	containers stored	11.45–18.00	6 hours 15 minutes
	loading on to lorry	18.00	
	containers left on lorry	42 hours	
17/03/00	containers arranged on lorry	12.00	8 hrs
	lorry leaves for market	Approx. 20.00	Approx. 24 hours
18/03/00	lorry arrives in market containers left on lorry	21.00	 13 hours
19/03/00	containers unloaded	10.00	
	fish unpacked and loss measured containers repacked and sold	11.00	1hour

Equipment

As at least part of the LT experiment may take place at locations remote from the research station it is important to think about what equipment will be required. Although LT is not heavily dependent on field equipment the following might prove useful:

- *weighing scales*
- *calibration weight*
- *3 x 3 m tarpaulin to place on ground when sorting fish*
- *marker pens*
- *pen and paper*
- *watch*
- *tagging material*
- *torch*
- *knife/scissors*
- *clipboard.*

Co-operation

Previous experience has shown that the most successful instances of LT have been where the researchers have good co-operation with the local community. There are numerous mechanisms for achieving this, such as:

- *using PRA techniques to include local people*
- *selecting key informants to report back to the community*
- *including local extension workers in the research team.*

PRA Skills Needed for Conducting Successful LT

The aim of LT is to observe a sample of fish as it moves through a distribution chain, with minimal disruption to 'normal' practice and this requires the co-operation of members of the local community.

Researchers need to have access to experimental units (i.e. the sample of fish) while they are being subjected to the usual handling, storage and transportation conditions. It is very important that the fisheries operators who handle the fish understand that they must treat the fish in the standard way. Furthermore, substantial financial savings can be made if the fish do not have to be purchased. This opportunity will only arise if there is good co-operation between the relevant local people and the research team.

In common with PRA surveys, co-operation and participation of key personnel can be improved by building relationships with the fisheries operators before the LT experiment.

TIP 20

Several casual visits of the researchers to key fisheries operators before the LT can form a good basis for a successful partnership.

In order to promote the co-operation of artisanal fisheries operators, a researcher would have to be knowledgeable and experienced in the following PRA skills.

- Communication and interpersonal skills – researchers must have open and clear discussions of their objectives and the modalities of the LT with the relevant local personnel. Researchers need to imbue a feeling of trust within the local community.
- Appropriate behaviour – the researchers must be polite and respectful and be willing to acknowledge the importance of local participation, without which the information being sought might be impossible or difficult to obtain.
- Confidentiality – assurances should be given that information artisanal fisheries operators make accessible will not be used against them, particularly for tax collection purposes.
- Sensitivity – researchers should be able to detect and avoid sensitive situations, which may undermine trust.
- Solidarity – the researchers should be willing / ready to accompany loads of fish products in the same conditions as operators themselves face.

Data Recording

The data for LT experiments often have to be recorded in the field under difficult conditions. It would not be appropriate to record the data electronically in this environment, but data sheets could be prepared and the results entered by hand in the field. Copies should immediately be made and checked by another member of the research team. An example prepared for an experiment with 12 containers is shown in Figure 7, where it was necessary to find the weight of fish in each container.

TIP 21 *Practically it is much easier to weigh the empty containers before filling them with fish and then weigh the full containers after filling and subtract the container weight to obtain the weight of the fish.*

Note there is no column for calculating weight of fish – derived calculations should **not be done in the field.** Once the fieldwork is completed the data can be transferred to an electronic form (Excel, for example) where the weight of fish can be calculated. The accuracy of the data recording should also be assessed. For example, with an analogue weighing scale, measurements are only likely to be accurate to between the nearest 100 g and 10 g. Consequently it would be sensible to round all weight in kg to 1 decimal place. Quoting results to more decimal places than the experimental accuracy is meaningless.

Before Storage Data Sheet : Date........... Time .... Units.....		
Container	Weight of container	Weight of container + fish
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Comments:		
Data entry by:		

Figure 7 Data entry sheet for fieldwork.

Reporting

The research should be written up as soon as possible using the template shown in this section. Even if the researchers do not perform the data analysis the report writing should not be delayed, as empirical inference can be drawn by an initial data analysis.

LT Report Template

Reporting or writing up a LT experiment should be done so that the reader will have a full understanding of the experiment. The reader should not be left in any doubt as to what was done and what the results and conclusions of the work are. Readers should be given enough detail so that they can themselves repeat the experiment or undertake similar studies. The following template has been produced, derived from completed studies and should enable the writer to produce a thorough and clear report. The use of such a template will also assist in standardizing the reporting of LT experiments and loss data produced by such studies. Comparison of data for different products or geographical locations and areas would then be more feasible.

Table 27 summarizes the key points required for a successful write-up and the following section contains an example of an actual report of a LT experiment, with the names of markets and specific local details removed. In addition to the full report there is a secondary summary, which was used to inform local traders of the results of the study.

Table 27 – Template for Reporting LT Experiments

Summary (1 side of A4)	describe losses quantified brief description of the experiment type of statistical analysis used key results table and a description key conclusions
Introduction	objective losses measured distribution chain or stage of the chain under study who undertook the work number of days, date and itinerary
Method	description of the design and sampling method fish species, product, quality and price information where was the fish from, was it purchased and if so how – was it done randomly? quality assessment method used and who assessed the quality type of loss measured – physical, quality description of the activities table giving timetable of key activities weights and measurements taken statistical methods used
Results Analysis	graphical presentation of results formal analysis of results and presentation of confidence intervals examination of relationships between response variables qualitative results/observations primary stakeholder perceptions researchers observations level of participation of primary stakeholders effects of any important observations from post-harvest history
Conclusions	were post-harvest losses recorded? if so, at what stages? describe each loss giving the type and level and whether the number of samples was appropriate was the loss significant? where appropriate give confidence intervals for the losses

continued overleaf

Table 27 cont.

	describe the possible reasons for the loss describe any trends, relationships or observations describe whether the experiment was successful describe any problems or adjustments that could be made to the method as a result of the experiment

Example of LT report

Use of LT to obtain statistically valid data for the assessment of post-harvest fish losses: a case study of the transport of smoked fish.

Summary

An LT experiment was undertaken to quantify the losses during loading, unloading and transport of smoked fish from a remote wholesale market to a large urban retail market. Two types of loss were considered: actual loss (physical loss) and the increase in weight of broken pieces (quality loss). Replicate measurements were taken to allow an assessment of the accuracy of the loss estimates. Paired t-tests were used to assess whether the losses were significantly different from zero, at the 5% level.

The fish were purchased at a wholesale market, then sorted before being packed into 10 containers. The LT exercise followed these 10 containers from packing and loading in the wholesale market to off-loading in the urban retail market. The losses recorded at each stage are described in Table 28.

Table 28 – Losses Recorded at each Stage of Transport from Remote Market to Urban Market

Key Results	Estimate	95% Confidence Interval	Comment
Broken fish sorted out before start of LT	3%+	-	Accuracy cannot be quantified because there is no replication for this measurement
Broken fish after packing	6.8%*	5.3% to 8.3%	At the 5% level the loss was significant
Increase in weight of broken pieces as a result of loading, unloading and transport	1.2%*	-0.4% to 2.9%	At the 5% level the increase in weight of broken pieces was not significant; some containers showed a decrease in the weight of broken pieces
Decrease in overall weight of fish due to loading, unloading and transport	8.3%*	7.4% to 9.2%	At the 5% level the loss was significant. Every container showed a weight decrease. Weight loss could be due to evaporation of water from fish, fragments falling from container, loss of oil from fish, loss of fragments during re-weighing, insect infestation.

+ expressed as % total of all the fish. * expressed as % of average weight of fish per container.

Regression techniques were used to show that as the weight of the fish in a container increased there was a tendency for the weight of broken fish to decrease. Results also showed that by the end of the exercise the containers were heavier than they were at the beginning. This was very small relative to the weight loss of the fish. It may have been caused by oil (fish) and water uptake by the packaging material.

1 Introduction

An LT exercise was conducted to assess the feasibility of combining the principle of LT with statistically valid data collection and tests. The LT experiment used paired samples to evaluate the effect of loading and transport on fish losses.

The loss of smoked fish due to loading, unloading and long-distance transport by lorry between two markets was assessed. Data were also collected on the quantity of broken fish prior to loading.

The exercise was planned and implemented by a team of researchers from a national fisheries research office.

The exercise took 7 days to complete in March 2000, which included the travel time of the research team. An itinerary of the exercise is given in the *Report Appendix*.

2 Method

The LT experiment used paired samples to evaluate the effect of loading and transport on fish losses. The use of paired samples is important for valid comparison of data of this type where there is a before and after measurement within each container. A sample size of 10 containers of smoked fish was chosen to give a compromise between precision and cost. Ten containers gives 9 degrees of freedom for the variance estimate, which should be viewed as a minimum for this type of experiment.

Ten containers of medium-sized smoked *Clarias gariepinus* were purchased from wholesale traders. There were many traders from whom fish could have been bought, but two were chosen because they offered a reasonable price.

Three grades of whole smoked fish are sold in the market. Grade 1 being the best quality and most expensive, grade 2 the medium priced of average quality and grade 3 the poorest quality and lowest price. The quality of fish purchased was assessed by local fisheries staff, who graded it by eye; colour and shine being the two most important criteria used by traders for grading smoked fish quality. The quality of the fish (grade 2) used was later confirmed by a trader at the retail market. Grade 2 medium-sized fish was chosen for this exercise, because it was assumed to be the most commonly available product and, therefore, the most representative.

The purpose of the LT experiment was to measure the losses due to loading, transport and unloading, but no effort was made to differentiate between the three.

Two categories of loss were considered, physical and quality loss. A previous PRA found that there was little physical loss due to all the fish being utilized. The LT experiment concentrated on the quality loss and this was quantified by dividing the fish into whole and broken categories. The categorization was performed by the traders themselves and although different traders were used in each market there appeared to be consistency in their choices.

A secondary exercise measured the loss between purchasing and packing, before the LT experiment began.

The fish were heaped on to a tarpaulin laid on the ground before being sorted and packed into 10 cardboard containers. The containers are made in the market and are one of several different container types used by traders. After filling, the containers were tied with rope. A marker pen was used to number the containers from 1 to 10. The name of the receiving trader at the retail market was written on each container along with the name of one of the research team. Broken pieces were graded out as part of the packing exercise. The broken pieces are either given to the packers as payment or are sold by the owner of the fish. It is used for either human consumption or for poultry feed and is sold for a lower price than whole fish.

Up to this stage, traditional practices had been followed. Normally, the next stage would be to either store the packed containers or to load them on to a lorry for onward transport to various destinations. However, for the LT exercise the containers were carefully unpacked and the weight of the container, the fish and the proportion of broken fish were measured using a dial weighing scale. The fish, including the broken pieces, was repacked and the containers stored.

The containers were loaded onto a DAF lorry, with a capacity of 9 tonnes. Loading consisted of rolling the containers on to the back of the lorry. One man would then stack the containers by stepping on already stacked containers. Some containers were jumped or stamped on to level a row. The containers were positioned at five different levels on the lorry. Two containers were placed at each level. The levels and the positions of the containers within each level were randomly selected. Any sampling scheme with a systematic allocation of containers is acceptable as long as there is some random placing of containers within levels.

