# Quantitative data on post-harvest fish losses in Tanzania. The fisheries of Lake Victoria and Mafia Island. February - 1996

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# Quantitative Data on Post-harvest Fish Losses in Tanzania. The Fisheries of Lake Victoria and Mafia Island.

*Prepared by:*

**Ansen Ward**

Natural Resources Institute
Chatham
Kent
United Kingdom

**February 1996**


Natural Resources Institute


Overseas Development Adminstration

## Acknowledgements

This research would not have been possible without the support of the Tanzania Fisheries Division. The author would like to thank Mr T Maembe, Director of Fisheries and all the Division staff that participated in the research for their efforts. The author would also like to express his gratitued to the Principals and staff of Mbegani Fisheries Development Centre where much of the planning and data analysis of the research took place. A special word of thanks must go to the Project National Co-ordinator, Mr Y Mndeme, also of Mbegani Fisheries Development Centre, whose valuable commitment and dedication to his work was highly commendable.

The British Council in Tanzania provided excellent support, both in terms of financial management and logistics. Much of this very important aspect of the project was orchestrated by the Deputy Director of the Council, Peter Llewellyn. Thanks must also go to all the other British Council staff who assisted over the course of the project.

This research was funded by the Overseas Development Administration of the United Kingdom, R5027. However, the Overseas Development Administration can accept no responsibility for any information provided or views expressed in this report.

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## Executive Summary

This report presents a summary of the data generated during the development of two fish loss assessment methodologies. A formal recall questionnaire survey was designed and used to generate quantitative data. The other methodology developed was an informal one based on the tools and techniques of Participatory and Rapid Appraisal, the development of this generated qualitative as well as indicative quantitative data on fish losses. The work was done in Tanzania by the Natural Resources Institute (NRI) as part of the Overseas Development Administration's Post Harvest Fisheries Research Programme. It was done in collaboration with the Fisheries Division of Tanzania between 1992 and 1995. Most of the data presented in the report is quantitative, from recall questionnaire surveys of the fishing, processing, transport and retail sectors of the Lake Victoria fishery from 1993 to 1995 and of the Mafia Island fishery from 1994 to 1995. The data on post-harvest losses is presented according to survey site, fishing method and product type. The report also presents data on the reasons why losses are occuring.

The report is designed primarily for use by the Government of Tanzania. It will also be of interest to non-governmental organisations planning work in the post-harvest fishery sector of Tanzania, and to fisheries researchers interested in the subject of post-harvest losses.

The questionnaire survey data shows that the most significant monetary loss in the fisheries surveyed is in the Nile perch gill net fishery of Lake Victoria - on average 4.1% of the value of a gill net catch is lost to fishermen. Most of this loss is due to selling fish for a reduced price to fish salters, mainly because it was of a quality that was unacceptable to fresh fish buyers and traders. Multiplying the figure of 4.1% with the estimated 2000 gill net fishing units on Lake Victoria gives an annual overall loss in revenue to fishermen of 267 million Tanzania shillings. The data for the fishing sector also indicates that loss levels are spatially variable: the loss level at more remote sites being greater than the levels at more urban sites.

The Nile perch export processing industry in the Lake Victoria region has expanded significantly over the last three years and now offers a major market for artisanally caught fish. Historical data suggests that losses were much higher in the Nile perch fishery and that because of the factory sector and the keen competition for perch the present total loss level of 4.1% at the fishing level is relatively low compared to loss levels in former times. It is likely that the growth of the export processing sector and the market for fish it has created, has played a significant role in the reduction of post-harvest losses in the Nile perch fishery. Fishermen now have an incentive to handle their catches better and sell to the factories, and this, coupled with the large number of operators in the sector, has led to the reduction in loss levels. This export sector, if it remains stable, is likely to play an important role in reducing losses at remoter sites where losses have been found to be relatively higher than at more accessible sites.

Average loss levels in the artisanal processing sector are generally the highest in terms of percentage. The average total loss in the frying sector per processor is 7.6%, for

scorching it is 7% and smoking it is 5.7%. The exception is in the salting sector where the total loss is lower at 2.5%.

Monetary loss from the dagaa processing sector is the second highest, and is estimated at 69.5 million Tanzania shillings per annum. The main causes of this loss to dagaa processors are bird predation, theft, spoilage and colour change. Losses of dagaa are especially high during the rainy seasons. Observations during the course of the research suggest work could be done to promote the use of appropriate preservation techniques that will help mitigate the problem of colour change. The first course of action would be to assess work on dagaa processing undertaken by other projects in the Lake Victoria and Tanganyika areas, especially the success of smoking dagaa in Kagera region which is being tried by a UNDP project there.

Survey data shows that loss levels are generally lower in the Mafia Island marine fishery than those of the Lake Victoria fishery.

In the Mafia fishery, the fishing sector has the highest monetary loss. Fishermen lose an estimated 14 million Tanzania shillings annually. The average percentage total loss in the Mafia fishing sector was found to be 2.5% of the value of a fisherman's catch, although much of this loss is recorded as "self processing" of fish by fishermen. The highest loss level was found to be in the processing sector where on average 3.1% of the value of processed fish is not realised.

The results of adding the sector losses together to give the average percentage total loss (the physical loss plus the loss due to selling fish for a reduced price) according to product type for the Lake Victoria the Mafia Island fishery is shown in Figure 1 below. This represents the loss from capture to consumer.

The results in Figure 1 show that for the two artisanal fisheries studied the post-harvest fish losses are lower than global historical loss figures of 20% suggest the losses ought to be. Also, the data clearly show the difference in loss levels according to product. For example the loss in percentage terms of smoked fish was found to be over twice that of salted fish.

As the questionnaire data have not been analysed exhaustively, there is scope for further analysis. It is suggested that the following analysis could be done to consolidate the existing research results.

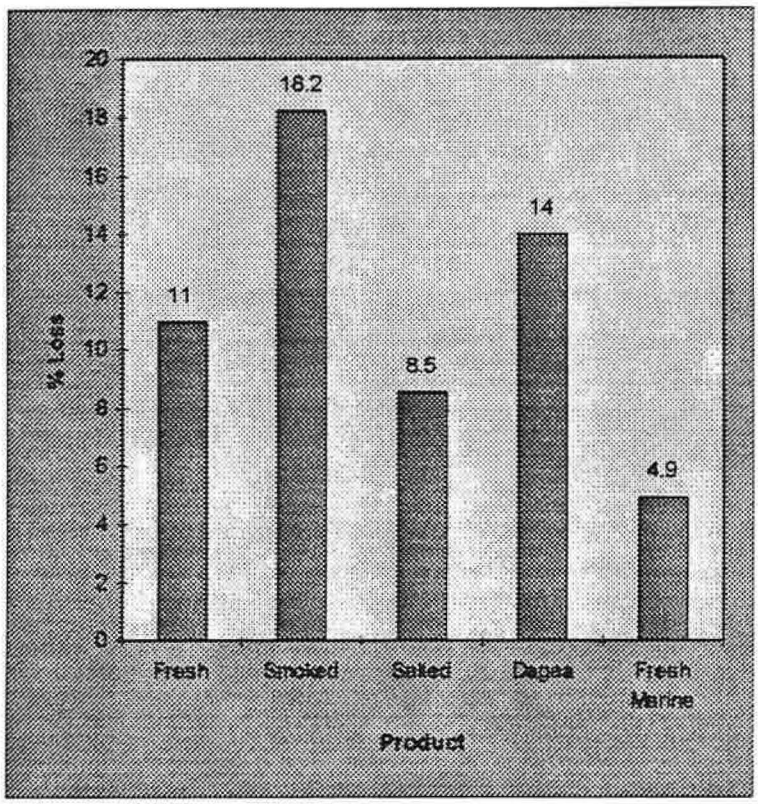
a) Investigate the reasons for the spatial variation in loss levels in the Lake Victoria fishing sector.

b) Investigate seasonal loss trends and determine whether the assumption that loss levels in the Nile perch gill net fishery have decreased over time.

c) Develop statistical tests that can be applied and incorporated into the methodologies as part of the analysis procedure.

e) Investigate the relationships between variables such as transport type and length of journey time and loss levels.

**Figure 1 Total Post-harvest Loss From Capture to Consumer**




The informal methodology based on the tools and techniques of Rapid/Participatory Rural Appraisal proved to be a quick and less costly method to implement than the formal questionnaires. In all, 13 studies were done as part of the development of this methodology. The studies focused on sectors covered by the questionnaire survey as well as other sectors such as the artisanal prawn fishery of the Rufiji delta. The methodolgy has generated qualitative as well as indicative quantitative data on fish losses and can be used to generate data on issues the questionnaire survey covered, such as the reasons for and the seasonality of losses.

A cursory appraisal of the data from the two methodologies shows examples where both have produced similar results when used in the same sectors. It is suggested that with a more rigorous application of certain aspects of the informal methodology, it could be used to produce good quality indicative quantitative data. As the two methodologies have been found to produce similar quantitative results when used to assess losses in the same fishery sectors, the choice of which methodology to use for quantifying losses may be determined by the resources available to the user. If time and money are constraints to potential users of the methodologies then of the two, the informal one is likely to be the more attractive option as it is cheaper to implement and produces results relatively quickly.

## Introduction

World fish production has remained at a fairly constant level for several years whereas the demand for fish and fish products is increasing in line with population growth. There is a clear and growing imbalance between fish supply and demand. For many years it has been recognised that one way to try and address this imbalance is to reduce post-harvest fish losses. Losses being typically defined as the throwing away of fish because of spoilage or the destruction of fish due to damage from pests, particularly insects.

Historically, there has been a lack of accurate quantitative data on fish loss levels. Most estimates of losses have been based on snap shot observations coupled with large extrapolations, with a result that 20% and over, from point of capture to consumer, has been generally regarded as the average level of post-harvest fish loss.

If fisheries planners and policy makers were to be able to make informed decisions in an attempt to reduce loss levels then tried and tested methodologies for accurately assessing losses should be available. Such methods have not been available mainly because of the the difficulties associated with assessing the losses in multi-species fisheries and the problem of measuring quantities of fish under survey conditions.

The 1992 Strategy for International Fisheries Research (SIFR) meeting concluded that research should be directed towards developing a more systematic approach to assessing fish losses. The aim of the research being to produce the methodologies needed by policy makers and planners. The Natural Resources Institute with funding from the Overseas Development Administration of the United Kingdom took on this research task in collaboration with the Fisheries Division of Tanzania.

Tanzania, with its freshwater and marine fisheries and extensive and diverse fish distribution network, provided an ideal country in which to research and develop loss assessment methodologies. The research took place over a three year period from 1992 to 1995, during which time two fish loss assessment methodologies were developed and a vast amount of data on fish losses in Tanzania produced.

This report presents a summary of the data generated by the two fish loss assessment methodologies developed and used in Tanzania. The methodologies are complementary, in that one was designed to generate quantitative data and the other qualitative data on fish losses. The report is designed primarily for use by the Government of Tanzania. It will also be of interest to non-governmental organisations planning work in the post-harvest fishery sector of Tanzania and to fisheries researchers generally.

Most of the data presented in the report is quantitative, from recall questionnaire surveys of the Lake Victoria fishery from 1993 to 1995 and of the Mafia Island fishery from 1994 to 1995. Included are data on the levels of post-harvest fish losses according to site, product type and fishing method.

Recall questionnaire surveys were conducted in the fishing, processing, transport and retail sectors of the Lake Victoria and Mafia Island fisheries. The Lake Victoria survey was designed to collect data on the losses of Nile perch (*Lates niloticus*) and dagaa (*Rastrineobola argentea*) in two lakeshore regions (Mwanza and Mara) as well as collecting data on the losses of these fish in Dar es Salaam. The survey of the Mafia

Island fishery targeted the four most commercially important species in the domestic market. These were identified as snappers (*Lutjanus spp & Lethrinus spp*) known locally as "changu", spinefoot (*Siganus spp*) known locally as "tasi", trevally (*Carangoides spp & Caranx spp*) known as "kolekole" and finally mackerel (*Atule spp & Rastrelliger spp*) known as "kibua". A map summarising some of the key sites related to the surveys appears in Figure 2. An overview of the questionnaire survey methodology is included as Appendix 1. The original survey methodology is described in detail in Ashley (1993).

A more detailed description of the two methodologies is being prepared by NRI in the form of a fish loss assessment manual. It is anticipated that a draft of the manual will be ready early 1996.

The purpose of Chapter 1 is to summarise the data on the post-harvest fish losses generated by the questionnaire methodology for the whole of Tanzania. Chapter 2 covers the questionnaire data in more detail and includes some observations from informal field studies. The quantitative data presented in these two chapters is a result of computerised analysis of data collected by questionnaire interviews.