The lorry was eventually packed with 374 containers, which constituted a half load. It left 2 days after loading and the journey to the retail market took 27 hours and the containers were unloaded 13 hours after arrival. Market workers unloaded the containers at the distant retail market. This was done relatively carefully, containers were not thrown or dropped, although stepping on containers to reach those stacked high up was unavoidable. Containers for traders were transferred to waiting vehicles. The 10 marked containers were placed to one side.

The weight of each container and its contents were recorded. With the help of a trader the containers were emptied on to a plastic sheet laid on the ground. The empty container was then weighed. The broken and whole fish were separated by the trader and his colleague. The weight of broken fish from each container was recorded. The containers were repacked and sold.

Paired t-tests were used to test the significance of before and after weight differences. All the data were in the form of weights and it is reasonable to assume that they could have been sampled from a normal distribution, thus justifying the use of a t-test. The variances of the before and after weight differences were also close enough to satisfy the constant variance assumption necessary for a t-test. If the weight losses are quoted as percentages, the normality and constant variance assumptions of the t-test may not be satisfied and a non-parametric test might be more appropriate. Mean values have been quoted to one decimal place as it would be difficult to justify more accuracy with the weighing scale that was used for the experiment.

The data from the 10 containers can also be used to provide some information on weight loss trends. Data were also collected from informal interviews with traders and workers at each market. Observations were made by the research team on marketing activities. These provided an understanding of where and why losses might be occurring.

3 *Results and analysis*

The analysis concentrates on overall weight loss of fish and the changes in weight of the broken pieces. It was recorded that 3% of the fish was broken and separated out before packing the containers. Observations suggest that some broken fish was also packed with whole fish. After packing, a container contained an average of 6.8% of broken fish with a 95% confidence interval of (5.3% to 8.3%).

3.1 *Weight loss of smoked fish*

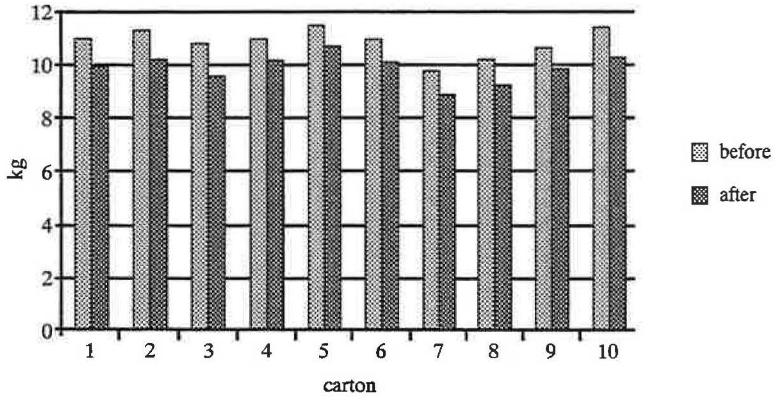

Figure 8 Before/after comparison.

Figure 8 compares the weight of fish in each container before and after the journey. There is a consistent weight loss in all containers, with an average weight loss of 0.9 kg (rounded to one decimal place). A paired t-test shows that the weight loss is highly significant with a *p*-value of less than 0.001. A 95% confidence interval for the weight loss is (0.8 – 1.0) kg which in terms of percentage of the initial weight of fish is (7.4 to 9.2)%. Note that the % loss has been calculated by dividing the actual losses by the average initial weight of the containers. This is more appropriate for a paired t-test than working with the % losses of each container, although the two approaches give similar values.

High ambient temperatures during the experiment may have caused evaporation of moisture from the fish. Fragments of fish may also have been lost from the container during loading, unloading and transport. Fragments were lost during re-weighing, but every effort was made to try and minimize this. Weight loss may also have been due to loss of oil and insect infestation.

3.2 *Container weight gain*

Some of the weight loss is explained by an actual gain in the weight of the containers, which is probably caused by oil absorbed from the fish into the cardboard packing material. Weight gain may also be due to the container absorbing water which has evaporated from the fish. Figure 9 compares the before and after weights of the containers.

The loss for container 4 may be explained by loss of packaging material during the journey, but amongst the other containers there is a definite trend of increased container weight. There is a significant (*p*-value = 0.018) increase in weight of container, but with a 95% confidence interval of (0 – 0.1) kg, it is unlikely to have any economic importance.

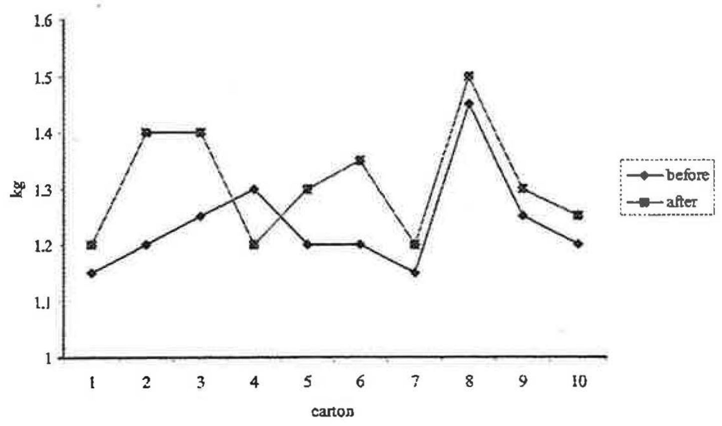

Figure 9 Before and after weight of containers.

3.3 Broken fish changes

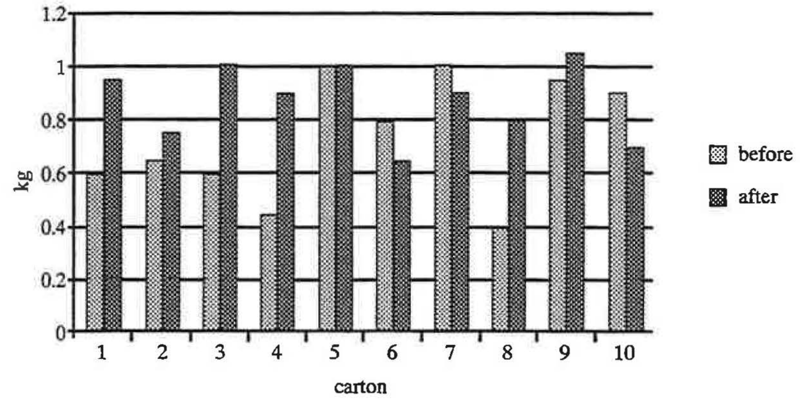

Figure 10 Before/after comparison of broken fish.

Figure 10 compares the weight of broken fish before and after the journey, with containers 1, 2, 3, 4, 8 and 9 showing an increase in broken pieces.

There is an average increase in the weight of broken pieces of 0.1 kg, but this is not a significant increase at the 5% level, having a p-value of 0.12. Expressed as a percentage of the initial weight of fish, the mean increase in broken fish is 1.2% of the initial weight of the fish and an approximate 95% confidence interval for the increase is –0.4% to 2.9%. There is no significant difference between before and after broken fish weight and consequently the confidence interval contains zero. A negative increase actually represents a decrease in the weight of broken fish.

3.4 Relationship between initial weight of fish in a container and loss

Figure 11 plots weight of fish before the journey against the weight increase in broken pieces and there is a trend for lighter containers to have more breakages, but the trend is not strong enough to give significance at the 5% level. Container 7 appears to be an outlier on this graph and despite having a low weight it actually showed a decrease in the weight of broken pieces. This could have been caused by an unusually large amount of fragmented pieces falling from the container. Dropping this container from the data set gives a much stronger trend, with a p-value of 0.07 and Figure 12 shows the fitted model.

There was no indication of trend for the actual weight losses recorded in Figure 8 against the weight of fish before the journey.

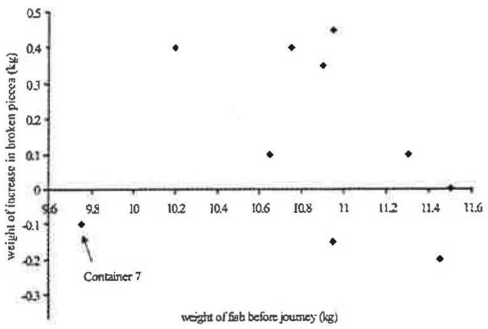

Figure 11 Plot of weight increase in broken pieces vs. weight of fish.

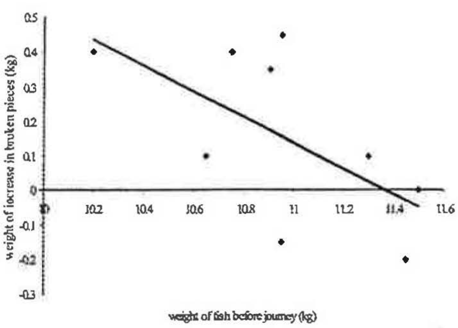

Figure 12 Fitted model for relationship between breakage and initial weight.

Traders were of the opinion that fully packed containers of smoked fish, such as those used for this exercise, will contain fewer broken pieces after transport. Loosely packed containers are also used by traders. An informal interview with a trader during the re-weighing revealed that traders are aware that breakage during transport can be reduced by the following:

- *fully loading the lorry to reduce general movement of containers*
- *arranging containers on the lorry in a certain way*
- *a driver who brakes carefully and avoids potholes.*

The smoked fish used during the exercise was infested with the larvae and adults of *Dermestes* spp. The level of infestation was not determined, but appeared low.

Some traders and workers were actively involved in the LT exercise. In return an appropriate payment was made in the form of cash and soft drinks. At the wholesale market they helped in buying the fish, sorting, packing, assessing the quality, storing and loading it into the lorry as well as arranging packaging materials and transport. The trader who received the fish at the retail market on the team's behalf was actively involved in the quality assessment, re-weighing of unpacked fish and re-packing.

The weighing and re-weighing exercises were carried out in the marketplace which meant that traders and workers could easily be involved. Others in the market could also observe the work and there was an element of dissemination involved in this public execution of the experiment.

4 Conclusion

Post-harvest losses were recorded at the sorting and packing stages and also during loading, transport and unloading.

At sorting, approximately 3% of fish were downgraded (quality loss) and given to workers. Observations suggested that some broken fish were also packed with whole fish. After packing, a container contained on average 6.8% of broken fish, a 95% confidence interval being 5.3 to 8.3 %. This interval is precise enough to justify using the minimum of 10 containers.

The total amount of broken fish (quality loss) that was recorded at sorting and after packing is 3% plus 6.8% (mean of broken pieces per container) which is 9.8%. However, the precision of the 3% loss at sorting cannot be calculated because there is no replication for this measurement.

Two types of losses as a result of loading, transport and unloading have been recorded:

- *actual loss from a container (physical loss)*
- *increase in weight of broken pieces (quality loss).*

The actual loss of 8.3% (95% confidence interval is 7.4% to 9.2%) is highly significant. This suggests that loading and transport cause significant actual loss in weight. This may be due to:

- *fragmented fish falling out of the box*
- *evaporation of water from fish*
- *loss of oil*
- *loss of fragments during re-weighing*
- *insect infestation.*

Loss due to evaporation and oil loss may have been brought about as a result of the containers remaining on the lorry under hot conditions for a prolonged period. Further research is required to verify this assumption. An experiment in which the container is lined with polythene to prevent moisture loss and loss of broken pieces could be used, although, this would not differentiate between the effect of evaporation and loss of fragments. The use of netting instead may enable loss of fragments to be measured. However, weight loss, if it is due to evaporation and loss of oil, may not be economically significant as fish is not sold by weight, but by volume.

The mean increase in broken fish as a result of loading, transport and unloading is 1.2% of the initial weight of the fish and an approximate 95% confidence interval for the increase is -10.4% to 2.9%. This interval contains 0 because there is no significant increase in broken pieces at the 5% level. The low level of breakage may be as a result of the containers being fully packed and there being less movement of fish in the container.

This hypothesis is supported by the fact that there is some indication that containers with less initial weight of fish have a higher weight increase for broken pieces. However, there is no corresponding trend for the initial weight of the container and the weight of the actual loss.

Nine of the containers gained weight during the journey, which was probably caused by the containers absorbing fish oil and moisture. Although this increase was statistically significant at the 5% level it is unlikely to have economic importance as the increases were very small.

Appendix – Itinerary

Date	Activity
Monday, March 13	Travel to market
Tuesday, March 14	Visited market and planned load tracking exercise

Wednesday, March 15	Purchased fish and began load tracking measurements and cartons loaded on lorry
Thursday, March 16	Other work
Friday, March 17	Team returned to city Lorry left market in the evening
Saturday, March 18	Other work
Sunday, March 19	Visited city smoked fish market and final load tracking measurements made on sample cartons
Monday, March 20	Analysed data, discussed results and prepared report
Tuesday, March 21	Draft report produced

Alternative Summary

If local communities have been involved in the LT, local ownership of the project can be promoted by providing appropriate feedback and alternative forms of dissemination of the report might be considered. For the report in the previous section, an alternative and simplified summary of the LT was prepared and disseminated through fishery extension workers. The summary is shown below, where losses have been reported in a form that is likely to be meaningful at local level.

Summary of LT Exercise from Wholesale to Retail Market

The purpose of the LT experiment was to record losses which occurred during the movement of fish from a remote wholesale market to an urban retail market.

Although the experiment was performed on 10 containers, it is easier to report the results based on 100 containers.

For every 100 containers of medium grade fish purchased, the following losses were recorded:

Type of Loss	**Amount of loss out of 100 containers**
Broken fish sorted out before packing into containers at wholesale market	3 containers
Broken fish packed into containers at wholesale market	7 containers
Increase in the amount of broken fish due to loading at wholesale market, transport to, and unloading at retail market	1 container (containers with more fish had less breakage)

The containers were weighed at the wholesale market before transport and afterwards at the retail market. In terms of weight, the equivalent of 8 out of 100 containers were lost. This could have been caused by the fish losing water and oil or by fragments falling from the container or by insect infestation.

It was observed that the cardboard container material gained weight between the two markets. This was probably caused by the absorption of oil (fish) and moisture from the atmosphere.

Empirical LT

The emphasis on the LT procedures described in this chapter has been to use sufficient replication to obtain an accurate representation of loss. This requires a 'scientific approach', where an experimental design is rigorously followed.

There are situations where a quick and simple experiment to give an indication of losses might be appropriate, such as:

- *verifying local opinion of loss*
- *identifying loss in previously unknown distribution chains.*

For an example, an empirical LT to assess the losses incurred by transport of fish from the processing area to market, might use two baskets of fish, where 30 fish in each basket are scored immediately after smoking and then again on arrival at market. The scores are then averaged to give a typical set of results shown in Table 29.

Table 29 – Results of Empirical LT

Parameter	After Smoking	After Transportation
Colour	1.9	1.6
Taste	1.8	1.8
Dryness	2.0	2.0
Physical State	2.0	1.6

Merit scoring (see Appendix 4) was used so a decrease in average score shows a decrease in quality. It is clear from Table 29 that colour and physical state show the largest decrease in quality. However, since there is very limited replication **the accuracy of the losses cannot be assessed and wider inference cannot be claimed.**

A valid conclusion would be that it appears that there are some losses for physical state and colour and a formal LT experiment could be designed to gain an accurate assessment of loss.

A further example of empirical LT used two samples of fish A and B each consisting of 10 fresh fish which were later frozen and transported. The samples were assessed for quality using a demerit scoring chart (giving a range of 0 to 32) (see Appendix 4) at the landing stage and then again at the sorting stage. Sample A scored 4 on average at the landing stage and then 12 at the sorting stage. Sample B scored 3 at landing and 12 at sorting. Table 30 shows the different stages of the distribution chain the fish went through and the main quality influencing factors of time and temperature.

Table 30 – Load Tracking of Fresh Fish Before and After Freezing

Sample	Quality Influences	Demerit Score		Time (hours)		Temp (°C)	
		A	B	A	B	A	B
Fishing	hauling time to landing			3	8	20–25	20–25
Landing*	fish left on wooden table covered with mat no washing fish gutted	4	3	11	4	25–30	25–30
Processing	freezing cold storage			18.5 14.5	18.5 14.5	-15 -10	-15 -10
Packing	insulated with wood shavings			2	2	25	25
Weighing	ambient temperature			7	7	25–30	25–30
Transport	train			40	40	25	25
Unloading				4.5	4.5	25	25
Sorting*		12	12	1	1	25	25
Total				**101.5**	**99.5**		

* Sample A and B each of consisted of 10 fish. The samples were assessed for quality using a demerit score chart at the landing stage and then again at the sorting stage.

The conclusion from this work was that although both samples had spent over 10 hours at high ambient temperatures before being frozen, the fish were still of a quality to be sold for the highest price after sorting.

For this LT two samples have been used and although it is not enough replication to justify statistical analysis, it strengthens the empirical inference. Using two samples also gives the experimenter more flexibility as one sample could be subjected to an intervention, such as chilling by icing between capture and the point of freezing. This could then be compared to the remaining sample, which would have been processed using standard practice. More accurate assessment of the effect of the interaction could then be obtained by designing a full LT experiment.

Some Common Problems Associated with LT

This chapter has concentrated on using quantitative responses to quantify quality loss. However, loss does not have a simple definition and loss is often measured qualitatively, for example, by colour as in the previous section. Consequently a lot of thought should be given to a meaningful response variable (what is actually measured to quantify loss).

Weight is an obvious choice, but if fish are not sold by weight or the categories of loss incurred during the processing chain cannot be related to weight, then the loss estimates obtained from LT might not be representative.

Qualitative measurements are subjective and it can be time consuming to score large samples of fish. Ranked and scored data are amongst the most difficult data to analyse and formal analysis is often not justified.

Compromises are available, for example, the response might be the number of broken fish. This has the advantage of being more representative than a score and can usually be formally analysed.

This is a dilemma faced by many designed experiments and relevant information can be found in the *Biometric Guidelines* produced by the University of Reading (2000).

Similarly other problems that can occur are typical of 'on-farm' experiments and key areas for LT are:

- *lack of co-operation with local communities*
- *time becomes a confounding factor*
- *failure of the distribution chain due to vehicle breakdown or severe weather*
- *lack of resources to complete experiment*
- *poor fieldwork (not recording measurements accurately)*
- *non-random selection of experimental units*
- *inadequate replication.*

Chapter 4 *Questionnaire Loss Assessment Method*

Introduction

The Questionnaire Loss Assessment Method (QLAM) is based on a formal questionnaire survey approach. Questionnaires are used by enumerators to interview a population sample in a community at a particular site. Providing the survey has been planned according to statistical protocol, the data on fish losses should be representative of the community, communities, fishery or geographical area within which the survey was conducted. Table 31 shows the key elements of the QLAM.

Table 31 – Key Components of the Questionnaire Loss Assessment Method

Planning	objectives survey design questionnaires
Survey	who and when to interview using questionnaires
Data Management and Analysis	inputting, checking, graphical techniques and tests, archiving
Reporting	report writing

The remainder of this chapter is a description of the method in terms of:

- *uses*
- *resources required*
- *planning*
- *survey*
- *data management and analysis*
- *reporting*
- *problems.*

Uses

QLAM is used by researchers to quantitatively assess key aspects of post-harvest fish losses. It has been used most effectively to generate statistically valid data on the following:

- *type of loss*
- *reasons for losses*
- *frequency of loss*
- *variables which affect losses, such as fishing gear type, processing methods, species*
- *livelihood activities and profile of those affected by loss.*

The QLAM can be used to build on and validate the findings of IFLAM and LT. It can be used to validate data over a wide geographical area or within a number of communities. The quantitative results produced will inform decision-making by planners and policy-makers.

BOX 13

In the research which was done prior to the production of this manual, various attempts were made to use QLA to quantify the level of post-harvest fish losses in percentage and monetary terms. Whilst it was possible to use QLA in a single species fishery to generate loss level data, by and large, the difficulties in recording data on: multi-species fisheries, prices, units of fish measurement, quality grades, and then analysing this data, led to the conclusion that QLA is not an easy method to use for loss level quantification. Hence this potential aspect of the method is not dealt with in the manual. Quantification is best done using LT, with less accurate indicative loss level data being derived using the IFLAM.

Resources Required

A typical QLA will require:

- *specialist skills*
- *training/orientation*
- *equipment*
- *finance.*

Specialist Skills

It is essential that a biometrician or statistician is involved in designing the QLA, and advises on or undertakes data management and analysis. Co-ordination and implementation of the QLAM is best done by either a research centre, appropriate consultancy company or university department. The co-ordinator should have experience of design and implementation of questionnaire surveys. If the QLA is to cover a wide geographical area and be conducted over several months or more then it may be practical to enlist the help of regional/area supervisors.

Enumerators are required to conduct the questionnaire interviews. They may be recruited and travel to the survey sites when required or they could already be working at or near a site. Enumerators should be diligent, honest and have good interpersonal skills. Their job is to ask the questions and try to ensure that the fishermen, processors or traders give an accurate answer. People who are involved in revenue collection or law enforcement activities do not always make the best enumerators as interviewees may be reluctant to disclose accurate information to people who may be seen to have conflicting roles.

Whilst a biometrician should oversee survey design and data management and analysis, it may be practical for someone else to assist by developing a computer database for the survey data, input data into the database and undertake basic analysis. However, researchers should also be involved in database design and basic analysis as they will know what basic analysis should generate in the way of results and information on losses. Data inputting may be best done by someone not involved in the research as then there would be less chance of data being changed without checking.

Training

This manual is designed to provide sufficient understanding to co-ordinators to enable them to plan and implement, with assistance from others, a QLA. It should also assist in identifying whether enumerators should be given training or not. Supervisors, if needed, may require orientation.

TIP 22

Training of enumerators maybe a requirement of a QLA. The trainer should be someone with previous experience of survey work and training.

An example of a training agenda for enumerators and supervisors is given as Appendix 5. The basic training materials should be based on information in this manual. Training should include as much practical interviewing work as possible. The practical sessions should be backed up with appraisals to identify strengths and weaknesses of the trainees. You should try and train more enumerators than are actually required for the survey as then reserve enumerators would be available in case of any changes or problems with availability later. During training it may become obvious that some enumerators who were originally thought appropriate may not be able to cope with what is required and they should be politely excused from further work.