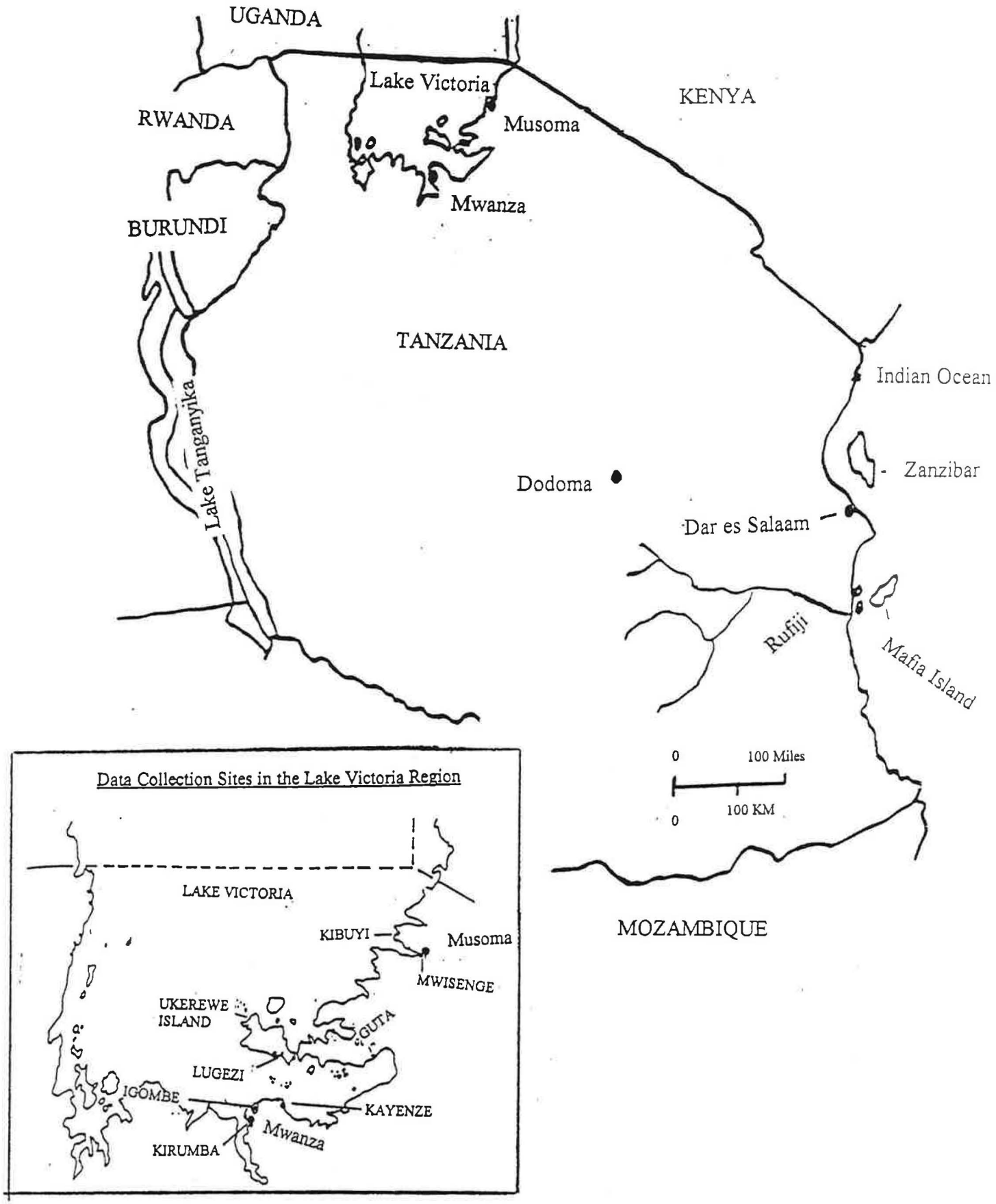
The report also includes, in Chapter 3, a summary of the qualitative and indicative quantitative data from 13 separate fish loss assessment studies carried out over a period of 12 months. These studies were used to develop an informal loss assessment methodology. This methodology is based on the principles of Rapid and Participatory Rural Appraisal. These studies are not included in detail in this report. They are to be combined in full by NRI as a separate report and also as a summarising document. An overview of the methodology is included as Appendix 2.

The last chapter, Chapter 4 is a comparison of the data generated by the questionnaire with that of the informal studies. It highlights some of the differences between the two methodologies and the financial costs involved in applying them.

The information presented in the report does not represent an exhaustive analysis of the raw data. The results presented have been produced as a result of the development of analysis procedures for the methodologies, especially the questionnaire survey. In other words there is scope for further analysis of the raw data to explore issues of interest and importance to the end user. At the time of writing, all the raw questionnaire survey data analysed for this report is held in a computerised database at Mbegani Fisheries Development Centre.

Much of raw data the project has generated will be used by NRI in a post-harvest fish loss assessment database and model. The database is currently being developed and will include post-harvest fish loss information from other sources and from fisheries in other parts of the world.

**Figure 2 MAP OF RELEVANT SITES AND PLACES**



A summary of the data presented in this report plus an outline of the two methodologies was presented by project staff to Tanzanian Fisheries Division staff at a one day workshop in July 1995. It was felt at the workshop that the most important next step would be to disseminate the research findings to two distinct target audiences: the fisherfolk of Tanzania and fisheries research institutions and organisations world-wide. An overview of the workshop is included as Appendix 3. A proposal for a project to disseminate the results presented in this report was drafted after the workshop and is presented as Appendix 4.

**Definitions.**

There are no hard and fast rules about the definition of post-harvest fish losses. The losses in this report are defined in terms of the loss to the operator i.e. the fishermen or retailer. There are four types of loss used in this report:

**Physical loss** - this refers to fish that has been thrown away or not sold. It is expressed as a percentage of the total batch or catch of fish.

**Reduced price loss** - this is the loss in revenue to the seller resulting from selling fish for a price less than the best price attainable. The loss in revenue is expressed as a percentage of the theoretical maximum value of a catch or batch of fish, based on all fish being sold for the best price.

**Total Loss** - this refers to the monetary value of the physical loss plus the loss in revenue because fish have been sold for a reduced price. The total is expressed as a percentage of the maximum value of a catch or batch of fish.

In some of the tables the proportion of fish sold for a reduced price is given, this is the physical amount of fish sold for a reduced price and is different to the reduced price loss defined above.

## CHAPTER 1 - Post-harvest Fish Losses in Tanzania - A Synopsis

This Chapter is a general summary of the data from the questionnaire surveys of the Lake Victoria and Mafia Island fisheries. It includes the levels of loss and the reasons why losses occur.

The data shown in Table 1 is from the questionnaire survey of the Lake Victoria and Mafia Island fisheries. The data for the Lake Victoria fishery is for Nile perch unless dagaa is mentioned in the sub sector column. The table shows the average percentage loss levels for an operator i.e. fishermen from a sample population at a data collection site. It has been assumed the operators sampled and the data collection sites are representative of the particular sector surveyed. Raising factors have been used to amplify the survey data to represent the relevant fishery sector. Due to a lack of available data on the numbers of operators working in each sector and the frequency at which they operate the raising factor data is mainly based on informed estimates. The paucity of the raising factor data coupled with time constraints is one reason why the data has not been subjected to statistical analysis.

**Table 1 Tanzanian Fish Losses Summary**

| Sector | Fishery | Sub Sector | Total Loss % | Physical Loss % | Average Max Value Tsh | Average Total Loss Tsh | Sectoral Number Operators | Frequency of Operation | Origin of Raising Factor | Annual Sector Loss Tsh |
|---|---|---|---|---|---|---|---|---|---|---|
| Fishing | L Victoria | | | | | | | | | |
| | | Gill net | 4.1 | 2 | 10865 | 445 | 2000 | 300 | Inf | 267,279,000 |
| | | Beach S | 0.3 | 0.1 | 8469 | 25 | 500 | 300 | E | 3,811,050 |
| | | Long | 4.1 | 3 | 12134 | 497 | 200 | 200 | E | 19,899,760 |
| | Mafia I | all | 2.5 | 2.3 | 11351 | 284 | 200 | 250 | E | 14,188,750 |
| Processing | L Victoria | Dagaa | 6.4 | 3.8 | 36214 | 2318 | 1000 | 30 | Inf | 69,530,880 |
| | | Smoke | 5.7 | 2.5 | 37245 | 2123 | 200 | 50 | E | 21,229,650 |
| | | Salt | 2.5 | 2.2 | 109877 | 2747 | 300 | 50 | E | 41,203,875 |
| | | Fried | 7.6 | 7.1 | 9403 | 715 | 200 | 50 | E | 7,146,280 |
| | | Scorch | 7 | 6.5 | 5320 | 372 | 100 | 50 | E | 1,862,000 |
| | Mafia I | all | 3.1 | 2.7 | 5320 | 165 | 100 | 50 | E | 824,600 |
| Transport | L Victoria | Fresh | 3.7 | 1 | 323561 | 11972 | 30 | 50 | Inf | 17,957,636 |
| | | Smoke | 4.3 | 0.01 | 284929 | 12252 | 10 | 20 | E | 2,450,389 |
| | | Salt | 1.4 | 0.1 | 497004 | 6958 | 20 | 20 | E | 2,783,222 |
| | | Dagaa | 1.7 | 0.3 | 1208141 | 20538 | 100 | 11 | Inf | 22,592,237 |
| | Mafia I | Fresh | 1.2 | 0 | 241113 | 2893 | 15 | 25 | | 1,085,009 |
| Retail | L Victoria | Fresh | 3.7 | 1.5 | 67311 | 2491 | 100 | 100 | E | 24,905,070 |
| | | Smoke | 5.4 | 0.8 | 47469 | 2563 | 100 | 50 | E | 12,816,630 |
| | | Salt | 1.8 | 0.1 | 352734 | 6349 | 50 | 50 | E | 15,873,030 |
| | | Dagaa | 2.7 | 0.8 | 62332 | 1683 | 200 | 50 | E | 16,829,640 |
| | Mafia I | all | 1.2 | 0.1 | 97374 | 1168 | 50 | 50 | | 2,921,220 |

"E" = data on raising factors is an informed estimate. (Exchange rate $US = 550 Tsh)
"Inf" indicates the data is derived from one of the project's informal studies

**Description of Terms in Table 1:**

Total Loss %

The total loss refers to the sum of the monetary value of the physical loss and the loss in revenue due to fish being sold for a reduced price, expressed as a percentage of the maximum value of the catch or batch of fish. The maximum value is calculated using the best price paid for fish.

For example if out of a catch of 100kg, 10kg is thrown away and 50kg are sold for a reduced price the total loss would be the physical loss (10kg) multiplied by the price paid for good quality fish, plus the reduced price loss (50kg x best price - 50kg x actual price), divided by the maximum value of the catch (100kg x best price) multiplied by 100.

To clarify what is meant by a reduced price loss. Fish may be sold for a lower price for various reasons. These include quality deterioration and changes in demand and supply. Whatever the cause, the fact remains there has been a loss in revenue to the seller.

Physical Loss %

The physical loss is the proportion of fish not sold by the seller for reasons such as spoilage, theft and damage.

Average Maximum Value

The average maximum value in Tanzania shillings is the theoretical value of a catch or batch of fish based on the price paid for the best quality fish of the batch and assumes all fish have been sold for the best price. The price used is from the questionnaire data.

Average Total Loss

The average total loss in Tanzania shillings is the average total loss percentage converted into a monetary value. It is the actual money the seller does not get because of losses each time he or she operates.

Sectoral Operators

Sectoral operators refers to the estimated total population of the sector surveyed. It is a raising factor. For example there are thought to be 2000 gill net canoes on Lake Victoria operating at any one time. As data on numbers of canoes, processors, transporters and retailers were not readily available, all the figures under sectoral operators are informed estimates based on observations and informal study findings.

Frequency of Operation

The number of times a sectoral operator fishes or sells fish in a year is termed the frequency of operation. This is another raising factor and as with sectoral operators this data is based on observation and informal studies.

Origin of Raising Factor

This column has been included in the table to denote the source of the data on the number of sectoral operators and frequency of operation.

Annual Sector Loss

The final column is perhaps the most significant in overall terms. Annual sector loss in Tanzania shillings is the total loss interpreted on a sector scale rather than on an individual operator level. The annual loss is calculated by multiplying the average total loss in Tanzania shillings by the number of sectoral operators and then by the frequency of operation.

From the table it can be seen that the most significant monetary loss, according to fishery sector, occurred in the Lake Victoria gill net fishery. Over the previous two years it has been estimated there has been an annual loss in revenue to fishermen of 267 million Tanzania shillings. On average 4.1% of the value of a gill net catch is not realised, and is lost to fishermen. This is equivalent to 445 Tsh per operator per fishing trip. About 1 % of the catch is physically lost before or after landing. And 1% of the catch is self processed by fishermen. The remainder of the loss is due to selling fish for a reduced price, mainly because the fish is of a quality that is unacceptable to fresh fish traders, many of whom supply fish to the export processing factories in Mwanza and Musoma.

Generally the highest percentage "total losses" occur in the processing sectors. For the Lake Victoria Nile perch fishery the total loss in the frying sector is 7.6%, and for scorching it is 7%. The average total loss in the dagaa processing sector is 6.4% and in overall terms this sector has the second highest annual monetary loss of 69.5 million Tanzania shillings. On average 3.8% of dagaa is physically lost during the processing stage. In the Mafia fishery the highest percentage loss also occurs in the processing sector. Generally the physical loss of fish also tends to be highest in the processing sector.

In the Mafia fishery, the fishing sector has the highest monetary loss. Fishermen in overall terms loose an estimated 14 million Tanzania shillings annually. The average percentage total loss in the Mafia fishing sector was found to be 2.5% of the value of a fisherman's catch. Although much of this loss is due to self processing of fish by fishermen.

## CHAPTER 2 - QUESTIONNAIRE DATA

This chapter presents a summary by fishery sector (fishing, processing, transport and retail) of the data on fish losses generated by the quantitative questionnaire survey of the Lake Victoria and Mafia Island fisheries. The data are presented according to fishery and sub sector. For Lake Victoria there are summaries according to data collection sites and for Mafia Island the summaries are according to fish species (the survey for Mafia concentrated on four commercially important species). In some sections of this chapter are data from the qualitative studies, highlighted in Chapter 3, which have been included to complement the quantitative data. At the end of the chapter there is a section on how the data generated by these surveys compare to historical data on post-harvest fish losses.

**Explanation of Data on Reasons For Post-Harvest Fish Losses:**
Before describing the losses in more detail it is worth mentioning the way the data on the reasons for losses are displayed in this chapter. Using the example of the Mafia Island fishing sector in the table below. The "reason" column shows the reasons why fish have been lost. The % figure indicates the proportion of fish that was lost according to the various reasons. For example 83.1% of the fish physically lost is due to fish being self processed and 14.3% of the fish has been "shared out". Likewise it can be seen that all the fish sold for a reduced price are done so because of reasons other than those in the choice of answers on the questionnaire. All this fish (100%) has been sold for salting as can be seen in the "end use" column.

**Mafia Island Fishery - Reasons For Losses**

| SECTOR | PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|---|
| | all | **Physical** | Self Processed | 83.1 | | |
| | | | Shared | 14.3 | | |
| **Fishing** | | | Stale | 2.5 | | |
| | | | Rotten | 0.1 | | |
| | | **Reduced** | Other | 100.0 | Salting | 100.0 |

## Fishing Sector - Lake Victoria

Recall questionnaires were used by trained enumerators over a two year period at the following sites to interview Nile perch fishermen twice monthly about their post-harvest fish losses:

| | |
|---|---|
| Igombe (fishing village) | - Mwanza Region |
| Lugezi (fishing village) | - Mwanza Region |
| Kayenze (fishing village) | - Mwanza Region |
| Guta (fishing village) | - Mara Region |
| Mwisenge (fish landing) | - Mara Region |

In total there were 2833 recorded interviews with fishermen. The survey enumerators interviewed predominantly gill net fishermen, except at Mwisenge where 98% of interviews were with beach seine fishermen. In overall terms, 71% of interviews were with gill net fishermen, 25% were with beach seiners and 4% with longline fishermen. Table 2 below shows the number of records per recording site and the proportion of records according to fishing gear type.