TIP 23

One of the main reasons why mistakes during data collection are made by enumerators is the lack of proper training in the data collection exercise, especially in conducting interviews and recording answers.

TIP 24

To reduce the problems that could occur after training, a written guide to data collection should be produced and given to all staff engaged in the survey.

Equipment

Key equipment for a QLA is a computer with database or spreadsheet software for storing and analysing data. A biometrican should advise, but software choice will depend upon what is available locally and what skills are available. As a rule of thumb, spreadsheets can be better for mathematical analysis of the data, but errors during data inputting are more common. Database software allows the design of data inputting screens which reduce the chance of errors during the inputting process. A good printer will be invaluable for producing reports. Power protection devices and un-interruptable power supply (UPS), will help protect equipment and data in case of power problems. In order to cut the cost of a survey it may be possible to use existing equipment rather than purchase some just for a QLA.

Enumerators will need work materials: clipboard, calculator, pens, notebook, plastic folder and ruler, and copies of questionnaires and possibly answer forms.

Finance

This section on finance does not provide any specific cost figures as these will vary, but what it does outline are the activities and costs which should be budgeted so that those intending to use QLAM can calculate their own costs. Typical expenditure associated with the use of the QLAM will be:

- *staff fees (co-ordinator, supervisors, enumerators, trainer training, planning, fieldwork, data management and analysis, report writing)*
- *travel (training, planning, to and from fieldwork, during survey)*
- *accommodation (training, planning, survey)*
- *stationery (training, planning, survey, photocopying, postage and other communication costs)*
- *equipment (i.e. computer, software).*

Fee rates may or may not apply and will vary from country to country and organization to organization. Training costs, if training is required, will depend on who conducts the training and where they travel from. The survey cost will depend on the numbers of enumerators and how much travel is involved and the number of days, on which interviews are to be conducted and the number of sites or communities involved.

If resources permit, and the prevailing situation is such that financial incentives for survey staff would improve the survey efficiency, then survey staff should be paid allowances for their work and allowance payments should be kept in line with inflation.

The supervisors should only pay enumerators when they have received and are satisfied with the data. In this way some control over data quality can be exerted by supervisors. Likewise the co-ordinator should only disburse funds when he or she is satisfied with the data received.

If a QLA covers a number of regions over a long period of time (6 months or more) then a system for the disbursement and accounting of funds may be required. This may entail opening bank accounts in regions. Funds can then be transferred by the co-ordinator from a main account to regional accounts as the survey progresses.

Planning

Planning is undertaken to set objectives, design the survey and draft questionnaires and is followed by implementation of the questionnaire survey.

There are two starting points for a QLA: an IFLAM or LT has already been completed and validation of data is required or, quantitative data on losses are required and no IFLAM or LT has been carried out. In the former case, enough data or information should be available to be able to undertake some or all planning for a QLA. In the latter case, where no or little relevant data are available for planning, conducting an IFLA is recommended prior to planning. LT would also provide data, which would assist in planning.

Objectives

Setting the objective or objectives of the QLA is essential and should be done before any other activity. Key questions to ask to help in setting objectives are:

- *who has commissioned the QLA and what do they want?*
- *why is a QLA necessary ?*
- *what will the results be used for?*

Objectives could be framed within the following examples:

- to *validate qualitative data on losses incurred by a particular group of operators (e.g. fishermen, processors, traders) on a regional or national level*
- to *produce quantitative data on post-harvest fish losses for a particular fish species or product within a particular distribution or marketing chain.*

Survey Design

Key elements of survey design are:

- *selecting sites where the questionnaire will be administered*
- *deciding on the sample size*
- *drafting questionnaires*
- *matching the sites and sample to the resources available.*

A biometrician or statistician or someone who has been involved in the design of questionnaire surveys, should be involved in survey design. The design should aim to produce a survey which will provide statistically valid or representative data. The Statistical Services Centre at The University of Reading, UK has produced a series of biometric guidelines for people working on projects dealing with renewable natural resources. The guidelines have been produced with support from DFID. Further details are available in Appendix 2.

Site Selection and Sampling

A site is a place where questionnaire interviews will be conducted by enumerators. Typical sites for a QLA, and where fishing communities are to be found, include:

- *fishing villages*
- *where fish is landed*
- *where fish is processed*
- *where fish is traded*
- *markets*
- *transport points.*

In some situations it may be possible to conduct a QLA at all the relevant sites, e.g. if a short fish distribution chain is the focus. More often than not the number of potential sites will be large and to survey all sites may be impractical and expensive so site selection is undertaken.

Sites should be selected at random if loss data, representative of a large population or geographical area, are required. A list of all available sites should be made, preferably with an indication of 'population', e.g. fishing boats or fish traders, size at each site. The sites should then be selected at random, possibly with probability proportional to size so that large sites have a greater chance of being included.

Bear in mind that if site selection is not done randomly and is done purposively, e.g during an IFLA, then it will be difficult to obtain representative data for the total population. This is because the selected sites will not be truly representative. Any estimates made in this case will refer only to selected sites and not to the whole population. Using population estimates in such situations requires an act of faith, which may or may not be justified. It is also important to be aware of bias with regard to survey sites. It might be attractive from an administrative point of view to have all survey sites within easy access of enumerators or supervisors, but excluding sites that are less accessible may mean the survey sites are not representative of the sectors being surveyed.

In practice though site selection can be influenced by:

- *accessibility of the site for an enumerator and supervisors*
- *relationship between sample population and enumerator*
- *size of the sample population*
- *resources available in terms of transport*
- *how representative the sites are of the fishery sector.*

For practical reasons sampling schemes are usually a mixture of systematic and random selection. Systematic selection could be:

- *division of a geographical zone into sectors*
- *stratification of operators into large, medium and small to avoid bias.*

It is then necessary to sample randomly within each of these systematic zones or strata.

Bear in mind that if enumerators are not stationed at a site they will have to travel there for data collection. Transport should be reliable and costed into the QLA.

The transient nature of some fisherfolk communities should be borne in mind if interviews are to be conducted over a period of time. A sample population may suddenly shift to another site, perhaps because of better business prospects. The likelihood of this happening should be identified beforehand, perhaps in an IFLA.

How many people should be interviewed? This is a difficult question to answer without knowing anything about the variability in the answers to questions.

TIP 25

A rule of thumb would be to interview a minimum of 30% of the sample population. So if there are 100 fish processors in a community and they are your target population, aim to interview 30 of them.

If a sample population is small then it might be feasible to interview all the sample. If a population is over 10 and 10 interviews are required and there is only one enumerator, then a valid sampling technique will be needed to identify who to interview, avoiding bias in the sample.

Two different methods of sampling can be used for choosing respondents, with the method chosen being determined by the ease of production of a sample frame in each site and for each questionnaire. The methods are random sampling and linear sampling.

Random Sampling

Where a complete sub-population list is available, sampling should be randomized by drawing lots. Each person/sampling unit in the list will be allocated a number, and each number will then be written on a separate piece of paper, which will be folded and put aside. Pieces of paper will then be drawn one by one, and the numbers written down to give a list of respondents to sample.

Enumerators should be trained in this method, and advised to select more potential respondents than are actually required (and to write them in the order in which they are drawn) to ensure that adequate numbers of respondents are selected. The importance of the completeness of a list and possible bias introduced should be highlighted during training.

Where random sampling by drawing lots is practised, enumerators should submit the list used with the results of the interviews.

Linear Sampling

Where a list of the population is not available, e.g. in a retail market where traders change from day to day, a linear sampling technique should be used. Enumerators should be trained to calculate a number '*n*' by dividing the population number of available respondents by number of respondents required (plus spares) to get a good spread of physical locations. The recorder then walks along the line of potential respondents and interviews every '*n*'th person/unit. For example, a retail market may have 26 stalls or retail outlets. If 10 interviews are to be conducted then divide the number of stalls by 10 to give 2.6. Round this up to a whole number, 3 and so interview every 3rd retailer. To account for any retailers who are not able to be interviewed then it may be practical to use 12 rather than 10. Thus every 2nd retailer is interviewed until the required 10 have been covered.

TIP 26

If a respondent refuses to be interviewed then another respondent should be chosen and interviewed instead. Bear in mind that a common sense approach to choosing an alternative respondent should be taken otherwise bias may be introduced. For example, either of the two sampling techniques could be used. The likelihood of non-response is something which a pilot study should be able to identify and so contingency plans can be made in advance.

Questionnaires

> "If one had to choose a single indicator of a successful survey it would be the questionnaire. It is, after all, the means by which the data are acquired. A good questionnaire does not guarantee a useful survey, but unless the questionnaire is well designed there will be little of value from the survey" (University of Reading, 2000a).

A QLA questionnaire consists of several different types of question. The answers are either recorded on the questionnaire by the enumerator or the answers to questions are coded and recorded on a separate answer form.

Planning includes the development of draft questionnaires which should be short and tailored according to the objectives of the QLA; the particular fishery and the marketing stage at which they will be used. Ideally, questionnaires should be in the language best understood by the enumerator and the respondents. The complete questionnaire should fit on to one sheet of A4 size card or paper, this will make interviewing easier. The questionnaires may be laminated in plastic, if a separate answer form is used, so that they can withstand field conditions.

Questionnaires are usually used to interview a respondent about either the last catch or load of fish dealt with, the fish landed or processed over the last certain number of days or what happened during the previous season. In other words, the questions are asking the respondent to recall information. If required, the questionnaire can also include prompts to the enumerator to assist the interview process.

BOX 14

Examples of Prompts for Enumerators

ENUMERATOR: MAKE SURE ALL ANSWERS RELATE TO A SINGLE BOAT THAT THE PERSON HIM/HERSELF FISHED IN

The other instructions are statements the enumerator should make during the interview to alert the respondent to exactly what information is required.

SAY: ALL QUESTIONS WHICH FOLLOW REFER TO THAT LAST TIME YOU FISHED FOR WHICH ALL FISH HAVE BEEN SOLD ALREADY

A further example, is that it may be practical to ask the respondent at the start of an interview if a certain time period has elapsed between the last time the respondent dealt or caught fish and the interview date. If the time lag is greater than that required then the interview should be ended there and then and another respondent sought.

Ideas For Different Types of Question

The following are examples of the sorts of question that can be used in a QLA questionnaire. Some of the questions also show ideas of how possible answers could be structured. In some cases the list of possible answer choices has not been included.

(a) Identifying the data source

It may be useful to record the identity of a respondent so that at a later date they can be contacted in case of clarifications or to check data. Asking a respondent's name at the start of an interview may not always be a good idea. Some people may be reluctant to give their names. It may, therefore, be more appropriate to ask such a question, if at all, at the end of an interview rather than at the beginning.

What is the number of the boat you fished in?

or

What is your name?

(b) Making sure the respondent has the information required

Early on in an interview the respondent can be asked when was the last time he or she went fishing or processed fish or sold a batch of fish. This helps to avoid asking the respondent more than once about the same fish. It also makes sure the respondent is not asked to recall data that are not relevant.

If the answer to the question below is more than, in this case 14 days, then the interview goes no further and another respondent is sought.