**Table 2 Lake Victoria Fishing - Data Collection Sites and Fishing Gears**

| | IGOMBE | LUGEZI | GUTA | KAYENZE | MWISENGE |
|---|---|---|---|---|---|
| Gill net % | 85 | 91 | 95 | 99 | 2 |
| Beach seine % | 2 | 4 | 2 | 0 | 98 |
| Longline % | 13 | 5 | 3 | 1 | 0 |
| Total Number of Interviews | 470 | 473 | 721 | 481 | 688 |

Analysis has shown that the loss to fishermen varies according to the type of fishing gear used as can be seen from Table 3. For gill net fishing, the total loss was found to be 4.1 % of the maximum value of the catch, for beach seines 0.3 % and for longlines 4.1%. Physical losses are on average 2 % for gillnets and only 0.1 % for beach seines. Although half of the gill net physical loss is accounted for by fish that are processed by fishermen for self consumption rather than thrown away.

From a batch of fish caught by gill net fishermen 4.4% by weight will be sold on average for a reduced price. The reduced price is 52% that of the best price (the price good quality fish would sell for).

## Table 3 Lake Victoria Fishing - Loss Summary

| | Gill Net | Beach Seine | Long Line |
|---|---|---|---|
| Average Catch (kg) | 82 | 141 | 88 |
| Average Catch Value (Tsh) | 10845 | 8472 | 12135 |
| Average Price for Good Quality Fish(Tsh/kg) | 141 | 68 | 147 |
| Average Total Loss (%) | 4.1 | 0.3 | 4.1 |
| Average Physical Loss (%) | 2 | 0.1 | 3 |
| Average % of fish sold for reduced price(%) | 4.4 | 0.3 | 3 |
| Average reduced price as % of best price(%) | 52 | 45 | 61 |

Table 4 shows how the average total loss varies from site to site. The loss is highest at Lugezi at 7.8% and lowest at Mwisenge. However, as the data on reasons why losses occur in Table 5 is not site specific it is not possible with the data available to explain the reasons for this difference. Further analysis of data is needed. It can be speculated that the relative remoteness of Lugezi and the consequential weakness in the marketing system is likely to be a reason why losses are high. Similarly the nearness of Mwisenge to Musoma town is likely to be a reason why losses are relatively low there.

## Table 4 Lake Victoria Fishing - Loss Summary by Site

| | IGOMBE | LUGEZI | GUTA | KAYENZE | MWISENGE |
|---|---|---|---|---|---|
| Average Total Catch (kg) | 88 | 109 | 57 | 99 | 136 |
| Average Catch Value (Tsh) | 12715 | 12121 | 8052 | 12648 | 8144 |
| Average Price for Good Quality Fish(Tsh/kg) | 162 | 118 | 145 | 138 | 67 |
| Average Total Monetary Loss (%) | 3.8 | 7.8 | 0.4 | 6.3 | 0.0 |
| Average Physical Loss (%) | 2.2 | 5.7 | 0.38 | 0.7 | 0.03 |
| Average of Fish Sold for Reduced Price (%) | 3.5 | 5.2 | 0.15 | 10.9 | 0 |
| Average reduce price as % of best price | 55 | 60 | 51 | 49 | NA |

Table 5 shows the reasons why losses occur. The percentage columns give the proportion of the loss by the different reasons or by the subsequent "end use" of the fish. It can be seen that approximately 88% of fish sold for a reduced price are stale and most of this fish is sold for salting. The data also shows that 31% of the physical loss is due to there being no demand for fish, whereas 29% of fish are thrown away because they are severely spoiled (rotten) and approximately 13% are thrown away because they are stale. No systematic analysis was done for the end use column, but it is known that half of the physical loss is due to self processing by fishermen.

**Table 5 Lake Victoria Fishing - Reasons for Losses**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | **Physical** | No Demand | 31.0 | NA | |
| | | Rotten | 29.3 | | |
| | | Other | 26.8 | | |
| **Fresh** | | Stale | 12.9 | | |
| | **Reduced** | Stale | 88.2 | Salting | 82.3 |
| | | Other | 11.2 | Smoking | 7.1 |
| | | No Demand | 0.6 | Frying | 6.9 |
| | | | | Sundrying | 2.7 |
| | | | | Mongers | 1.0 |

During the course of the survey it was observed that the Nile perch export processing sector has rapidly expanded in the region, particularly in Mwanza town. This sector is now providing an important market for artisanally caught Nile perch. Competition between the different factories for fish is now so keen that each factory has its own fish collection system. Fish are iced and brought by motorised insulated boats and lorries to the factories. This collection system now appears to extend to even the remotest areas of the lake shore, including the islands. However, the factory buyers are selective about the quality of fish they purchase. They do reject fish of poor quality and this is sold by fishermen to fish salters for roughly half the price the factory buyer would have paid. So there is an incentive for fishermen to take better care of their catch and reduce losses. Anecdotal evidence suggests that in the late 1980s and early 1990s the level of post-harvest fish losses for Nile perch was higher than it is now. It is likely that the growth of the export processing sector and the market for fish it has created, has played a significant role in the reduction of post-harvest losses in the Nile perch fishery of Lake Victoria. This sector, if it remains stable, will help in reducing the losses at remote sites such as Lugezi where loss levels are relatively high.

## The Lake Victoria Nile Perch Processing Sector

Recall questionnaires were used at two sites, Igombe and Kayenze fishing villages, to interview Nile perch processors on a twice monthly basis over two years. Both sites were in Mwanza region. In all 874 interviews were conducted with fish smokers, salters, fryers and processors who scorch fish (burning fish in dried grass). Table 6 shows the proportion of interviews for each processing method.

**Table 6 Lake Victoria Processing - Sites and Processing Method**

| | IGOMBE | KAYENZE |
|---|---|---|
| Smoked % | 30 | 69 |
| Salted % | 25 | 31 |
| Fried % | 29 | 0 |
| Scorched % | 16 | 0 |
| Total number of interviews | 569 | 305 |

Table 7 summarises the survey data according to processing method. Within the Lake Victoria Nile perch processing sector the most significant monetary loss is associated with the salting sector (Table 1). About 41 million Tanzania shillings is lost to fish salters annually, even though the average total loss per batch of salted fish to the processor is relatively low at 2.5% of the maximum value of the revenue of the processed fish. The physical loss of salted fish is 2.2%. The main cause of physical losses are theft and spoilage (Table 8).

**Table 7 Lake Victoria Processing - Summary**

| | Smoked | Salted | Fried | Scorched |
|---|---|---|---|---|
| Average size of processed batch (kg) | 122 | 694 | 41 | 53 |
| Average value of batch (Tsh) | 37245 | 109877 | 9403 | 11928 |
| Average price of good quality product (Tsh/kg) | 520 | 196 | 360 | 239 |
| Average total loss (%) | 5.7 | 2.5 | 7.6 | 7.0 |
| Average physical loss (%) | 2.5 | 2.2 | 7.1 | 6.5 |
| Average proportion of fish sold for a reduced price (%) | 7.5 | 0.7 | 0.9 | 1.4 |
| Average value of total loss (Tsh) | 1925 | 1845 | 608 | 785 |

**Table 8 Lake Victoria Processing - Reason for Loss, Salted Nile Perch**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | Physical | Theft | 48.5 | No Use | 100.0 |
| | | Rotten | 38.0 | | |
| | | Stale | 10.4 | | |
| | | Eaten.by Animals | 1.9 | | |
| | | Other | 0.7 | | |
| Salted | | Mould | 0.4 | | |
| | | Eaten by Birds | 0.1 | | |
| | Reduced | Other | 37.5 | Food | 63.2 |
| | | Mould | 36.3 | Don't Know | 36.8 |
| | | Stale | 25.6 | | |
| | | Insects | 0.7 | | |

However, the average total loss varies according to the processing method. Frying incurs the highest percentage total loss of 7.6%. Most of this loss is physical in nature, with the average physical loss of fish per batch being 7.1%. The main causes of the physical loss of fried fish are mould growth, burning during processing, theft and spoilage, as shown in Table 9. Any fried fish sold for a reduced price are sold so because of breakage.

**Table 9 Lake Victoria Processing - Reasons for Loss, Fried Nile Perch**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | **Physical** | Mould | 29.0 | No use | 99.1 |
| | | Burnt | 25.9 | Food | 0.5 |
| | | Theft | 23.0 | Animal Feed | 0.4 |
| | | Rotten | 13.5 | | |
| Fried | | Eaten by Animals | 4.4 | | |
| | | Stale | 3.8 | | |
| | | Broken | 0.5 | | |
| | **Reduced** | Broken | 82.7 | Food | 100.0 |
| | | Other | 12.2 | | |
| | | Burnt | 5.0 | | |

Scorching of fish incurs an average total loss of 7%. Again a high proportion of this loss is physical, 6.5 %. The main reasons for the physical loss are burning and theft (see Table 10).

**Table 10 Lake Victoria Processing - Reason for Loss, Scorched Nile Perch**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | **Physical** | Burnt | 51.8 | No use | 100.0 |
| | | Theft | 31.6 | Don't know | 0.0 |
| | | Mould | 9.2 | | |
| **Scorched** | | Rotten | 5.4 | | |
| | | Broken | 1.8 | | |
| | | Eaten by Birds | 0.2 | | |
| | **Reduced** | Other | 64.8 | Food | 100.0 |
| | | Burnt | 35.2 | | |

On a sector basis smoking incurs the second highest monetary loss. A loss of income to fish smokers, estimated to be 21 million Tanzanian shillings annually. The average total loss for a batch of smoked fish is 5.7%. A small proportion of the loss is physical, 2.5%. The reasons for the physical loss are burning and theft as can be seen in Table 11. The more significant loss associated with the smoking sector is selling final products for a reduced price because of breakage. Data show 7.5% of fish is sold for a reduced price, 85% of this has been broken (Table 11). Breakage of smoked fish can be attributed to processing of stale fish, which tends to be more fragile after smoking, and generally to rough handling and transportation. Breakage has been one reason why processors have switched from smoking to salting. Salted products are more robust than smoked and hence are less prone to damage.

**Table 11 Lake Victoria Processing - Reasons for Loss, Smoked Nile Perch**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | **Physical** | Burnt | 45.9 | No Use | 96.9 |
| | | Theft | 26.4 | Other | 3.1 |
| | | Rotten | 12.1 | | |
| | | Eaten by Animals | 7.1 | | |
| | | Stale | 5.8 | | |
| | | Other | 1.7 | | |
| **Smoked** | | Broken | 1.1 | | |
| | | Eaten by Birds | 0.0 | | |
| | **Reduced** | Broken | 85.3 | Food | 99.9 |
| | | Mould | 6.4 | Don't know | 0.1 |
| | | Stale | 5.7 | | |
| | | Burnt | 1.9 | | |
| | | Other | 0.7 | | |

Table 12 shows the variation according to survey site. It can be seen that losses for smoked and salted fish are higher in Igombe than in Kayenze.

**Table 12 Lake Victoria Processing - Summary by Site and Method**

| | IGOMBE | | | | KAYENZE | |
|---|---|---|---|---|---|---|
| | Smoked | Fried | Salted | Scorched | Smoked | Salted |
| Average size of processed batch (kg) | 201 | 39 | 792 | 54 | 61 | 543 |
| Average value of batch (Tsh) | 52673 | 8612 | 88761 | 12021 | 25509 | 142449 |
| Average price of good quality product (Tsh/kg) | 360 | 360 | 116 | 239 | 642 | 318 |
| Average total loss (%) | 7.4 | 7.6 | 3.2 | 7.1 | 4.4 | 1.5 |
| Average physical loss (%) | 3.3 | 7.2 | 3.0 | 6.6 | 1.9 | 1.1 |
| Average proportion of fish sold for a reduced price (%) | 10.0 | 0.9 | 0.7 | 1.4 | 5.6 | 0.9 |
| Average value of total loss (Tsh) | 3240 | 611 | 2367 | 793 | 925 | 1041 |
| Average reduced price as a % of the best price | 59 | 46 | 57 | 64 | 52 | 45 |

Observations and anecdotal evidence suggests that salting has emerged over the last few years as an important processing method for Nile perch and that smoking is a less important method now than it was 5 years ago. Much of the Nile perch rejected because it is stale by buyers from processing factories is bought by fish salters. The price paid for this fish by salters is roughly half the price the fish would have fetched had it been in good condition. Traders say that salting is a good way of disguising low quality fresh fish, as it is difficult to tell products produced from good quality fish from those produced from poor quality. The trend towards a preference for salting is good in terms of loss reduction. As the total loss associated with salting is on average much less in percentage terms than that related to other processing methods it would be in interests of loss reduction if salting were to be encouraged as a processing method for Nile perch.

## Dagaa Processing - Lake Victoria

Recall questionnaires were used at three sites by enumerators to interview dagaa processors about their losses. The sites were Igombe and Lugezi in Mwanza Region and Kibuyi in Mara Region. Processors were interviewed twice monthly over a period of two years. Table 13 shows the summarised data from all the interviews at all three sites. There is only one processing method for dagaa, that is sundrying.

**Table 13 Lake Victoria Dagaa Processing - Summary**

| | |
|---|---|
| Average Processed Batch (dry wt)(kg) | 246.5 |
| Average value (Tsh) | 36214 |
| Average Total Loss (%) | 6.40 |
| Average Physical Loss (%) | 3.80 |
| Average Monetary Loss per processor (Tsh) | 2981 |
| Average Selling Price for Good Quality Fish (Tsh/kg) | 163 |
| Average Proportion of Fish Sold for a Reduced Price (%) | 6.30 |

Analysis of data has shown the total monetary loss to processors of dagaa in the Lake Victoria fishery is the second highest identified by the study at 69.5 million Tanzania shillings lost annually to processors (see Table 1). The average total loss is 6.4% of the value of a batch of processed dagaa.