When was the last time before today you went fishing ?

[a] date (estimate)

ENUMERATOR: IF MORE THAN 14 DAYS AGO, END OF QUESTIONS

or

When was the last time you processed fish which have now all been disposed of ?

[a] date (estimate)

ENUMERATOR: IF MORE THAN 14 DAYS, END OF QUESTIONS

(c) Reasons for losses

Did you throw any fish into the lake before landing because of spoilage?

number	**unit**	**reason**
(record number)	(list of units)	(list of reasons)

Did you *throw away* any fish due to spoilage or for any other reason?

[a] number **[b] unit** **[c] fish** **[d] process** **[e] reason [f] end-use**

Did you sell any fish for a lower price (e.g. for processing or to fishmongers)?

[a] price **[b] unit** **[c] number** **[d] use** **[e] reason**

Did you sell any fish for a reduced price *due to spoilage ?*

[a] price **[b] unit** **[c] no** **[d] fish** **[e] process** **[f] reason** **[g] end-use**

If answers may be associated with a variety of species:

Did you throw any fish into the lake before landing because of spoilage?

[a] species **[b] number** **[c] unit** **[d] reason**

(d) Frequency of loss

Whilst losses may occur, it is important to determine how often they occur in order to understand the magnitude of the problem.

How often did you discard fish during the last......?

a) never
b) once
c) twice
d) more than twice

and

Did you sell fish for a low price because of quality problems during the last......?

(e) Variables which affect losses

A number of things can influence how often and how much fish and value are lost. These include the time taken to travel from fishing grounds to shore, whether ice was used or not, the type of processing method, packaging materials and methods.

Which fishing gear was used in the boat you went fishing in? **(list of fishing gears)**

Are there species which you normally associate with losses? **(list of possible species)**

(f) Coping strategies used

Quite often people have their own ways of dealing with losses. These may not be ideal in terms of poverty alleviation, but they can form the basis of practical loss reduction interventions.

How did you manage to cope with any losses? **a) make up in subsequent lots** **b) borrow money** **c) reduce turnover** **d) increase turnover** **e) stopped processing** **f) other**

(g) General questions

If validating data from an IFLA, it may be useful to validate not only the qualitative data on losses, but also data on those who are affected by losses and who could be the beneficiaries of loss reduction initiatives. Such additional information can assist in identifying whether respondents are the more marginalized or poorer members of society. Such general questions could be based on any socio-economic or fishery-related activity such as gender, family size, household income sources, numbers of years experience of fishing, processing, type of processing method used. The following are some examples.

When you purchase fish for processing, how much money do you spend? **(list of expenditure levels)**

Which is the most important income source for your family?

BOX 15

Traditional Units of Measurement

If loss levels are to be quantified, then information on the traditional units of fish measurement is required. One of the reasons why it proves difficult to use QLA to quantify loss levels is the difficulty in standardizing units of fish measurement. It is rarely the case that a single standard unit is used within a marketing chain or between stages. There are likely to be a number of different units used and respondents may use different ones. For example, fish may be bought by a certain traditional measure, then processed and sold by a variety of different units. The units may vary in size. For example, the size of a basket of fish can vary greatly. This makes recording information on units, comparing data on losses and calculating loss levels very difficult in practice.

Recording Answers

Hand in hand with choosing the right questions for a questionnaire is deciding how the answers to the questions are recorded.

There are two standard ways of recording answers during an interview:

- *using a separate answer form so that data are kept separate from the questionnaires*
- *recording the answers directly on to the questionnaires.*

Using a separate form such as the one in Figure 13 has the advantage of making computerization of the data easier. It also cuts down on the amount of paper generated by the QLA. However, it does make recording data more difficult as there is more room for error. The answers to questions are pre-coded, and this makes recording easier as the enumerators do not have to write out whole answers but simply write either a single digit code or a figure in the appropriate box on the answer form. Enumerators should record the answers given by respondents directly on to the answer forms and all parts of a question must be answered on the form. To assist this there are some characters that can be used to make the meaning of answers clear:

'0' is used as the number zero

'-' a dash is used where a question is not applicable or relevant

if a question does not have to be answered then an 'X' is used to indicate this.

The answers should be recorded neatly and preferably in black ink as this will produce better quality photocopies. Answer forms should be of a manageable size, i.e. A4, and should have space for the answers from several interviews. They should be made from card and have a matrix on both sides. The data are recorded on both sides, saving paper and postage. A different form should be used for different interview days.

Recording answers on to the questionnaire is easier to implement in the field and less prone to error. The questionnaire is designed in a such a way as to allow the answers to the questions to be ticked or marked on the questionnaire. Boxes for recording answers can be placed adjacent to questions. However, producing a questionnaire for every interview generates a lot of paperwork and makes more work for the survey co-ordinator.

Questionnaire: Data Collection Site: Date: Enumerator:

Interview								Int							
Quest	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**Quest**	**a**	**b**	**c**	**d**	**e**	**f**	**g**

Other Information

Checked (sign & date)

Supervisor: Co-ordinator: Data Inputter:

Figure 13 Matrix answer form.

After developing a questionnaire it should be pilot tested to see if the:

- *questions are worded correctly*
- *respondents understand the questions*
- *enumerators understand the questions*
- *questionnaires are too long and complicated*
- *check for non-response.*

Pilot testing involves enumerators interviewing a sample of respondents as if implementing the QLA. The interviews may be observed by the co-ordinator.

Long complex questionnaires can make the interview time consuming for both the respondent and the enumerator causing interviewer and respondent fatigue. This results in poor quality results and may affect the willingness of respondents and enumerators to undertake the QLA.

After pilot testing, the questionnaires should be revised if necessary and final versions produced for the actual QLA.

Survey

Implementing a QLA is centred on enumerators interviewing the appropriate sample of respondents (see Planning) using a pilot tested, and if need be, revised questionnaire. In order to achieve this efficiently and successfully the enumerators must be aware of who should be interviewed, when is best to conduct the interview and how to actually interview properly.

Who to Interview

Enumerators must interview people who will definitely know the full history of the fish catch or batch. For example, in the fishing sector the questionnaire should be used to interview people who are aware of what has happened to the fish from the time of capture until when it is sold. Therefore, it would make sense to interview the fishermen who did the fishing rather than the owner of a fishing boat who did not actually go fishing and will not know what exactly happened.

TIP 27

Make sure you interview the person who definitely knows what has happened to the fish.

When to Collect Data

When to interview and how often will be influenced by the following:

- *resources available*
- *frequency that target sample population operate, i.e. go fishing*
- *when sample population operates*
- *other data collection exercises*
- *local holidays and festivals.*

If fish processors only process and sell one batch of fish per month then it will not be sensible to conduct interviews twice a month otherwise a processor may be interviewed about the same batch of fish twice.

It may be pragmatic to set data collection days according to a fishing cycle or pattern of activity so that the job of the enumerator is made easier as the respondents will be more easily located.

TIP 28

In a marine fishery a neap tide may be synonymous with rest periods for fishermen and a time for gear repair. At such times it should be easy to locate and interview fishermen who are more relaxed.

You should identify the best time to interview respondents according to the respondents activities. If a respondent is busy then the enumerator should either wait until the respondent is not busy or arrange a suitable alternative time later. Enumerators under no circumstances should stop a respondent from doing work or other activities to interview them. This is impolite and may lead to poor quality data as questions may be rushed. Respondents may also then form a bad impression of the survey.

If other surveys or data collection are going on at the same time at the same sites then this may also influence when interviews should take place.

If a survey is to run for a year or longer, then interviewing people too frequently may become tiresome for the sample population, particularly if they are being disturbed during the course of their work and are not seeing any tangible benefits from answering questions.

As a rule of thumb, it is probably a good thing to avoid data collection during public holidays and weekends.

Conducting Interviews

It is very common for fishermen, processors and traders to be wary of answering questions concerning livelihood, especially questions relating to income and prices. To try to overcome this problem it is important that the interview technique is good.

At the start of every interview the enumerator must introduce his or herself to the respondent and state clearly the reasons for the interview and the survey. At the same time the enumerator must not raise expectations or make any false statements about what the survey may lead to in terms of benefits to the respondent or community at large.

The enumerator must be careful when asking sensitive questions such as those concerning income. It may be necessary to ask the question indirectly in order to get an answer. In some cases asking about prices is often best left until the end of an interview.

Another sensitive question can be asking for the name of the respondent. Asking someone's name at the start of an interview can make the respondent suspicious of the reasons for the interview. It may be better to ask a respondent's name at the end of the interview. Enumerators should explain the reason for having the name of a respondent, which is so that follow-ups may be made in case some of the data needs re-checking.

When actually conducting the interview the enumerator should:

- *be patient*
- *be polite*
- *be ready to answer any questions the respondents may have*
- *keep the interview flowing*
- *not rush*
- *not go too slow so respondent becomes agitated or bored.*

At the end of an interview the respondent should thanked for his or her time.

If a respondent refuses to be interviewed then the enumerator should locate an alternative respondent. An attempt to interview the required number of respondents should be made and a note made on the reason why respondents preferred not to be interviewed.

Data Management

"Research projects often involve the collection of a large volume of data. The data have then to be processed and analysed, with results and summaries being prepared for publication in some form. For this sequence to proceed smoothly, the project requires a well-defined system of data management" (University of Reading, 2000b).

The key elements of data management are:

- *inputting raw data into a computer and checking the data*
- *organizing data into an appropriate form for analysis*
- *archive the data so that they remain available throughout subsequent phases of a project, and afterwards.*

Ideally, interviews should be monitored throughout the survey, especially during the first few data collection days. This is to make sure that enumerators are recording data properly and to provide on the spot guidance if required.

Unannounced spot checks at sites during interviews can be also be conducted. These visits should check the:

- *presence of the enumerator at the site*
- *time at which the enumerator starts interviewing*
- *correctness of the sampling method*
- *interview technique*
- *tidiness of the answer forms.*

If the names of respondents have been recorded on answer forms as part of the interview, then if need be these respondents who have been interviewed on previous occasions could be asked about the interview process. This technique can be used if there are doubts about data and a suspicion that enumerators are not doing their work properly.

Data from interviews should be checked to see if answers are legible and clear and the answers are mathematically correct.

The possibility of data fabrication should not be ignored. It is not easy to detect false data, but the following are clues:

- *answers are repeatedly similar with little variation compared with previous records or answer sheets filled by other recorders*
- *the absence of unusual results*
- *absence of expected results.*

Evidence of any of the above does not necessarily mean that the data have been fabricated, but may mean that further investigations should be made. If an enumerator is found to have fabricated data then they should be excluded from the survey and a suitable replacement found and trained.

Along with the raw data, enumerators should be encouraged to submit a short report that outlines any interesting occurrences relevant to the survey which were not recorded. Such occurrences could include the migration of sample populations and the introduction of new technologies in the fishery.

If the co-ordinator is not within easy access of the enumerators then photocopies of the data should be made by the enumerators and the originals sent to the co-ordinator by the quickest and most practical means possible. The photocopies could then be referred to if the co-ordinator has any queries about the data.