The physical loss of dagaa is 3.8%. The main causes of physical losses are predation by birds, theft and spoilage (see Table 14). The reason why dagaa are sold by processors for a reduced price is colour change, an explanation of which is given late rin this section. Over half of the dagaa sold for a reduced price is sold for animal feeds. Dagaa that have changed colour will fetch a selling price of 30 - 60% of the price the fish would have fetched if it had not changed colour.

## Table 14 Lake Victoria Processing - Reasons for Loss, Dagaa

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| Dagaa | Physical | Eaten by Birds | 40.6 | No Use | 95.0 |
| | | Theft | 31.5 | Animal Feed | 3.5 |
| | | Rotten | 21.5 | Don't Know | 1.2 |
| | | Eaten by Animals | 4.0 | Food | 0.3 |
| | | Other | 0.9 | | |
| | | Colour change | 0.7 | | |
| | | Mouldy | 0.7 | | |
| | Reduced | Colour change | 75.9 | Animal Feed | 56.1 |
| | | Mouldy | 19.1 | Food | 40.1 |
| | | Rotten | 3.7 | Don't Know | 3.8 |
| | | Other | 1.4 | | |

Table 15 shows the dagaa processing data summarised according to site.

## Table 15 Lake Victoria Dagaa - Summary of Data by Site

| | KIBUYI | LUGEZI | IGOMBE |
|---|---|---|---|
| Average Total Batch (kg) | 74 | 366 | 396 |
| Catch Value (Tsh) | 10633 | 35219 | 75273 |
| Average Good Price (Tsh/kg) | 155 | 103 | 230 |
| Total Loss (%) | 5.3 | 8.5 | 6.3 |
| Average Physical Loss (%) | 4.5 | 4.8 | 1.7 |
| Average Loss per interview (Tsh) | 521 | 3274 | 6383 |
| Average proportion of fish sold for a reduced price (%) | 1.5 | 10.9 | 9.5 |
| Average reduce price as a % of good price (%) | 51 | 63 | 52 |

Graphical presentation of the data indicates there is a seasonal trend to the total loss level at Lugezi, though this is less apparent at Igombe and Kibuyi. Figure 3 displays the data recorded at Lugezi it can be seen that high total loss occurs at times of year synonymous with rain - November, December, April and May. In Igombe, Figure 4, significant losses occurred from November 1993 to June 1994, with the loss climbing in January, February and March 1995. Rain is a contributing factor to dagaa rotting and changing colour (see Table 14).

**Figure 3 Dagaa Total Loss at Lugezi**

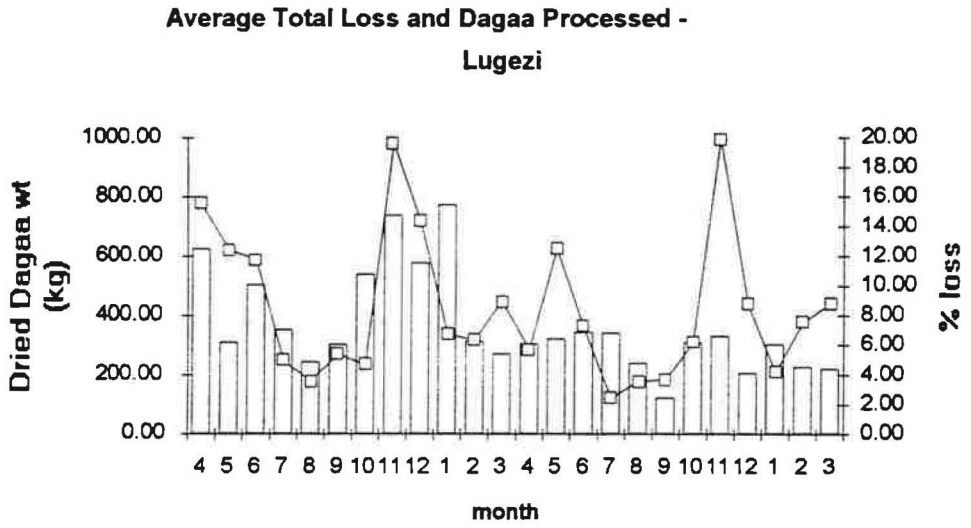
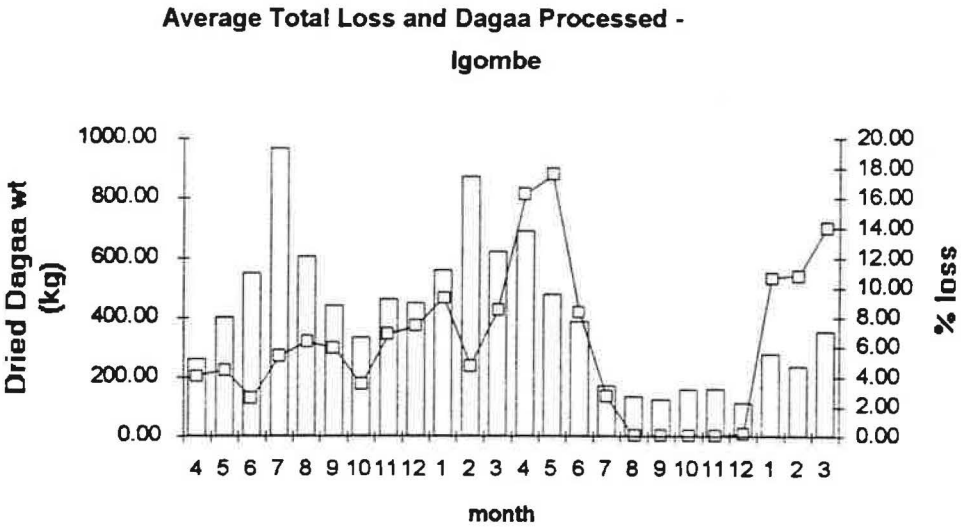



**Figure 4 Dagaa Total Loss at Igombe**



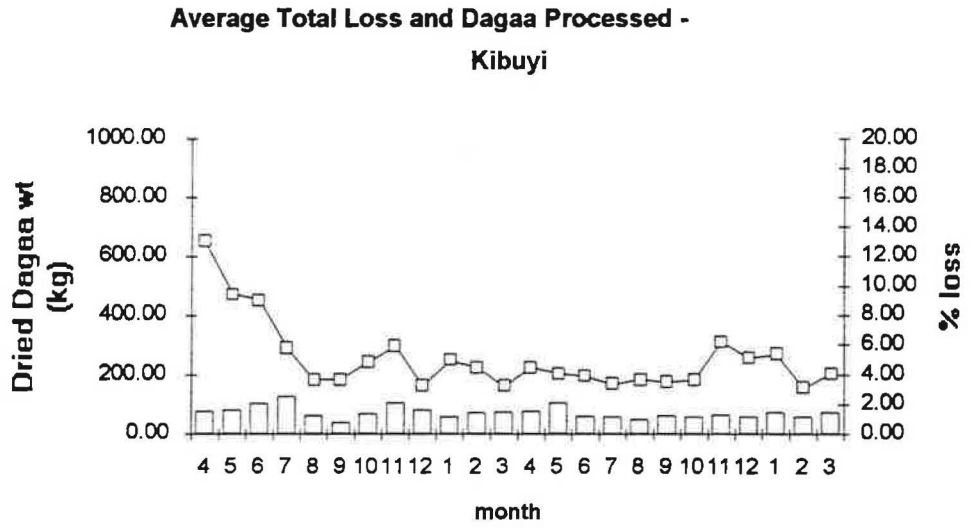

NB On the graphs the ____ line represents the Average Total Loss data.

The data for Kibuyi shown in Figure 5 indicate that the average total loss remains relatively constant over the survey period with only slight peaks around November which could be associated with rain. This lack of variation in loss level at Kibuyi could be related to the relatively small size dagaa batches that are processed there. The suggestion

is that it will be easier to take better care of smaller amounts of dagaa than larger ones, assuming labour levels are constant, so that more care can be taken during processing at Kibuyi even during adverse weather conditions like rain. A batch of dagaa weighs on average 75 kg at Kibuyi where as it weighs 366 kg at Lugezi and 396 kg at Igombe.

There are other factors which may affect loss levels such as the experience of the individual processors and the type of surface the dagaa are dried on. At Kibuyi for example dagaa are dried on rock surfaces, where as in Igombe and Lugezi dagaa are usually dried on sand.

**Figure 5 Dagaa Total Loss at Kibuyi**




There is no doubt that one of the most important causes of dagaa loss is colour change (see Table 14) . The problem with dagaa that have changed colour is that they have a bitter taste when eaten and so dagaa that have changed colour are often sold cheaply for animal feed. Dried dagaa can change from a "normal" silver shiny appearance to a dull reddish brown colour if drying conditions are poor i.e. during the rainy season and if the dagaa are stored for long periods of time. Hence, colour change is synonymous with dagaa caught and dried during the rainy seasons. Also, dried dagaa that have become wet during transport and are then redried will also be susceptible to colour change. Another factor related to colour change is the lipid content of the fish. The higher the lipid content the more likely colour change will occur. Interestingly, fishermen will often associate fish from certain fishing grounds with having either high or low lipid contents.

Observations during the course of the survey suggest work could be done to promote the use of appropriate, preservation techniques that will help overcome the problem of colour change. The first course of action would be to assess work on dagaa processing undertaken by other projects in the Lake Victoria and Lake Tanganyika areas, especially the results of smoking dagaa which is being tried by a UNDP project in Kagera region.

## Transport Sector - Lake Victoria

Recall questionnaires were used by enumerators to interview fish transporters (traders) at three sites: Kirumba market and the Railway Station in Mwanza town and Kariakoo market in Dar es Salaam. The traders dealt in fresh, salted and smoked Nile perch as well as dagaa. They were interviewed about fish losses occurring during transportation. The two main types of transport covered by the survey were rail and lorry with fish being transported from Mwanza to all areas of Tanzania, especially to Dar es Salaam. Table 16 shows the proportion of interviews according to product type and site.

### Table 16 Lake Victoria Transport

| | KARIAKOO | KIRUMBA | RAILWAY |
|---|---|---|---|
| Fresh % | 18 | 0 | 100 |
| Smoked % | 29 | 1 | 0 |
| Salted % | 27 | 49 | 0 |
| Dagaa % | 26 | 50 | 0 |
| Total number of interviews | 496 | 480 | 115 |

Table 17 shows the losses data summarised according to product type for all transport types and sites. The highest average total loss is for smoked fish at 4.3% of the value of a batch of fish. Physical losses are minimal for each product type. Selling fish for a reduced price is the main cause of loss in this sector.

### Table 17 Lake Victoria Transport - Summary

| | Fresh | Smoked | Salted | Dagaa |
|---|---|---|---|---|
| Average load transported (kg) | 1017 | 497 | 938 | 4383 |
| Average value of load (Tsh) | 323561 | 284929 | 497004 | 1208141 |
| Price for good Quality product (Tsh/kg) | 316 | 608 | 531 | 294 |
| Average Total Loss (%) | 3.7 | 4.3 | 1.4 | 1.7 |
| Average physical Loss (%) | 1 | 0.0 | 0.1 | 0.3 |
| Average proportion of fish sold for a reduced price (%) | 7.9 | 9.9 | 2.5 | 4.4 |
| Average value of loss per interview (Tsh) | 11265 | 11497 | 8483 | 20928 |

In terms of weight, 9.9% of a batch of smoked fish is sold for a reduced price and the reason is because products arrive broken after transport (see Table 18). On average 7.9 % of fresh fish are sold for a reduced price after transportation because the fish are classed as stale.

**Table 18 Lake Victoria Transport - Reasons for Loss**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| | **Physical** | Rotten | 99.3 | No Use | 99.3 |
| | | Broken | 0.6 | Dont Know | 0.5 |
| | | Other | 0.1 | Livestock | 0.2 |
| **Dagaa** | | | | | |
| | **Reduced** | Mouldy | 78.9 | Livestock | 96.6 |
| | | Rain | 17.5 | Food | 3.4 |
| | | Insects | 3.5 | | |
| | | Other | 0.1 | | |
| | **Physical** | Rotten | 73.2 | No Use | 54.3 |
| | | Other | 18.9 | Dont Know | 45.7 |
| | | Rain | 7.6 | | |
| **Salted** | | Mouldy | 0.4 | | |
| **Perch** | | | | | |
| | **Reduced** | Mouldy | 91.6 | Food | 99.8 |
| | | Broken | 5.3 | Livestock | 0.2 |
| | | Rain | 1.8 | | |
| | | Insects | 0.7 | | |
| | | Stale | 0.5 | | |
| | **Physical** | Rotten | 100.0 | No Use | 100 |
| **Smoked** | | | | | |
| **Perch** | **Reduced** | Broken | 100.0 | Food | 92.3 |
| | **Physical** | Rotten | 100.0 | No Use | 100.0 |
| **Fresh** | | | | Livestock | 7.7 |
| **Perch** | **Reduced** | Stale | 97.7 | Food | 98.0 |
| | | Rain | 0.9 | Livestock | 1.4 |
| | | Broken | 0.9 | Processed | 0.6 |
| | | Other | 0.5 | | |

Table 19 below shows the transport sector data summarised according to the survey sites and products. There is scope to analyse the data on transport losses further, particularly to see if there is a relationship between type of transport, transport time and loss levels.

## Table 19 Lake Victoria Transport - Summary by Site

| | KARIAKOO | | | | KIRUMBA | | | RAILWAY |
|---|---|---|---|---|---|---|---|---|
| | Fresh | Smoked | Salted | Dagaa | Smoked | Salted | Dagaa | Fresh |
| **Average load size (kg)** | 979 | 475 | 1287 | 2224 | 1298 | 739 | 5543 | 1047 |
| **Average value of load (Tsh)** | 281634 | 276356 | 700380 | 712405 | 595626 | 381529 | 1474601 | 355644 |
| **Average price for good quality fish (Tsh/kg)** | 286 | 610 | 561 | 364 | 503 | 514 | 257 | 340 |
| **Average total loss (%)** | 3.6 | 4.4 | 2.5 | 0.4 | 1.6 | 0.8 | 2.5 | 3.7 |
| **Average physical loss (%)** | 1 | 0 | 0.2 | 0.1 | 0.4 | 0.1 | 0.3 | 1.1 |
| **Average proportion sold for reduced price (%)** | 7.4 | 10.1 | 4.4 | 1.3 | 0.5 | 1.5 | 6.1 | 8.3 |
| **Average value of total loss per interview (Tsh)** | 8702 | 11652 | 17399 | 2988 | 5858 | 3420 | 30571 | 13227 |

## Retail Sector - Lake Victoria

Recall questionnaires were used by enumerators to interview fish retailers about losses at the retail stage of fish distribution. Retailers of fresh and processed Nile perch and dried dagaa were interviewed at 6 sites on a twice monthly basis over the course of two years. The sites were:

Nyasho market (Musoma town)
Soko Kuu market (Musoma town)
Kirumba market (Mwanza town)
Main market (Mwanza town)
Mongers* (Dar es Salaam city)
Kariakoo market (Dar es Salaam city)

(* Mongers refers to small fresh fish retail shops in different parts of Dar es Salaam city).

Table 20 shows the proportion of interviews for the different products according to the 6 sites, and Table 21 summarises the data on retail losses.

### Table 20 Lake Victoria Retail

| | NYASHO | SOKO KUU | KIRUMBA | MAIN | MONGERS | KARIAKOO |
|---|---|---|---|---|---|---|
| Fresh % | 47 | 19 | 88 | 33 | 100 | 0 |
| Smoked % | 50 | 8 | 12 | 33 | 0 | 8 |
| Salted % | 0 | 0 | 0 | 0 | 0 | 42 |
| Dagaa % | 3 | 73 | 0 | 34 | 0 | 50 |
| Number of Interviews | 363 | 312 | 399 | 720 | 477 | 482 |

### Table 21 Lake Victoria Retail - Summary

| | Fresh | Smoked | Salted | Dagaa |
|---|---|---|---|---|
| Average size of batch (kg) | 194 | 115 | 551 | 205 |
| Average value of batch (Tsh) | 67311 | 47469 | 352734 | 62332 |
| Average best price (Tsh/kg) | 276 | 414 | 662 | 336 |
| Average Total Loss (%) | 3.7 | 5.4 | 1.8 | 2.7 |
| Average Physical Loss (%) | 1.5 | 0.8 | 0.1 | 0.8 |
| Average % of fish sold for reduced price(%) | 6.1 | 11.8 | 4.4 | 5.7 |
| Average Total loss value (Tsh) | 782 | 2063 | 5096 | 2325 |

Fresh Fish

The most significant monetary loss detected by the survey in the retail sector is associated with fresh Nile perch retailing. It ranks as the fourth most significant monetary loss in terms of sector detected by the survey. It is estimated that just under 25 million Tanzania shillings

has been lost in income to fresh fish retailers annually (see Table 1). The total loss for fresh fish is 3.7% including some 1.5% of retailed fresh perch physically lost because of spoilage (see Table 21). And spoilage is also responsible for much of the loss associated with selling fish for a reduced price. From Table 21 it can be seen that 6.1% of a batch of retailed fresh fish is sold for a reduced price. Table 22 shows that quality deterioration is the main reason for the loss.

**Table 22 Lake Victoria Retail - Reasons for Loss**

| PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|
| Dagaa | Physical | No Demand | 61.8 | Don't know | 84.5 |
| | | Other | 35.6 | Animal Feed | 15.0 |
| | | Broken | 1.8 | No use | 0.5 |
| | | Mould | 0.8 | | |
| | Reduced | Mould | 81.5 | Animal feed | 80.8 |
| | | Broken | 12.1 | Food | 19.2 |
| | | Other | 6.1 | | |
| | | insects | 0.3 | | |
| Salted Perch | Physical | Rotten | 100 | Animal Feed | 61.5 |
| | | | | Don't know | 38.5 |
| | Reduced | Mould | 86.0 | Food | 100 |
| | | Other | 9.1 | | |
| | | Broken | 4.9 | | |
| Smoked Perch | Physical | Insects | 88.1 | No use | 97.3 |
| | | Mould | 6.4 | Animal Feed | 2.7 |
| | | Broken | 4.1 | | |
| | | Rotten | 0.8 | | |
| | | No Demand | 0.6 | | |
| | Reduced | Broken | 86.4 | Food | 99.8 |
| | | Stale | 7.8 | Animal Feed | 0.2 |
| | | Mould | 4.6 | | |
| | | Insects | 1.2 | | |
| Fresh Perch | Physical | Rotten | 95.5 | No use | 90.3 |
| | | No Demand | 4.4 | Don't Know | 9.7 |
| | | Other | 0.1 | | |
| | Reduced | Stale | 98.7 | Food | 98.8 |
| | | Other | 1.3 | Processing | 1.0 |
| | | | | Animal feed | 0.1 |
| | | | | Don't know | 0.1 |

Smoked Fish

Of the four product types, smoked fish is associated with the highest average total loss in percentage terms. The average total loss for smoked fish is 5.4%. The bulk of this loss is attributed to selling products for a reduced price because of breakage (see Table 22). By weight, 11.8% of all smoked fish are sold for a reduced price, mainly for human

consumption. However, it is not clear from the data whether breakage occurs during retailing or whether some broken fish are discovered in consignments before retailing, in which case breakage would more likely to have occurred during processing and transportation.

Dagaa

According to the survey mould growth and quality deterioration during storage are responsible for most of the dagaa loss in the retail sector. The total loss for dagaa is 2.7%, incurring a monetary loss of just under 17 million Tanzania Shillings annually (see Table 1).

Salted Fish

The lowest loss level is associated with salted fish. Only 1.8% of the maximum value of salted fish is lost annually. The loss here is attributed to selling products for a reduced price because of quality deterioration.

Tables 23 and 24 show there is some variation in loss levels between sites for the same product type. Data recorded in Dar es Salaam for fresh fish give an average total loss of 0.3%, where as at sites in Mwanza and Musoma the total loss is relatively high at 9.2% for Mwanza Central Market and 4.2% at Nyasho Market. Soko Kuu in Musoma proves to be an exception to this trend, with a total loss of only 0.4%. Certainly the use of refrigeration by retailers in Dar es Salaam is likely to be a strong reason why losses of fresh fish are generally lower there.

More widespread use of chilling techniques would be an obvious way of addressing the loss in the fresh fish retail sector. A first step would be identifying appropriate techniques and strategies to do this, meanwhile taking into consideration the associated marginal costs and benefits.

## Table 23 Lake Victoria Retail - Summary by Site and Product

| | NYASHO | | | SOKO KUU | | | MAIN | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fresh | Smoked | Dagaa | Dagaa | Smoked | Fresh | Fresh | Smoked | Dagaa |
| Average size of batch (kg) | 103 | 62 | 22 | 28 | 56 | 54 | 57 | 111 | 286 |
| Average value of batch (Tsh) | 12442 | 21921 | 2208 | 10299 | 32548 | 13540 | 8332 | 33419 | 58398 |
| Average best price (Tsh/kg) | 157 | 353 | 111 | 364 | 587 | 257 | 162 | 404 | 261 |
| Average Total Loss (%) | 4.2 | 3.8 | 1.2 | 1.9 | 1.9 | 0.4 | 9.2 | 7.5 | 1.4 |
| Average Physical Loss (%) | 1.3 | 0.4 | 0 | 0.2 | 0 | 0.2 | 4.3 | 1.5 | 0.3 |
| Average % of fish sold for reduced price(%) | 6.1 | 6.5 | 2.4 | 3.3 | 4 | 0.7 | 17 | 18.3 | 8.9 |
| Average reduce price % of best price | 50 | 50 | 50 | 48 | 54 | 49 | 80 | 72 | 96 |

## Table 24 Lake Victoria Retail - Summary by Site and Product

| | KIRUMBA | | KARIAKOO | | | MONGERS |
|---|---|---|---|---|---|---|
| | Smoked | Fresh | Smoked | Salted | Dagaa | Fresh |
| Average size of batch (kg) | 201 | 185 | 325 | 551 | 300 | 318 |
| Average value of batch (Tsh) | 80808 | 29079 | 229126 | 352734 | 118986 | 149902 |
| Average best price (Tsh/kg) | 393 | 149 | 679 | 662 | 397 | 467 |
| Average Total Loss (%) | 4.4 | 5 | 3.4 | 1.8 | 4.8 | 0.3 |
| Average Physical Loss (%) | 0.2 | 1.7 | 0.1 | 0.1 | 1.8 | 0.1 |
| Average % of fish sold for reduced price(%) | 7.4 | 7.2 | 7.3 | 4.4 | 4.8 | 0.7 |
| Average reduce price % of best price | 44 | 68 | 59 | 86 | 53 | 95 |

## Fishing Sector - Mafia Island

The Mafia fishery is multi-species and at the request of the Fisheries Division the survey focused on the four most commercially important species in the fishery. These species groups were identified by a rapid appraisal (informal methodology study) and are shown in Table 25.

**Table 25 Mafia Island Survey Species**

| Local name | Common | Scientific | Interviews |
|---|---|---|---|
| Changu | Snapper, Emperor | *Lutjanus spp, Lethrinus spp* | 50% |
| Tasi | Spinefoot | *Siganus spp* | 25% |
| Kolekole | Trevally | *Carangoides spp, Caranx spp* | 10% |
| Kibua | Scad, Mackerel | *Atule spp, Rastrelliger kanagurta* | 15% |

Recall questionnaires were used by enumerators to interview fishermen about their losses twice monthly at Kilindoni and Tumbuju villages on Mafia Island over a 12 month period. Table 25 also shows the proportion of interviews for each species. For example 50% of interviews were with fishermen who had caught "changu".

Over the 12 month survey period 387 interviews were conducted with fishermen. Of these 51 % were with beach seine fishermen, 20 % with longline or hook fishermen, 16 % with trap fishermen, 11 % with fixed fence trap ("wando") fishermen and 2 % with sharknet fishermen.

Table 26 summarises the data on losses for all four species combined. The average total loss for the four commercially important fish species of the Mafia fishery was found to be 2.5 %. The average physical loss of fish in a catch was 2.3%. Most of the physical loss was not fish that was thrown away, but fish that has been self processed and shared out, so losses are therefore minimal in this sector.

**Table 26 Mafia Island Fishing Summary**

| | |
|---|---|
| Average Catch (kg) | 53 |
| Average Catch Value (Tsh) | 11351 |
| Average Price for Good Quality Fish (Tsh/kg) | 295 |
| Average Total Loss (%) | 2.50 |
| Average Physical Loss (%) | 2.30 |
| Average fish sold for reduced price (%) | 0.30 |
| Average reduced price as % of best price (%) | 51 |

Table 27 shows that in terms of species the average total loss for kolekole is relatively high. However, Table 28 shows that the loss is in fact due to self processing of the fish by the fishermen, probably for home consumption. This may be a loss in income, but is not necessarily classed as a loss to fishermen.

**Table 27 Mafia Island Fishing - Summary by Species**

| | CHANGU | TASI | KIBUA | KOLEKOLE |
|---|---|---|---|---|
| **Average Catch (kg)** | 40 | 33 | 124 | 61 |
| **Average Catch Value (Tsh)** | 8884 | 7094 | 24010 | 15490 |
| **Average Price for Good Quality Fish (Tsh/kg)** | 306 | 266 | 201 | 449 |
| **Average Total Loss (%)** | 1.8 | 0.9 | 0 | 13.8 |
| **Average Physical Loss (%)** | 1.8 | 0.9 | 0 | 11.3 |
| **Average % of fish sold for reduced price (%)** | 0 | 0 | 0 | 2.5 |
| **Average reduced price as % of best price** | 0 | 0 | 0 | 51 |

**Table 28 Mafia Island Fishing - Reason for Loss**

| SECTOR | PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|---|
| | all | **Physical** | Self Processed | 75.9 | | |
| | | | Shared | 13.1 | | |
| **Fishing** | | | Rotten | 11.0 | | |
| | | **Reduced** | Other | 100.0 | Salting | 100.0 |

## Transport Sector - Mafia Island

Recall questionnaires were used at one site, Banda Beach fish market in Dar es Salaam, to interview transporters who bring fish on ice by boat from Mafia Island to the market. The survey focused on the four commercially important species "changu", "tasi", "kibua" and "kolekole". 50 % of the interviews included information on changu, 29% had information on tasi, 13% information on kibua and 8% covered kolekole. In all 348 interviews were conducted.

The data showed that there were no physical losses for fish and that the average total loss in the fish transport sector is low at 1.2%. Table 29 summarises the data for all species combined. The average batch size of 490 kg only reflects weight of the surveyed species carried by the transporters. Table 30 displays the data according to species group. Any fish sold for a reduced price are sold that way because they are "stale", or are of substandard quality.

### Table 29 Mafia Island Transport - Summary

| | |
|---|---|
| **Average batch (kg)** | 490 |
| **Average batch Value (Tsh)** | 241113 |
| **Average Price for Good Quality Fish (Tsh/kg)** | 482 |
| **Average Total Loss (%)** | 1.2 |
| **Average Physical Loss (%)** | 0.0 |
| **Average % of fish sold for reduced price (%)** | 1.8 |
| **Average reduced price as % of best price (%)** | 50 |

### Table 30 Mafia Island Transport - Summary by Species

| | CHANGU | TASI | KIBUA | KOLEKOLE |
|---|---|---|---|---|
| **Average Catch (kg)** | 500 | 480 | 502 | 444 |
| **Average Catch Value (Tsh)** | 260563 | 213565 | 224207 | 245884 |
| **Average Price for Good Quality Fish (Tsh/kg)** | 513 | 433 | 435 | 549 |
| **Average Total Loss (%)** | 1.0 | 2.0 | 1.0 | 0 |
| **Average Physical Loss (%)** | 0 | 0 | 0 | 0 |
| **Average % of fish sold for reduced price (%)** | 1.9 | 2.0 | 2.1 | 0 |
| **Average reduced price as % of best price** | 47 | 56 | 51 | 0 |

## Processing Sector - Mafia Island

Recall questionnaires were used to interview fish processors twice monthly at Kilindoni and Tumbuju fishing villages on Mafia Island. Processors were interviewed about loss related to the four commercially important species of the fishery: changu, tasi, kibua and kolekole. In all 271 interviews were conducted of which 44% included data on changu, 33% on kibua, 15% on tasi and 8% on kolekole. Most of the interviews (86%) were with fish fryers and remaining interviews were with fish salters (7%), fish smokers and sundriers.