If supervisors are acting as an intermediary between enumerator and co-ordinator then supervisors may wish to provide a more detailed report along with data, based on the following:

- *progress during the data collection period*
- *any problems that have arisen*
- *any observations*
- *the sites visited by supervisor*
- *summarize the reports from the enumerators*
- *financial summary and accounts.*

On receiving data the co-ordinator should check a sample of answers for correctness. If there are any queries the co-ordinator should try to resolve these with the appropriate person. Once the co-ordinator is satisfied the data should be entered into a computer using an appropriate software.

Computer Database

It is assumed the co-ordinator has now received the raw data from interviews. Because of the amount of data a survey can generate, and the lengthy process of analysing it on paper, the most obvious tool to assist in storing and analysing data is a computerized database.

The first task is to design and create a database or spreadsheet for the survey data. This may be done at the planning stage in order to test data entry and to enable some basic analysis to be done. Many database software packages allow the user to design data entry screens. These screens allow someone to type data in easily and with a minimum of error.

TIP 29

It is suggested that if a database is used each part of a question on the questionnaire should have a separate field (allocated space) in the database. In addition the extra fields that are mentioned in the data analysis section should also be included at the design stage even though these will not be needed initially.

If more than one type of questionnaire has been used, and the questionnaires are different in layout and number of questions, then the easiest action to take is to create separate database files for the data from each questionnaire. Later during analysis it may be possible to join several different databases together by virtue of the fact they will have common fields.

Inputting Data

Data inputting is the process of keying the raw data into the database. It can be a time consuming task and if there is a lot of data it is useful to plan ahead how much time is needed. It is a good idea to set deadlines by when data should be inputted.

> "The process of data entry will normally involve a skilled person who designs the system, while more junior staff, e.g. trained data entry operators or field staff, carry out the actual keying. Checking is done both at the time of keying and afterwards. If the project is small, then the same person may plan the system, key the data and do the checking, but it is still useful to have a clear strategy for the activities" (University of Reading, 2000b).

It is important to make back-up copies of the data at regular intervals. If there is only one copy of the files on the hard disk of a computer and for some reason the hard disk fails, then unless external copies of data are available all the data may have to be inputted again – a soul destroying and time consuming task. It is good practice to back-up files after every inputting session.

Checking of data can be done during and after inputting – this time for errors that have occurred during keying. It is very easy for data to be wrongly entered, even with the aid of data entry screens.

Organizing Data

Once the data are in the database, calculations may be required to re-structure the data into the appropriate form for analysis. This can either be performed in the software used for the data entry, or in a statistics package that will be used for the analysis. It is good practice to keep:

- *a record of all changes to the data*
- *a single 'master copy' of the data.*

Archiving

In order to preserve the results of a QLA in full for others to see and use at a later date it is good practice to create an archive which holds:

- *project data*
- *record of how and why data were acquired, and what they represent*
- *documentation about computer files which will allow later data retrieval.*

To be useful beyond the project lifespan, archives need to be in an organized form, in almost all cases computerized (University of Reading, 2000c).

A good data archive should be:

- *accessible, so that users can reach the stored information via widely available software*
- *easy to use*
- *reliable – free of errors.*

It should hold relevant information on:

- *procedures used for data collection including sampling methodology and sampling units used*
- *structure of the archive, e.g. how different files link together*
- *a list of computer files comprising the archive*
- *a full list of all variables including notes on how missing values are treated*
- *summary statistics that allow the user to cross-check if the information retrieved corresponds to that required*
- *relevant warnings and comments relating to any part of the database.*

Data Analysis

Data analysis converts raw data from questionnaire interviews into quantitative information on post-harvest fish losses. The information can be used by policy-makers and planners to make informed decisions on intervention strategies to reduce losses or to improve the livelihoods of those affected by losses in other ways. Data analysis is best done after a survey has been completed and all data have been correctly entered into a computer database. However, analysis at the pilot survey stage can help streamline the process for the final QLA. Likewise, trial analysis is advisable as the survey progresses to highlight any shortcomings that can be rectified before the final data analysis.

Analysis will provide quantitative information on:

- *frequency of quality and physical losses*
- *reasons for the different types of loss*
- *relationship between losses and variables such as season and fishing gear type, location (spatial), time (temporal), type of processing method, transportation times, fish species*
- *livelihood issues of people affected by loss*
- *coping strategies used to overcome loss.*

The basic steps of data analysis are as follows, these are normally done using a computer database or spreadsheet:

- *initial data analysis giving basic summary statistics and informative graphs*
- *extraction of meaningful cross-tabulations*
- *examination of inter-variable relationships using scatter plots and correlations*
- *formal statistical analysis, if necessary, in collaboration with somebody with statistical knowledge; most common techniques are significance testing, multiple regression and interpretative multivariate methods.*

Statistics

Statistical analysis will quantify the accuracy of loss estimates and investigate the relationships between variables. Most of the objectives of QLAs such as this can be met by simple tabulation and/or cross tabulation of frequency counts, percentages and means. It is also useful to calculate standard deviations and 95% confidence limits for the means. This will allow better comparisons to be made between data, e.g. could differences in loss be due to survey variation?

Whatever variables are used, data will usually need to be averaged. There are two general approaches to averaging data from interviews. The first approach will give the 'straight mean' and the second will give the 'weighted mean'.

The **straight mean** is the average of number of values. For example, if the % physical loss values for a number of interviews are simply added together and then divided by the number of interviews, then the resulting average will be the straight mean. In this case the straight mean will be the average physical loss per interviewee.

The **weighted mean** is used to express average losses per site, sector fishery, etc. For example, to work out the physical loss per sector over a certain time period the weight of fish lost from all relevant interviews is added together as is the weight of the total amount of fish for each interview. The total weight of fish lost is then divided by the total fish and multiplied by 100 to give the weighted mean.

The following are a list of useful statistical methods that could be used during the analysis of QLA data.

Graphical Techniques

As in any survey analysis graphical methods have an important role for the concise representation of data. Venn diagrams can be particularly useful in analysis for displaying the intersecting relationships between up to four classifications. They can be used with any number of classification groups, but they can become so intricate that they are no longer simple to interpret. It should be noted that pie charts are generally only used when the classification groups are not intersecting.

Basic Statistics

Basic summary statistics have a central role in any analysis. Point estimates (the mean of a data set, for example) of summary statistics should where possible be accompanied by some indication of their accuracy.

The relationship between two variables can be quantified by calculating a correlation coefficient. Note this only measures linear relationships – low correlation does not necessarily imply no relationship. Always accompany correlation calculations with scatter plots.

Comparison of Means

The comparison of means is a very common statistical test with both parametric and non-parametric versions. The most common test is the t-test for comparing two means, where the raw data are required, not just the two mean values. This is generalized to more than two means by analysis of variance. A key feature of both tests is the estimation of experimental variability which is used for the calculation of confidence intervals described in the following section.

TIP 30

If in doubt about which test to apply, particularly parametric versus non-parametric, seek statistical advice.

Confidence Intervals

Point estimates are often accompanied by an estimate of their standard deviation (usually called the standard error). Although this conveys some information, it is more informative to actually give a 95% confidence interval for the point estimate. This can be interpreted as meaning that the confidence interval has a 95% chance of containing the true mean of the population.

Assuming that the data are sampled from a normal distribution, the confidence interval can be estimated as point estimate ± 2 * (* = times) standard error of the mean. However, it is difficult to justify the assumption of normality, especially for counts, scores or ratios. As the distributions are often skewed, a central confidence interval might not be representative.

Calculation of Confidence Intervals for Non-normal Distributions

The median is often a better summary statistic for a skewed distribution (i.e. non-normal) than the mean, because it is less affected by extreme values. However, there are no general parametric methods for calculating the confidence interval for a median. Consequently a numerical technique called bootstrapping (Manly, 1991) is used. This re-samples from the observed data to quantify how unusual the observed data set is.

It is also useful to calculate the confidence interval for the mean, but as the non-normality implies that the standard central interval of the previous section might not be appropriate. Again the bootstrapping technique can be used to estimate a non-central interval. If the distribution is approximately normal then bootstrapping intervals will be very close to the parametric central intervals.

If non-normality and skewness are suspected then it is often better to quote both the median and the mean and their respective confidence intervals.

Cross-tabulations

These are excellent methods for comparing information from two or more responses. Two-dimensional tables can be analysed using the chi-squared technique to determine whether the rows and columns are independent. However, this makes the important assumption that cell counts within the cross-tabulation should be greater than five. This case is often violated and the chi-squared test result should then be validated using a numerical permutation test.

This is another numerical technique and samples all possible tables given the row and column totals. This is an intensive technique and the number of possible tables can grow very large, even for small numbers of rows and columns. If computationally feasible, all possible tables are evaluated and this is termed an exact test chi-squared test. Often it is not possible to enumerate all possible tables and a large sample (in excess of a 1000) of the tables is taken and this is called a Monte-Carlo chi-squared test.

Examples of Data Analysis

The following are a number of examples showing how data can be analysed and presented in reports.

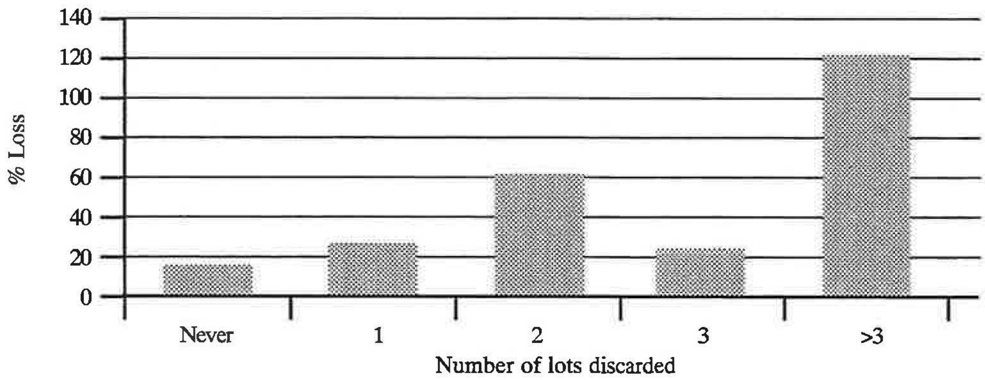

Figure 14 Graph showing frequency of loss over a certain time period.

(a) Figure 14 shows how the number of times fish is discarded (physical loss) by a respondent during a particular time period, can be presented. The figure shows that in this example most processors reported physical loss.

(b) A more in-depth analysis of more than one type of loss is shown in Table 32. This table shows the cross-tabulation of how many lots are discarded (physical loss) against how many lots are sold at reduced price (quality loss). The highlighted cells show those combinations with the highest counts.

Table 32 – Cross-tabulation of Physical and Quality Losses

		How Many Lots Sell at Reduced Price					
		0	**1**	**2**	**3**	**>3**	
How Many Lots are Discarded	**0**	3	0	1	1	5	10
	1	5	13	2	0	2	22
	2	$\boxed{30}$	2	13	4	4	53
	3	7	3	7	3	2	22
	>3	$\boxed{43}$	8	19	4	$\boxed{42}$	116
		88	26	42	12	55	223

In this example, a Pearson chi-squared test (Monte-Carlo version of the exact test to allow for small cell counts) gives highly significant evidence (p-value < 0.001) for rejecting the null hypothesis that the number of lots discarded and the number of lots sold at reduced prices are independent.

(c) Two variables that can be used as a basis for analysis are the reason why fish is lost and the end-use of fish classed as a loss. The simplest way to do this is to analyse the data on reasons according to the weight of fish lost for each reason to produce weighted means.

For example, from the question below it can be seen that fish could have been physically lost for seven different reasons (part [e]).

Did you *throw away* any fish due to spoilage?

[a] unit	**[b] no**	**[c] fish**	**[d]process**	**[e] reason**	**[f] end-use**
1=piece		1=perch	1=fresh	1=rain	1=food
2=kg		2=dagaa	2=smoked	2=rotten	2=livestock
3=debe			3=fried	3=stale	3=no use
4=tenga			4=salted	4=broken	4=don't know
5=gunia			5=sundried	5=mouldy	5=other
6=other			6=other	6=insects	
				7=others	

(NB: note the variety of traditional units recorded in this example. Accurate data must be available on these units in order to undertake any calculations.)

The total weight of fish lost for each reason should be calculated. These totals are then each divided by the total amount of fish physically lost for all reasons and the answer multiplied by 100. This will give the proportion of fish lost for each reason as a percentage.

Table 33 shows the proportion of dried and smoked fish physically lost for various reasons. The table shows that of the fish physically lost 41% was lost because of insect infestation and 20% was lost because it was eaten by animals.

Table 33 – Reasons for Physical Losses of Fish

Reason	%
Insect infestation	41
Eaten by animals	20
Other	20
Spoilage	8
Mould	5
Burnt	3
Theft	2
Eaten by birds	2
Broken	1

The end-use data are a measure of what happens to the fish after it has been physically lost or sold for a reduced price. An example is part 'f' of the above question which is designed to generate data on 'end-use'. The percentages of each end-use are calculated in the same way as the reasons for loss. Looking at the End-Use column in Table 34 below, 88% of the fish physically lost is used for animal feed.

Table 34 – End-use of Fish

End-use	%
Animal feed	88
Food	11
Other	1

(d) In another QLA seven causes of losses were recorded by the survey and respondents may have incurred loss by more than one cause. The combination of answers is summarized in Table 35. The highlighted rows give the most important combinations and the data in the table can be summarized by considering a Venn diagram representation of the first three columns (as most of the Yes answers appear in these columns) (Figure 15).

This example shows clearly the main reasons for loss and, therefore, the focus of any technical intervention.

(e) Data from a question which aims to show differences between the socio-economic circumstances of two or more groups within a population can be tabulated as shown in Table 36.

Table 35 – Combinations of Reasons for Loss

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	No	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 processors did report monsoon losses, but gave no reason.

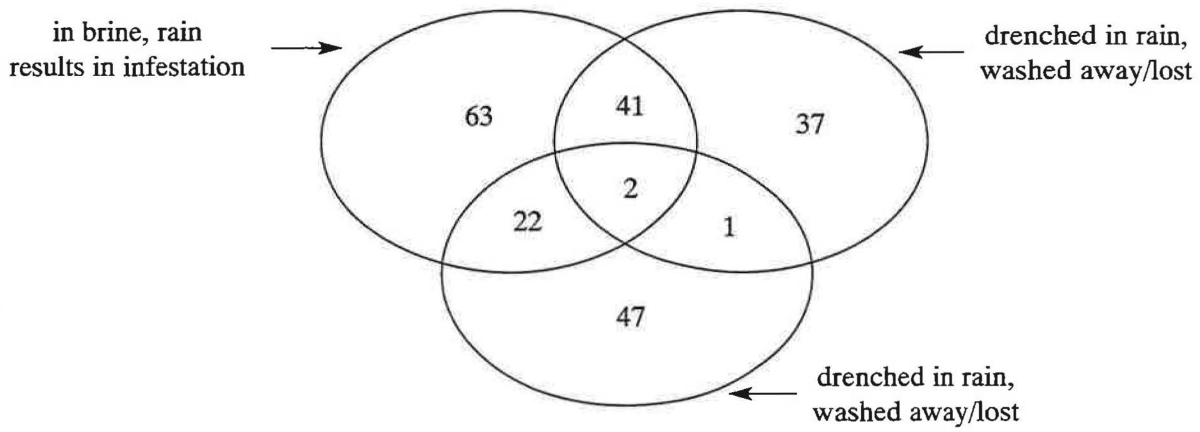

Figure 15 – Venn diagram.

Table 36 – Distribution of Working Capital

Rs.	Men-headed Households (200)	Women-headed Households (42)	All Households (242)
< 500	38	15	53
501–1000	52	10	62
1001–2000	90	11	101
2001–3000	7	5	12
3001–5000	12	1	13
>5001	1	0	1

(NB: Rs = Indian Rupees. The figures in brackets are the numbers of respondents.)

The table enables simple percentage calculations to be undertaken to show the proportions of respondents according to different levels of working capital.

The table also is useful as it shows there are clear differences between male and female-headed households and there is an indication that female-headed households have less capital at their disposal. Using only the two columns for men and women-headed households, a chi-squared test can be performed to test whether the gender of household head is independent of working capital. Due to some small cell counts an exact permutation test must be performed. An 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.

Table 37 – 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	Yes = 240	Yes = 184	Yes = 57	Yes = 12	Yes = 9	
No = 79	No = 2	No = 58	No = 185	No = 230	No = 233	

(f) In another example, which shows the answers to a question referring to the different sources of income a respondent relies on, the data are tabulated in a slightly different way as shown in Table 37. The combinations of income sources with the highest counts have been highlighted.

The table shows that it is clear that other labour and own agriculture account for a minority of respondents income. The data in this table are summarized by using a Venn diagram to represent the first four columns (Figure 16).

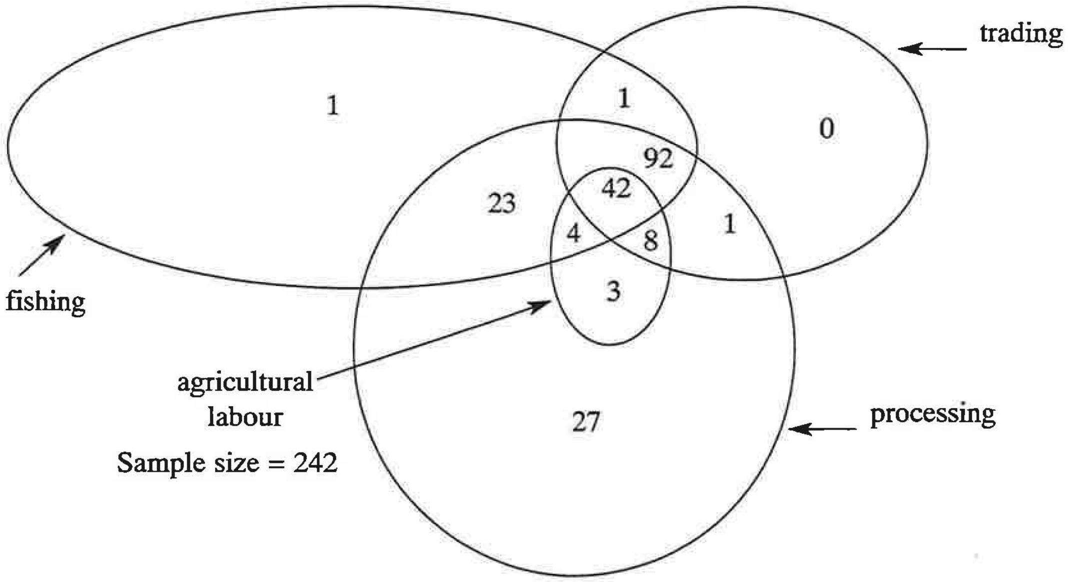

Figure 16 – Venn diagram for fishing, agricultural labour, processing and trading.

Raising Factors and Overall Monetary Loss

Combining the results of a QLA with data and information derived from other sources can be done to provide assumptions or estimates of other elements of post-harvest fish losses. A QLA may provide representative data for a sample of a population of fish processors. If there are data on the size of the entire population of processors then the data from the QLA could be extrapolated to represent the population as a whole. Such extra data may be readily available from statistical records and other secondary sources and is termed raising factors in the context of this manual.

An alternative scenario is to combine qualitative data from an IFLA with QLA data. This could be done to provide estimates of financial losses for a population, the loss level data being derived from the IFLA and the frequency of loss data from the QLA.

If site selection for a QLA is done purposively rather than randomly then it will not be easy to determine confident estimates for 'total population' as the sites will not be truly representative. Using population estimates in such cases requires an act of faith which may or may not be justified.

Reporting

Reporting or writing up the results of a QLA should be done so that the reader or the person to be informed has a clear understanding of what has been done, what the key findings are and what tools and principles have been used and by whom. The latter will give the reader an indication of how reliable the results of the assessment are. In order to assist the co-ordinator or user write up the results of a QLA the following report template has been produced (Table 38). This represents the essential issues and topics, which should be included in a report. Use of this template will also assist in standardizing the reporting and presentation of post-harvest fish loss data, making comparison of data across communities, regions and countries more meaningful in future.

Table 38 – Template for Reporting a QLA

Summary (ideally on no more than of 2 sides of A4 size paper)	who, what, where, how, why? loss level data brief outline of analysis process and statistical tests key conclusions key recommendations
Introduction	objective reason for the QLA focus of the QLA – products, species, distribution chain, geographical area who did what, where and when? dates of fieldwork and duration training and orientation
Method	QLA design – sampling, questionnaires pilot phase activities analysis process in detail
Results	results of the analysis presented as graphs, tables and details of statistical tests details of any extrapolation observations problems encountered
Conclusions	description of key results/findings are losses significant? are loss reduction initiatives worthwhile? should there be any follow-up – Load Tracking or IFLA?

Some Common Problems Associated with QLA

A drawback with QLA is that if statistically valid data is required on a small number of fish species or products from a multi-species fishery then, unless a survey is going to be very large, the species of focus must be prioritized according to logical criteria. Otherwise the survey may collect data on a large number of different species/products and there may not be enough data on particular species of interest which could be used to draw statistical conclusions.

Questionnaires which include a large number of questions (more than 10) and require quite detailed answers can cause respondent and enumerator fatigue – keep questionnaires as short as possible.

Whilst it is possible to quantify losses using a QLA, for reasons such as the difficulty in standardizing traditional units and collecting data on prices, the method is best used for simpler investigations and validations. Load Tracking is the method recommended for accurate quantification.

Fabrication of data by enumerators can occur because of laziness, lack of incentive, a lack of understanding of the QLA purpose or difficulty in relationship with respondents.

Appendices

Appendix 1 – Measuring Fish Price

Fish is a highly perishable commodity and like many other such foods the price at which it is sold can vary on a weekly, daily and even hourly basis. Traders often accept that they will not be able to sell all their fish at the same price irrespective of quality changes.

For example, at a major urban fresh fish wholesale and retail market in India, one merchant commented that he will try to sell all the fish he buys in the morning by the end of the day even if this means dropping the price of the fish. This was so he would avoid the cost of icing the fish overnight and would not have to worry about fish being stolen when held overnight.