Table 31 summarises the data for all species and all processing methods combined.
The average total loss for processed fish to the processor was found to be 3.1%. Table 32 summarises the data according to species and Table 33 shows the reasons for the losses.

### Table 31 Mafia Island Processing - Summary

| | |
|---|---|
| Average Batch of processed fish (dry wt)(kg) | 11 |
| Average Catch Value (Tsh) | 5320 |
| Average Price for Good Quality Fish (Tsh/kg) | 746 |
| Average Total Loss (%) | 3.1 |
| Average Physical Loss (%) | 2.7 |
| Average % of fish sold for reduced price(%) | 0.9 |
| Average reduced price as % of best price(%) | 48 |

### Table 32 Mafia Island - Summary by Species

| | CHANGU | TASI | KIBUA | KOLEKOLE |
|---|---|---|---|---|
| Average Catch (kg) | 13 | 5 | 5 | 36 |
| Average Catch Value (Tsh) | 4142 | 2107 | 6811 | 11439 |
| Average Price for Good Quality Fish (Tsh/kg) | 552 | 525 | 1120 | 669 |
| Average Total Loss (%) | 2.8 | 3.6 | 3.7 | 1.7 |
| Average Physical Loss (%) | 2.7 | 2.7 | 3.3 | 0.2 |
| Average % of fish sold for reduced price (%) | 0.1 | 1.8 | 0.9 | 2.8 |
| Average reduced price as % of best price | 63 | 48 | 46 | 45 |

## Table 33 Mafia Island Processing - Reasons for Loss

| SECTOR | PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|---|
| Processing | All | Physical | Insects | 41.2 | Animal Feed | 88.0 |
| | | | Eaten by Animals | 20.4 | Food | 11.3 |
| | | | Other | 20.2 | Other | 0.7 |
| | | | Rotten | 6.5 | | |
| | | | Mould | 5.0 | (excluding fish eaten & stolen) | |
| | | | Burnt | 2.4 | | |
| | | | Theft | 1.8 | | |
| | | | Eaten by Birds | 1.6 | | |
| | | | Broken | 1.0 | | |
| | | Reduced | Broken | 96.9 | | |
| | | | Burnt | 3.1 | | |

## Retail Sector - Mafia Island

Recall questionnaires were used to interview fish retailers at 3 sites about fish loss: Kilindoni retail market on Mafia Island, Banda Beach and Kariakoo markets in Dar es Salaam. The survey focused on four species groups of fish: changu, tasi, kibua and kolekole. In all 818 interviews were conducted, 50% collected data on changu, 20% collected data on tasi, 20% collected data on kibua and 10% on kolekole. 91% of the interviews collected data on fresh fish, the remaining 9% on fried, salted and sundried products.

Table 34 summarises the data for all species and products combined. It shows the average total loss to retailers is 1.2% of the value of the fish sold. Table 35 summarises the data according to species and Table 36 gives the reasons why losses occur.

### Table 34 Mafia Island - Summary

| | |
|---|---|
| Average Catch (kg) | 116 |
| Average Catch Value (Tsh) | 97374 |
| Average Price for Good Quality Fish (Tsh/kg) | 750 |
| Average Total Loss (%) | 1.20 |
| Average Physical Loss (%) | 0.10 |
| Average % of fish sold for reduced price (%) | 2.50 |
| Average reduced price as % of best price (%) | 58 |

### Table 35 Mafia Island Retail - Summary by Species

| | CHANGU | TASI | KIBUA | KOLEKOLE |
|---|---|---|---|---|
| Average Catch (kg) | 213 | 17 | 22 | 20 |
| Average Catch Value (Tsh) | 184285 | 11853 | 11099 | 12799 |
| Average Price for Good Quality Fish (Tsh/kg) | 798 | 785 | 615 | 715 |
| Average Total Loss (%) | 1.3 | 1 | 1.4 | 0.6 |
| Average Physical Loss (%) | 0.1 | 0.1 | 0.1 | 0 |
| Average % of fish sold for reduced price (%) | 2.8 | 2.1 | 2.8 | 0.9 |
| Average reduced price as % of best price | 59 | 60 | 57 | 39 |

**Table 36 Mafia Island Retail - Reasons for Loss**

| SECTOR | PRODUCT | LOSS | REASON | % | END USE | % |
|---|---|---|---|---|---|---|
| | | **Physical** | Rotten | 61.5 | Other | 38.6 |
| | | | No Demand | 38.6 | Food | 31.3 |
| **Retail** | **All** | | | | Don't know | 21.0 |
| | | | | | Animal feed | 9.2 |
| | | **Reduced** | Stale | 79.9 | Food | 66.0 |
| | | | Other | 16.3 | Processing | 34.0 |
| | | | Broken | 3.8 | | |

## Historical Post-harvest Fish Loss Levels and Survey Data

There have been very few detailed quantitative studies of post-harvest fish losses. Much of the available data on fish loss levels has been based on qualitative estimates involving massive extrapolation ( Poulter *et al* 1988). According to the National Research Council (1978), post harvest fish loss levels are 20% to 40% from time of capture to point of consumption. This is the level of losses that has most often been quoted and used in planning. The paucity and variable nature of much of the historical data and the lack of systematic methods for assessing losses have been the main driving force behind this research.

It is interesting to note then that the data from the recall questionnaire surveys shows the loss levels in the Lake Victoria and Mafia Island fisheries are generally less than the often quoted historical levels of fish loss. According to the data the total loss from capture to consumer for the different products is as follows (also see Figure 1):

- Fresh Nile perch 11%
- Smoked Nile perch 18.2%
- Salted Nile perch 8.5%
- Dagaa 14%
- Fresh marine fish 4.9%

These figures are calculated by adding the fishing, processing, transport and retail sector losses together for each product, taking account of the loss at each stage being cumulative. There is no processing stage included for the fresh perch and as no data were collected on the dagaa fishing losses it has been assumed that the loss at that stage is the same as for Nile perch at 4.1%. Although it is not clear how accurate an assumption this is.

These results indicate that, for the two artisanal fisheries surveyed in Tanzania, post-harvest fish losses are lower than global historical figures suggest the losses ought to be. It is also clear there is a difference between the levels of loss of the different product types. For example the loss associated with smoked fish is over twice that of salted fish.

## CHAPTER 3 - Informal Post-harvest Fish Loss Data

This section of the report summarises the data collected as part of the development of the informal methodology. In all 13 informal studies of different marine and freshwater fishery sectors of Tanzania were completed over a twelve month period. These were:

- PRA and Post-harvest Fish Losses, Mafia Island, Tanzania - A Ward, M Pritchard, Y Mndeme, F Hemile, G Mokoki.
- NRI/Tanzania Post-harvest Fish Losses Study Participatory Rural/Rapid Appraisal Seminar, Implementation Report, Moshi Co-operative College - J J Temu.
- Experimenting with PRA in Mlingotini fishing village, Bagamoyo District, Tanzania - G Mokoki, M Moyo, S Juma, A Ward.
- A Rapid Informal Study to Determine the Most Important Commercial Fish Species in a Multi-species Fishery - A Ward, Y Mndeme, F Hemile, G Mokoki, M Ndagala, F Ntima, M Moyo.
- Report on an Analysis of Losses Affecting a Prawn Processing Company Sourcing Raw Material From the Artisanal Fishery Sector - A Ward, Y Mndeme, M Ndagala, M Moyo, F Ntima.
- The Air Transportation of Fish Especially Nile Perch From Mwanza to Dar es Salaam. An Overview of the Sector and It's Post-Harvest Losses - A Ward, Y Mndeme, M Ndagala, M Moyo, F Ntima, K Kauswa, J Mairi.
- The Dagaa Fishery: A PRA Study to Support Questionnaire Survey Data - A Ward, Y Mndeme, K Kauswa, J Mairi.
- A PRA Study of Fish Traders and Transporters of Banda Beach, Dar es Salaam - M Ndagala, F Ntima, M Moyo, S Juma.
- PRA/RRA on Post-harvest Fish Losses in the Fish Retail Sector of Musoma. - JJ Temu, Y Mndeme, M Ndagala.
- A Study of the Dagaa Fishery, Kibuyi Fishing Village, Mara Region - March 1995 - Y Mndeme, M Ndagala, JJ Temu.
- The Artisanal Nile Perch Fishery and Post-harvest Losses - A Report to Support Quantitative Survey Data. - A Ward, Y Mndeme, A Kiduli, J Mairi, K Kauswa.
- Post-harvest Fish Losses in the Fish Transportation Sector. A Case Study: the Transport of Fish by Road, Rail and Air From Mwanza to Dar es Salaam. - M Ndagala, M Moyo, F Ntima
- A Losses study of the Jibondo Island Fishery, Mafia Island. - G Mokoki, F Hemili, A Ward

These studies generated general qualitative information on the sectors studied as well more specific qualitative and indicative quantitative data on post-harvest fish losses. A report that combines all the studies in their entirety will be produced as a separate output in due course. Only a summary of the data from the studies is given here as a series of tables. An outline of the informal methodology is given as Appendix 2.

The informal methodology has been used to generate data on similar topics to those covered by the questionnaire survey. The data is summarised in the following Tables 37 to 44 under the headings of fishery, site, product, indicative loss estimate, reasons (for losses), seasonality (of losses), perceptions and comments. The first 6 headings are aspects of losses

on which data can and has been generated by the questionnaire survey covered in the previous chapter.

When reading this section it is important to bear in mind that the data was collected as part of the methodology development process. Therefore the quality of the data is likely to be variable, although to what degree is difficult to determine as the unscientific nature of the methodology renders judgement of data quality relatively difficult.

Reference is made in the summary tables to "time temperature" as a reason for loss. Time temperature indicates that fish spends time at temperatures which are likely to have adverse affects on quality. One of the key losses mentioned in the tables is the "reduced price" loss. This refers to selling fish for a reduced price. The percentage figures which are indicated alongside the reduced price loss refer to the proportion of fish which is sold for a reduced price.

**Table 37 Mafia Island Fishing - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Fishing (Tumbuju) | Fin fish | Handlines up to 25% | lack of wind - long sailing times | High during NE Monsoon | Losses a normal part of operations | |
| | | Traps up to 15% | | | | |
| | | Shark nets up to 5% | high temp., net damage,theft | | | |
| | | Beach seine <5% | | | | |
| Fishing (Jibondo I) | Fin fish | Traps 6% (tot.loss) | weather makes it difficult to empty, damage, price control, eels. | High during SE Monsoon | losses are normal part of operations | High catch during NE Monsoon |
| | | Shark nets 6% (tot.loss) | spoilage at sea -time in nets, not enough salt,damage to nets, price control, lost during haul. | High during NE Monsoon | losses are normal part of operations | SE Monsoon -sharks & rays NE Monsoon - plus other species |
| Fishing | Octopus | negligible | | | | Quick harvest and sale reduces loss level |
| Fishing | Fin fish | Surround.net (negligible) | | | | Quick harvest and sale reduces loss level |

Table 37 summarise the data from two studies of the Mafia Island fishing sector. The difference in loss levels according to fishing gear type is shown clearly. Surround nets and beach seines are similar methods of fishing and both are synonymous with low levels of fish losses, whereas handlines and traps are associated with high losses. Losses in the fishing sector are seasonal and generally considered to be a normal part of the fishing operation.

**Table 38 Mafia Island Processing - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Processing | Fin fish | Total loss 5% | spoilage | | not willing to invest in improved processing technique | More fish processed during NE Monsoon. |
| Processing | Fin fish | negligible | | | | small quantities of fish hence easy to avoid losses |
| Processing | Beche de mer | 3% | burning, spoilage | | | |

Table 38 summarises the data from two studies of the Mafia island processing sector. One reason why losses are low in this sector is because usually small quantities of fish are processed which makes it easier to handle the product with more care.

**Table 39 Mafia Island Transport - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Transport (Jibondo I) | Fin fish | Total loss 40% | selling fish for reduced price<br>poor quality, demand & supply at DSM<br>throw away spoiled fish<br>long collection time<br>ice meltage,buying poor quality fish, engine failure, poor handling | physical loss high during SE Monsoon | | 4.1 million Tsh lost to one operator in a year. |
| Transport (Jibondo I) | Octopus | Total loss 23% | 6.5% rejected by factory due to spoilage. Drying small octopus.<br>Poor icing, dragging over coral mixing with beche de mer | High during NE Monsoon | | 300,000 Tsh lost to one operator in a year. |
| Transport (DSM) | Fin Fish | Reduced price up to 25% | long collection times<br>insufficient ice<br>supply & demand at DSM | Warmer months | some concern over losses<br>some of well off traders use more ice during warm months | June/July less fish collected<br>reduced price fish often processed in Dar es Salaam |

Table 39 summarises the data from the Mafia Island transport sector. The transportation of fresh fish on ice from Mafia fishing grounds to Dar es Salaam appears to be the sector which is associated with highest losses of the sectors studied. This contradicts the data from the questionnaire survey which shows losses in this sector to be relatively low. Losses of up to 40% were recorded. The main reasons for loss being selling fish for a reduced price because of quality deterioration caused by long collection times for fish (up to 15 days) and insufficient ice used on a trip to collect fish.

**Table 40 Rufiji Delta Prawn Fishery - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Transport from Delta to DSM | Prawns | Up to 15% bought by factory for reduced price | poor icing and handling by prawn collectors<br>long collection times | | factory management concerned about losses | 14,000 US$ in gross income lost to one factory because of losses |
| At factory | | Rejected 3% | small size, poor quality | | | |
| Fishing | Prawns | Rejected up to 20% | poor quality, small size<br>time temperature<br>lack of buying capital<br>lack of storage & ice | | fishermen complain buyers don't take all catch | |

Table 40 summarises the data from a study of the artisanal gill net and trap fishery of the Rufiji Delta region. The study specifically looked at the distribution of prawns from the delta to Dar es Salaam and was done specifically for the management of a prawn processing factory which had identified losses due to poor quality raw material as a constraint to business.

After capture the prawns are held on ice in the delta region by traders who basically accumulate prawns over several days before selling them to processing factories. Even though the proportion of prawns that is rejected by the factory is relatively small at 3% the loss in gross income is estimated to be 14,000 US$ annually (7.7 million Tanzania shillings).

Poor icing practice and handling of by traders coupled with long collection times are the main reasons why the factory was receiving poor quality prawns.

**Table 41 Lake Victoria Fishing - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Fishing | N Perch | Reduce price 2 - 8 % | stale<br>time temperature | High during warm months | | sold at landing to salters |
| Fishing | N.perch | reduced price up to 15%<br>(average 3-9%) | stale fish rejected<br>time temperature<br>"fish kills" | High during warm months<br>Dec-April<br>when "siaga" wind blows | post-harvest losses<br>not a priority issue for fishermen | Fish is rejected by buyers for fish factories and sold to salters for 60% of good price |

Table 41 summarises the data from informal studies of the Lake Victoria fishing sector. The studies focused on the Nile perch gill net fishery in Mwanza region. The major loss to fishermen in this sector was found to be the selling stale fish for a reduced price, especially during the warmer months of the year to fish salters. "Time temperature" in the reasons column refers to the long periods of time fish spend at high ambient temperatures - a major reason why fish quality tends to suffer.

**Table 42 Lake Victoria Processing - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Processing (Mwanza) | Dagaa | Reduced price | colour change<br>poor drying conditions<br>contamination<br>rain during transport to wholesale market and during storage | Rainy season | losses accepted as normal "God's work" | sold for 60 to 70% of best price, much for animal feed |
| Processing (Igombe) | N Perch (smoked) | Reduced price - 15% | breakage<br>burning<br>mould | | | distance to market related to breakage. |
| Processing | N Perch (salted) | Reduced price 10 to 15% | too little salt | | use more salt in rainy season to prevent spoilage | Figures based on one case study<br>no triangulation |
| Processing Kibuyi | Dagaa | up to 18% | birds & animals | | | |
| | | up to 2% | off loading from canoe | | | |
| | | 1% | blown by wind | | | |
| | | 24% | 2 days rain during drying | rainy season | | |
| | | up to 100% | > 2days rain during drying | rainy season | | |
| | | reduced price | poor drying conditions<br>lipid content<br>storage time | rainy season | | Sold for human consumption & animal feed for 30% of good price |

Table 42 summarises the data on the Lake Victoria processing sector. It shows the rainy season is clearly a time of loss in the dagaa processing sector.

**Table 43 Lake Victoria Transport - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Transport Air Mwanza-DSM | N Perch fresh | Reduced price 2 to 8% | Time temperature power interruptions (not due to transport) | High during warm months | losses not perceived as a problem by traders | stale fish sold to fish fryers in Dar es Salaam |
| Transport Rail Mwanza-DSM | N. Perch (fresh) | Reduced price 3 to 19% | time temperature transport delays | High in warm months | traders aware of problems causing spoilage | In 1994 200 tonnes brought to DSM. (see load tracking) |
| Transport Lorry Mwanza-DSM | Dagaa | Reduced price up to 16.5% | poor processing & storage conditions (not due to transport) | High during rainy season | | sold for 50% of good price. In 1994 34 mill Tsh lost.. |
| Transport Lorry Mwanza-DSM | N.Perch (salted) | negligible | | | | |
| Transport Lorry Mwanza-DSM | N Perch (smoked) | Reduced price 2 to 25% | breakage - repeated handling, processing poor quality fish. | | losses of some concern to traders | 19 million Tsh lost in 1994. |

Table 43 summarises the data on the transportation sector. Losses are negligible for salted fish and air transport incurs the least losses for fresh Nile perch. Time temperature is mentioned as a reason for losses for fresh fish. This refers to the long time that fish can spend at high ambient temperatures (up to 16 hours) with no chilling. Breakage is a problem with smoked fish. Loss levels vary according to season. Fresh fish losses are higher during the warmer months of the year and dagaa losses are highest during the rainy season. There is also an indication that losses to traders are perceived as a problem.

**Table 44 Lake Victoria Retail - Informal Data**

| Sector | Product | Indicative Loss Estimate | Reasons | Seasonality | Perceptions | Comments |
|---|---|---|---|---|---|---|
| Retail (Musoma) | Dagaa | Reduced price 8 to 25% | colour change<br>rain during boat transport | Rainy season | | |
| Retail (Musoma) | N.Perch Tilapia (fresh) | Physical loss 7 to 8% | buying early night catch market, prolonged retailing due to high supply. | Rainy season | traders avoid buying early night catches and reduce price to sell quickly to avoid losses. | transport & selling delays a problem during rainy season. customers do not want gutted or frozen fish. |
| Retail (Musoma) | N Perch Tilapia (smoked) | Physical - 2 to 5%<br>Reduced price 5 to 25%<br>Physical - 2 to 3% | breakage due to handling<br>mould<br>insects | | traders select good quality fish to sell breakage is accepted | |

Table 44 summarises the data from studies of the retail sector in Musoma town. It shows that the rainy season is associated with losses of dagaa as well as fresh Nile perch and tilapia and that traders will try to avoid suffering losses by buying good quality fish.

## CHAPTER 4 - Informal vs Formal, A Comparison of the Results of the Two Methodologies

This section sets out to appraise the data generated by the two, essentially different methodologies each with a different approach to data collection and analysis, yet both generating data on similar topics. An overview of the methodologies is presented in Appendices 1 and 2.

The questionnaire methodology was designed to generate quantitative information on loss levels and the reasons for losses. The informal methodology is a less structured approach to data collection that was used to generate primarily qualitative information on the cause and socio-economic context of losses. However, as shown in the summary of the informal data, it has also produced indicative quantitative data on losses.

Comparing the data produced by the application of the two methods in sectors where both have been used shows that there are substantial similarities. The questionnaire survey data on the Lake Victoria Nile perch gill net fishery show the main loss is due to selling fish to fish salters for approximately half price. The proportion of fish sold for a reduced price was on average 4.4% of a catch. The informal approach produced the same conclusions and quantified the loss at between 2 and 8%, reaching 15% at times.

Most of the interviews in the Mafia Island fishing questionnaire survey were conducted with beach seine fishermen and the total loss was found to average 2.5%. The informal data indicate that losses associated with beach seine fishing are also low at less than 5%.

In the questionnaire survey of the Lake Victoria transport sector salted fish losses are shown to be negligible, informal data shows the same. Likewise, both methodologies have shown smoked fish losses to be a result of high reduced price losses and that breakage is the main reason for this loss. For dagaa transport both methods indicate physical losses are negligible, although the reduced price loss is shown to be up to 16.5% by the informal data and an average of 4.4% by the quantitative data.

The informal data for the Mafia Island fishery show the variation in loss level according to fishing gear type. The questionnaire data for the Lake Victoria fishing sector highlights this variation in loss level to gear type also.

In general many informal studies have tended to demonstrate seasonal loss trends where they exist. Because much of the quantitative data has not been analysed for seasonal trends it is difficult to make comparisons between the two methods on the seasonality of losses. Although, in the one sector where data on seasonality is available from both methods, the dagaa processing sector of Lake Victoria, the conclusions are the same - losses are associated with the rainy season.

So far the evidence suggests that the two methodologies can produce similar results on the same issues. However, the Mafia Island transport sector data are atypical to this

assumption. The questionnaire survey data show losses to be negligible, while the informal data indicate losses are high, with reduced price losses up to 25% and the total loss 40%. It is not exactly certain why there is this difference, but it is known that the questionnaire data were recorded by someone who was involved in revenue collection at the site where the data was recorded. This may have affected the quality of data as revenue collectors are not often the most popular people in a community and as a consequence people may have been reluctant to offer information during interviews. This however also raises a question mark against other data collected by people who are involved in revenue collection or other occupations such as law enforcement. Secondly, the total loss figure of 40% was derived from one interview with a single transporter. There was no cross checking (triangulation) to see if the data were representative of the sector. The figure of 25% is an "up to" figure which means that a direct comparison is difficult because an average figure has not been determined. So this example remains an exception to the general trend in similarity between data from the two methodologies.

Generally though, with one exception, the results of this appraisal suggests that in terms of data both methodologies can produce similar findings on the same issues namely, quantification of loss levels, the seasonality of losses and loss levels in relation to variables such as fishing gear type. In many of the informal studies quantitative data on loss has been given as "up to x %" rather than "average is x%". It is suggested that with more application of certain tools and techniques the informal methodology could be used to produce accurate quantitative data on average levels of loss comparable to that which would be produced by a formal questionnaire survey. This could be achieved by using the informal methodology with more rigorous use of certain data collection tools such as seasonal calendars and triangulation. Likewise, more systematic use of ranking as a tool could prioritise the reasons for losses, as well as people's perceptions of loss in relation to other problems.

However, the credibility of informal methodologies can be open to criticism, primarily because the methodology does not employ recognised scientific sampling techniques.

Putting this last issue aside, if the methodologies can produce similar data there may be less need to use the two methods to complement each other and that one method could be used. The choice of which method to use may therefore be more dependant upon the cost, ease and speed of its implementation..

In terms of cost the informal methodology has proved to be less expensive and less time consuming to implement in Tanzania than the questionnaire survey. A rough costing of the two approaches is shown in Tables 45 and 46 which demonstrates that a 12 month questionnaire survey would cost US$ 18,500 and need 870 man days of time to implement, where as an informal study of the same sector would cost US$14,300 and require 288 man days. The experience of this project is that the informal studies also yield results more quickly than the formal questionnaires

For an organisation or fisheries department that would like to investigate post-harvest fish losses in detail, and are constrained by resources such as time and money, the informal methodology would therefore seem the more attractive method of the two.

**Table 45 Informal Methodology Costs**

| | Days | US$ |
|---|---|---|
| **Training** | | |
| 5 days for 10 staff total costs | | 2000 |
| **Fieldwork** | | |
| 4 people x 4 regions x four sectors x four days per sector | 256 | |
| report writing x 4 regions x 8 days | 32 | |
| **Stationary** | | 200 |
| **Travel & subsistence** | | |
| subs 4 people x four regions x 4 studies x 4days xUS$25 | | 6400 |
| travel 4 x 4 x 200 | | 3200 |
| **lap top computer + printer + consumables** | | 2500 |
| **Contingencies** | | 1100 |
| | **288** | **15400** |

These costs are based on local rates of subsistence in Tanzania.

**Table 46 Questionnaire Survey Costs**

| | | | Days | US$ |
|---|---|---|---|---|
| **Staff training** | | | | |
| Instructor | 2 days x 4 regions | | 8 | 800 |
| **Stationary,** communications, photocopying stationary (30 x US$5) | | | | 150 |
| communications 12 x 10 x US$2 | | | | 240 |
| photocopies | 4 x 30 x 12 | US$0.08 | | 115 |
| **Computer** | | | | |
| computer + printer + software | | | | 4000 |
| training | | | | 400 |
| consumables | | | | 100 |
| **Staff time** | | | | |
| 1 National co-ordinator @ 8 days per month | | | 96 | 1200 |
| 8 Regional Supervisors @ 2 days per month | | | 192 | 960 |
| 21 Field recorders @ 2 days per month | | | 504 | 3000 |
| travel | | | | |
| 30 staff x 10US$ per month | | | | 3600 |
| National Co 4 field visits x US$250 | | | | 1000 |
| monitoring | | | | |
| 8 Reg Sup 2 days per month | | | 192 | 960 |
| **Data inputting** @ 30 records per hour5000 records= | 167 hours | | 24 | 240 |
| **Data checking** @ 100 records per hour | | | | |
| 5000 records = | 50 hours | | 7 | 70 |
| **Data analysis** | 4 man weeks | | 20 | 200 |
| **Contingencies** | | | | 1500 |
| | | | **869** | **18535** |

These costs are based on local rates of subsistence and travel.

## References

Ashley S D (1993) Report of a visit to Tanzania to establish a post-harvest loss monitoring system for the Lake Victoria fishery. NRI Internal Report R 1965 (S).

National Research Council (NRC) (1978) Post-harvest food losses in developing countries. US National Academy of Sciences, Washington DC.

Poulter G R , Ames G R, Evans N J (1988) Post-harvest fish losses in traditionally processed fish products in less developed countries. In. Morrissey M T (ed) (1988) Post-harvest Fishery Losses Proceedings of an International Workshop held April 12 - 16 1987 at the University of Rhode Island, Kingston.

## Appendix 1 - Recall Questionnaires

Two surveys using recall questionnaires were conducted by the project. The first was of the Lake Victoria fishery and concentrated on generating data on two species of fish: Nile perch (*Lates niloticus*) and dagaa (*Rastrineobola argentea*). This survey ran for two years. The second survey was of the multi-species marine fishery centred around Mafia Island, which ran for 1 year. These surveys did two things. Firstly they generated a vast amount of quantitative data on post-harvest fish losses. Secondly, they provided the opportunity to test and develop the appropriateness of the methodology. Due to the different nature of the two fisheries surveyed it was anticipated that the eventual methodology would be a robust one, adaptable enough for use in diverse fisheries in other parts of the world.

Essentially four different questionnaires were developed in Ki-swahili. These were used by trained enumerators at selected sites on a monthly basis to interview fisherfolk. Each questionnaire was tailored to generate data on fish losses in a particular fishery sector. The four sectors surveyed were: fishing, processing, transportation, and retailing. A fifth questionnaire for use in the dagaa processing sector of the Lake Victoria fishery was also developed.

Much of the background to and guidelines for setting up a questionnaire survey are covered by the NRI report by S Ashley (1993) "Report of a visit to Tanzania to establish a post-harvest loss monitoring system for the Lake Victoria fishery." The following sections outline the key developments that have taken place since the survey development work in Ashley's report began in April 1993. In brief these involved: overcoming the problem of standardising traditional units of fish measurement; surveying a multi-species fishery; and data analysis.

### Traditional Units of Fish Measurement

After six months of the Lake Victoria survey it became apparent that the questionnaires were not collecting enough information on the traditional units of fish measurement commonly used by fishermen, processors and traders for buying and selling fish. Without this extra information it would be difficult to standardise measurements for quantities of fish being caught and traded and hence be able to calculate loss levels.

So two developments were initiated. The first was to introduce a separate, monthly, survey to collect information specifically on traditional units of fish measurement. This survey ran for over twelve months, in parallel with the questionnaire survey. The data it generated were used to convert traditional unit values to kilograms for the data for the first twelve months of the Lake Victoria survey.

The second development was to revise the original questionnaires, introducing additional questions that would collect the data needed to standardise traditional units of measurement.