Furthermore, price reductions may not necessarily be a loss in the sense that they may be part of a promotional marketing strategy to attract customers.

The manual includes references to the **best price**, which is used as a bench mark to measure loss due to price reductions. It is recommended that ideally, the best price is an average price based on several observations taken over the course of a sampling period.

There are two ways in which average prices can be measured, i.e. **weighted average selling price** and **clean average pricing**.

Weighted Average Price
Assume a 100 kg consignment of fresh mackerel is sold as follows:

50 kg	sold at	100 sh	= 5000
20 kg	sold at	75 sh	= 1500
20 kg	sold at	50 sh	= 1000
5 kg	sold at	20 sh	= 100
(5 kg which cannot be sold)			

Total revenue = 7600

The average selling price is 7600/100 = 76 sh

(For more information see Shepherd, 1993.)

Clean Average Price
If five prices are available for a particular fish or from different respondents:

1	15
2	22.5
3	22.5
4	20
5	20

Step 1 Cross out the highest price (22.5) and the lowest price (15).

Step 2 Calculate the average of the remaining three prices
(20 + 20 + 22.5)/3 = 62.5/3 = 20.83

Step 3 Round-off the average to the nearest 0.5
20.83 becomes 21

A similar process is applied to other numbers of prices.

(For more information see Shubert, B., 1983.)

Bear in mind that collecting detailed data on prices may adversely affect the rapport between researcher and respondent. Likewise, a great deal of data on prices can make data anlysis complicated and lengthy.

Appendix 2 – Resource Organizations to Contact Regarding Post-harvest Fish Loss Assessment

Natural Resources Institute
Central Avenue
Chatham Maritime
Kent
ME4 4TB
United Kingdom

Tel: +44 (0)1634 880088
Fax: +44 (0)1634 880066/77

Nigerian Institute for Oceanography and Marine Research
PMB 12729
Victoria Island
Lagos
Nigeria

Tel: (234) 01 2617530, 2617535, 2617540
Fax: (234) 01 2619517

West African Association for the Development of Artisanal Fisheries
17 BP 56 Abidjan 17
Côte d'Ivoire

Tel: +(225) 20227588/20217170
Fax: +(225) 20227592

Catalyst Management Services Ltd
179, 6th Main
KEB Layout 1st Stage
Geddalahalli
Bangalore
India 560 094

Tel/Fax: (91) 80 3419616

Statistical Services Centre
The University of Reading
Harry Pitt Building
Whiteknights Road
Reading, RG6 6FN, UK

Tel: +44/0 118 931 8025
Fax: +44/0 118 975 3169
statistics@reading.ac.uk
http://www.rdg.ac.uk/ssc/

Appendix 3 – Glossary of Statistical Terms

5% level	The usual level at which significance is tested. If significant at 5% it means the result had less than 5% chance of occurring.
Analysis of variance	Method for comparing more than two treatments
Blocking	Technique for controlling variability during experiments
Confidence interval	Limits defining how accurate an estimate is
Confounding factor	Something other than the experimental factors which might effect a LT experiment. e.g. adverse weather conditions during transport
Continuous data	Data where all values can exist within a certain range, i.e. length of fish
Correlation	Simple technique for quantifying linear trend
Covariate	An observation that can affect treatment comparisons, e.g. if all containers with the intervention were heavier than those without, initial weight might have a covariate effect
Data points	One measurement equals one data point
Degrees of freedom	One less than the number of items in a sample
Diagnostic plots	Plots of residuals that test analysis of variance assumptions, available in most software packages
Discrete data	Scores, grades, ranks or counts
Experimental unit	One response is measured for each unit – should not be one fish
Factor	Term used to describe a quantity within an analysis of variance, e.g. time can be a factor with levels before and after storage
Mean	Identical to the average
Median	The middle number in a set of observations arranged in ascending order
Non-parametric methods	Alternative techniques which do not assume normally distributed data
Normal data	Refers to data that are normally distributed, i.e. have a central tendency with equal tails at each side
Numerical methods	Modern non-parametric techniques, that can only be applied by specialized software
Paired t-test	Techniques for comparing two treatments that have been measured on the same unit
Pseudo-replication	Repeated sampling from the same container. For example, if a container contains 100 fish, using the fish to give 100 replicates. This should be avoided and experimental units of more than one fish sub-sampled.
Quartile	The number at 1st, 2nd (median), and 3rd quarter in a set of ascending observations
Regression	Method for formal modelling of trend in data
Replication	Number of experimental units
Residual degrees of freedom	Represents amount of data used to estimate variance of data in analysis of variance – should be at least double figures
Residuals	The difference between the actual and fitted data used to check the assumptions of analysis of variance
Response	The quantity physically measured by the experiment
Scatter plot	Used to quickly examine the relationship between two variables
Significant	Refers to a statistically large and likely to be important difference
Skewed data	Distributions with one tail much longer than the other
Split-plot analysis	An analysis technique for experiments with within and between experimental unit variation

Standard deviation	The square root of the variance
Standard error	Usually refers to the variability in the average value
Summary statistic	Often the average of a data set
Systematic/random	Very common form of sampling, with both a systematic sampling and a random component
Transformation	Transformations are used to try and improve the normality assumption, e.g. for count data a square root or log transformation might be appropriate
Treatment	Refers to items being compared, i.e. before and after can be termed a treatment
Trend	Relationships between variables
t-test	Technique for comparing two treatment means
Variables	Different responses recorded in same experiment, for example the number of broken of fish and the weight of cartons
Variance	Represents the variability in the data

Appendix 4 – Demerit and Merit Scoring

Demerit scoring systems have long been used by fish buyers in some parts of the world to assess systematically fish quality. An extension of this has been used during fish loss assessments to give indicative quantitative data on the relationship between quality and price and hence financial loss. Demerit scoring could also be used to monitor changes in fish quality that occur when intervention strategies are used to improve fish quality. Demerit refers to quality deterioration given increasingly higher scores or numerical values. In some situations the reverse approach may be more appropriate whereby the score decreases as quality deteriorates. This latter approach is termed merit scoring.

Demerit or merit scoring relies on objective scoring of particular attributes of a fish such as gill colour, gill smell and eye shape in the case of fresh fish and colour, damage and insect infestation in the case of traditionally processed fish. Each attribute is scored according to its condition and the total score of all attributes for a fish is calculated. The score for the freshest or best quality fish is always zero for a demerit system. As quality changes and the condition of attributes changes this will be reflected in the score.

Some preparation will be needed beforehand for this tool. A score chart should be developed for the fish species or products to be assessed. Different scoring systems are used for fresh and cured fish as well as for crustaceans. An example of a merit score sheet for smoked fish is given below followed by a comprehensive demerit score sheet for assessing the quality of gutted whole fresh fish. In reality a much simplified version of this using only one or two attributes may work best. Often the attributes which local processors and traders use to assess quality are ideal. It is important though that the same score sheet is used for a particular product or species and that all attributes are scored for each sample. It is also important to be objective about the scoring.

By weighing and pricing fish that has been assessed, it will be possible to work out the price per kilogram of fish according to the score. Standardizing like this will make comparison between different samples easier. It is important to bear in mind how price can vary for the same species and the same quality score. For example, the size of fish can also affect price, as can the time at which samples are taken. Price can vary over time on a particular day due to supply and demand.

A problem with using this tool is that the owner or seller of the fish may be reluctant to let his or her fish be assessed, especially if the fish are on display for sale at the time of assessment. A way to overcome this problem is to purchase the fish from the seller (resources permitting).

Parameter	Quality		
	Good (2)	Average (1)	Poor (0)
Colour	Golden brown	Dark brown	Black
Taste	Meaty/smoke flavour	Bland	Sour/bitter
Physical state	Whole (head/tail intact)	Head/tail dangling	Broken (head/tail off)
Dryness	Brittle	Slightly dry	Soft
Burn	None	One side	Both sides
Skin	Completely intact (no peeling off)	Part peeling off	Completely peeling off

Figure 17 Merit score sheet for smoked fish.

APPEARANCE		v.bright	bright	sl.dull	dull
		0	1	2	3
SKIN		firm	soft		
		0	1		
SCALES		firm	sl.loose	loose	
		0	1	2	
SLIME		absent	sl.slimy	slimy	v.slimy
		0	1	2	3
STIFFNESS		pre rigor	rigor	post rigor	
		0	1	2	
EYES	clarity	clear	sl cloudy	cloudy	
		0	1	2	
	shape	normal	sl sunken	sunken	
		0	1	2	
	iris	visible	not visible		
		0	1		
	blood	no blood	sl blood	bloody	
		0	1	2	
GILLS	colour	red	dull red	pale pink	
		0	1	2	
	mucus	absent	moderate	excessive	
		0	1	2	
	smell	fresh	fishy	stale	spoilt
		0	1	2	3
BELLY	discoloration	absent	detectable	moderate	excessive
		0	1	2	3
	firmness	firm	soft	burst	
		0	1	2	
VENT	condition	normal	exudes	opening	
		0	1	2	
	smell	fresh	neutral	fishy	spoilt
		0	1	2	3
BELLY CAVITY	stains	opalescent	greyish	yellow/brown/green	
		0	1	2	

Figure 18 Demerit score sheet for whole fresh gutted fish.

Appendix 5 – Training Seminar Agenda

DAY 1
Introduction
- *Enumerators*

Post-harvest Fish Losses Research
- *Background to fish loss assessments*
- *Previous work (if any) in the country/area including pre-survey appraisal*
- *Survey objectives*
- *What information the survey will provide*
- *Importance of that information*

Shape of the Research
- *Areas and fisheries involved: the reason behind site selection*
- *Data management regime/hierarchy*
- *Different stages for losses: overview of the questionnaires*

Role of Each Level of Staff
- *Requirements*
- *Expectations*
- *Job Descriptions: no fabrication; record at right time; clean, legible data sheets; make additional interesting notes on losses and any explanations; tell supervisor immediately of any problems or difficulties; send data quickly every month, with any interesting notes to supervisor*

DAY 2
Payments
- *Level of enumerator payment*
- *How payments are organized*
- *Accountability*
- *How often, depending on data timeliness and quality*
- *If delay, don't worry – it will arrive soon*
- *New books, pens, etc. from supervisors*

Questionnaire Rationale. For Each Questionnaire:
- *Who to interview; who <u>not</u> to interview*
- *Reason for focus*
- *Sampling: practice for random and linear methods*
- *Method of data collection: questions, answers and codes*
- *Run through each one on a board*

Interview Technique
- *Nature of data collection: favour, confidence, no obligation*
- *Introduction: who you are, what you are doing,*
  – assurance of confidentiality, no negative effects
  – answer any questions politely and correctly
- *Manner: polite, patient, not critical, not aggressive*
  – appear interested, speak clearly
- *Their work is more important: wait if necessary*
- *All leads to better quality data*
- *Understanding what information is required is more important than learning directly. Then you can be flexible if necessary * How to do each one, including filling answers on board * How <u>not</u> to do each one * Recorders try on each other*

DAY 3
Visit the Data Collection Sites
- *Enumerators practise filling in questionnaires*
- *One interviews and fills, the others fill*

DAY 4
If resources permit, the enumerators and supervisors should spend an extra day practising the interviewing technique, preferably in the field.

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