## Multi-Species Fishery

A multi-species fishery such as the artisanal inshore marine fishery of Tanzania offered the challenge of collecting data on a potentially large number and diverse range of fish species. To overcome this challenge would be a major step forward in the development of a robust and universally applicable quantitative methodology. The project and the Tanzanian Fisheries Division agreed that the Mafia Island fishery should be surveyed for post-harvest losses. This fishery was suitably multi-species as it had over 200 species of commercial value.

The questionnaires used were essentially the same as those used in the Lake Victoria survey. Initially, however, the survey tried to cover all the commercial species of fish in the fishery. A coded list of 44 of the most common species was used to identify fish during interviews. An interview concentrated on only the "two most abundant" species of fish in a catch or batch (more than two species led to the problem of respondent fatigue).

It quickly became apparent that by focusing on only two of over 200 species of fish per interview could lead to a thin spread of data over potentially many (44) species. The data would end up being statistically weak. The approach was also inflexible.

A re-think resulted in the identification of four possible alternatives to overcome this problem:

a) determine losses for the whole fishery with no knowledge about species;

b) determine losses for the most abundant species or species groups;

c) determine losses for the most "important species";

d) determine losses about all species associated with the interviewee.

The most logical step to take in deciding which alternative to use was to consult the commissioning agent of the survey. In the case of this project, the Tanzania Fisheries Division were consulted as they would be the primary end users of the raw data. Their request was to focus on the most commercially important fish species. An informal study was conducted to identify these species (this study appears in a separate project report that includes all the project's informal studies). The commercially important species, in terms of groups, were found to be: snappers & emperors (changu), trevally (kolekole), spinefoots (tasi) and mackerel (kibua). So the survey of fishing, processing, transportation and retailing was adapted to generate data on these four species.

## Data Analysis

This section sets out the key steps to analysis of questionnaire survey data.

For this work in Tanzania the questionnaire data was entered into a computer database. The software used was Dbase IV. This is a common package in Tanzania and hence training for project staff in its use was relatively easy to arrange.

It was envisaged that data analysis could be done using data base tools and that files of data could also be downloaded into a spread sheet for further analysis.

Briefly the basic steps used to analyse the questionnaire data were as follows:

a) input data into database;

b) check inputted records have been entered correctly;

c) convert traditional unit data into standard units (kg);

d) calculate key values such as catch and losses for individual interviews;

e) calculate average values for sectors and sites according to time periods;

f) summarise raw data on the reasons for losses.

g) use raising factors to amplify survey results to a fishery level.

Further mention should be made here of the last point. To interpret the data to reflect what is happening in the fishery as a whole will give policy makers and planners a better perspective on post-harvest losses in relative terms.

The questions in the questionnaires were designed so that answers could be recorded in code form in a matrix table or answer form. This made computer data inputting relatively straightforward. It also meant data could be transferred directly from the answer forms into the database, avoiding the need for extra processing.

For many of the questions in the recall questionnaires more than one answer was given by respondents. These additional answers arose because the fish could be sold by more than one unit, or for different prices for the same unit. To ease further analysis it made sense to first combine these answers to give one answer for a question.

To do this the questionnaire answers were combined with data on units so all measurements were converted to kilograms and multiple answers converted to a single answer. This meant there were new fields in the database which contained the weight of fish in kilograms for each question of an interview. These new fields formed the focus of the first stage of data analysis, which was calculating catch weight and value and losses for each interview. Once this was done then losses for each sector could be calculated according to variables such as fishing gear type.

## Appendix 2 - Informal Fish Loss Assessments

This is an overview of the informal methodology tested by the project to generate qualitative data on fish losses.

There are now a number of informal methodologies that have been developed over the last decade to collect information, identify problems, and to formulate, and evaluate projects. Some have been well documented and rigorously field tested in the agriculture, forestry and urban sectors. Of these "off the shelf approaches", Rapid and Participatory Rural Appraisal (RRA & PRA) were chosen as a starting point for the development of an informal fish loss assessment methodology.

The first experimental work with an informal approach to assessing fish losses was conducted in July 1994 at Tumbuju fishing village on Mafia Island. As a result of the success of this work the project ran a training course at Mbegani Fisheries Development Centre in Rapid Rural Appraisal for fisheries staff connected with the project. The objective was to train staff to conduct field studies in different fishery sectors. The project eventually under took 13 field work studies in all. Through this fieldwork a general qualitative methodology has been developed with a suite of tools and techniques.

In essence the informal fish loss assessment methodology is a planned yet flexible approach to collecting qualitative and indicative quantitative data on post-harvest fish losses. It can be used to draw conclusions on the nature and importance of fish post-harvest fish losses. Unlike formal questionnaire studies, which are structured and have set questions, this method relies mostly on semi-structured interviews with fisherfolk who are knowlegeable about the fishery, and/or post-harvest fish losses. The approach also includes various other data collection aids and techniques, including observation and diagram tools which facilitate dialogue as well as also generating specific data.

The informal loss assessment methodology can be used in a variety of ways: for broad studies which explore losses, or for more intensive studies of particular losses. It can also be used to do a pre-survey appraisal for a formal questionnaire survey.

The scope of the methodology is not limited to specific fisheries, it is applicable for use in most fishery sectors and marketing stages in both artisanal and more industrialised fisheries. For example it has been used to good effect by a prawn processing factory to troubleshoot for losses at the supply stage of the business.

The sort of data that can be produced by using this informal methodology are wide ranging. Data on the following issues are some of the specific outputs that could be expected:

- indicative physical and quality loss levels
- estimates of monetary losses
- reasons for losses
- seasonal variations in loss levels
- the perceptions of fish losses by those who are affected
- importance of fish losses compared to other issues
- historical levels of fish losses

The methodology should be used by a well motivated multi-disciplinary team who have a full understanding of the methodology. Ideally, the team should include at least one person who has had previous experience of using informal data collection methods such as Rapid and Participatory Rural Appraisal or similar methodologies. Even if at least one person in the team has this experience it still may be appropriate for the team to undergo some pre fieldwork training or practice in the methodology, involving as much "hands on" fieldwork as possible.

It is an intensive method and is demanding in terms of committement from the user. The quality of a loss assessment 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.

Furthermore, because this method is not so structured as a more formal methodology great care must taken in its use. There is generally more room for error in implementing an informal fish loss assessment. One of the main reasons for weak studies is the failure to address the objectives of the assessment.

On the positive side, the informal methodology can be used over a short space of time to produce results relatively quickly, while the results from a questionnaire survey may take much longer to get. Hence informal methods can be used to provide up to date information.

The informal methodology may lack the potential quantitative accuracy of a formal questionnaire survey, but it can be used to generate very detailed qualitative information on losses, as well as good indicative quantitative data, which is important in making policy and planning decisions. However, it is open to criticisism in that it is seen as being less scientific than formal approaches to data collection, especially since it lacks a statistical sampling component.

The methodology can be broken down into the following parts:

- the resources required to undertake a study,
- planning a study,
- the tools and techniques needed for the data collection exercise,
- reporting the results.

## Appendix 3 - Post-harvest Fish Losses Workshop, 20th July 1995

**Summary**

A workshop was held in July 1995 to present the findings of the research to an audience of Fisheries Division staff and members of the private sector. A list of participants appears at the end of this Appendix

The following is a list of the presentations made by project staff on the methodologies developed and the data generated.

| | |
|---|---|
| Introduction | A Ward |
| Recall Questionnaires | Y Mndeme |
| Informal approach | A Ward |
| Summary of Post-harvest fish losses in Tanzania | A Ward |
| Fishing Sector Losses | Y Mndeme |
| Processing Sector and Dagaa | A Ward |
| Transport Sector | M Ndagala |
| Retail Sector | A Ward |
| Informal Studies of the Mafia Island fishery | G Mokoki |
| Artisanal Prawn fishery | Y Mndeme |
| Comments on the Questionnaire Survey | Y Mndeme |
| Comments on the Informal Approach | A Ward |
| Future Work | A Ward |
| Discussion & Recommendations | |
| Reception | |

It was concluded that the loss data best represent the Tanzanian situation. In other words they are data on losses in artisanal fisheries affecting artisanal fisherfolk. And that the the private sector fish processing industry has played an important role in the control of fish losses. A question mark was raised against the accuracy of raising factor data.

In summary it was felt by workshop participants that the most important next step is to disseminate the research findings of the project to the participants of the research and to a wider international audience.

The following sets out a number of general, issues raised during the course of the workshop that are relevant to post-harvest fish losses in Tanzania.

**Definition of What is a Fish Loss**

The project has defined the loss to fisherfolk as being the physical loss of fish and the loss in revenue because fish were sold for a lower than best price. The total loss is the monetary value of these two types of loss.

However, the issue of what is a loss and what is not is something that can be argued about. It was suggested that a loss also occurs when juvenile fish are harvested, and they are therefore not allowed to grow on to reach a larger size for capture in the future. Again if dagaa is eaten by birds is that a loss? as the bird has gained.

The question is who is being identified as suffering a loss. In the case of the project it has been the sector operators: the fishermen, traders and processors. In which case the project definition of losses is seen as correct.

**Fish Losses in Tanzania**

The data generated by the questionnaire survey shows that the post-harvest fish losses in two of Tanzania's artisanal fisheries are at lower levels than historical loss estimates would suggest.

It was concluded that the losses identified best represent the Tanzanian situation. In other words they are losses in artisanal fisheries affecting artisanal fisherfolk. The important point to remember is that if different standards are applied to what is and is not a loss then the loss levels will change.

The Director General of the Tanzanian Fisheries Research Institute pointed out that a previous survey in the 1980s had shown losses in Tanzania to be around the higher historical level of 20%. The reason for the lower levels now in the Lake Victoria region is thought to be due to the presence of an active industrial fish processing sector there, providing a ready and strong demand for good quality fish. The incentive to avoid losses is strong. Equally in the marine fishery, there appears to be a strong demand for fish in Dar es Salaam especially. Prices are high, hence there is an incentive for people to take better care of fish to avoid losses.

Highlighted by this is the important role that the private sector fish processing industry plays in the control of losses. Ironically only one representative from the private sector attended the workshop, and then only briefly.

**Fish Quality**

The subject of improving fish quality proved to be a controversial one. There were two schools of thought represented at the workshop. Their arguments can be summed up thus. On the one hand placing too much effort in improving the quality of fish would eventually exclude lower income earners from being able to purchase fish. The other argument was that fish quality should be controlled and improved by forming co-operatives through which all fish would be landed and distributed.

**Raising Factors**

The most significant loss identified by the project in monetary terms occurs in the Nile perch gill net fishery of Lake Victoria. It is estimated that there are 2000 gill net fishing units operating 300 hundred times a year, incurring a loss of Tsh 267 million annually to fishermen.

It was suggested that the number of gill net fishing units may in fact be higher: a figure of 8000 was put forward as being more representative. If this is the case then the initial monetary loss will be a significant under-estimate. Instead the loss for 8000 fishing units would be 1 billion Tsh annually.

If there is doubt about the number of gill net fishermen then the numbers of processors and traders of the different products surveyed by the project may also be unrepresentative.

**Infrastructure**
It was agreed that as the infrastructure improves in Tanzania (better roads to fishing villages and better telecommunications generally) then the level of losses should reduce further.

**Artisanal Prawn Fishery**
It was noted that generally not enough ice is used in this fishery. And ice is often used inefficiently and is of poor quality.

Apart from increasing the supply of ice it was suggested that more inspection of prawns be done at landing sites and at distribution points. This could be done by field staff trained to assess prawn quality.

The topic of promoting the use of sodium metabisulphite was raised and generally it was thought not a good idea to pursue, because of the perceived reaction from consumers. However, this chemical is widely used in the food processing industry in Europe and so it may be worth reviewing this line of thought.

Although the chemical is said to be relatively expensive and difficult to obtain.in Tanzania.

An alternative approach could be to develop natural products to slow down the onset of spoilage in prawns. The use of citrus plants was suggested.

A point was made that to boil prawns may help reduce the problems of post-harvest losses. It was suggested that marketing of boiled prawns be investigated.

**Insulated Containers**
Some possible technical interventions have already been highlighted. In addition the use of insulated containers was discussed in relation to rail transport. Rail transporters could use better insulated containers for frozen fish. There is at least one factory in Dar es Salaam (Cotex) that produces locally made insulated boxes.

However, from the experiences of workshop participants it was concluded that insulated containers would only be appropriate where high value species such as prawns are being transported. Although the cost-benefit of such an idea was not examined, it was felt unlikely that Nile perch transporters would be willing to invest in better insulated containers.

**Dagaa Drying**
The main loss in the dagaa fishery is associated with the rainy season and the issue of how to improve the drying of dagaa in the rainy season was raised. Technical interventions have been tried by other projects active in the Lake Victoria and Lake Tanganyika regions. The lessons learnt from this work should provide an important guide to the feasibility of improving dagaa drying in other areas.

In a post-workshop meeting the idea of using plastic sheeting as a drying surface for dagaa was put forward as being a practical way of improving the process. Such

sheeting is cheap, transportable and long lasting (up to 3 years). Using it would also reduce contamination of the final products with sand and dirt.

Dagaa is now being salted in Mwanza region for the Zambian market. The effects of the process on dagaa quality, particularly colour change, should be studied.

**Dissemination of Findings**

Generally it was felt by workshop participants that the most important next step is to disseminate the research findings of the project. For this there are two distinct target audiences: the fisherfolk of Tanzania; and fisheries research institutions and organisations world-wide. The Director of Fisheries of Tanzania is keen to see the result of this project presented internationally. He expressed an interest in publishing a report for wider distribution.

In the case of Tanzanian fisherfolk it was decided that the findings should be presented through a series of seminars in fishing villages and at data collection sites that had been used in the questionnaire survey. The seminars would be conducted by regional fisheries staff. The aim would be to present the research findings and discuss these with fisherfolk with a view to planning strategies to reduce post-harvest fish losses in sectors where this would be appropriate. In conveying the findings, the emphasis should be placed on the monetary aspect of losses. This angle is likely to be of the greatest interest to fisherfolk and policy makers.

Certain tools could be used to help with dissemination. The production of a video cassette based on the research findings was generally thought to be a very good way of presenting the results to fisherfolk.

The possibility of using any other relevant video cassettes at seminars will be investigared.

A good way of disseminating the results in Dar es Salaam would be by television. Discussions have already begun between project staff and a representative of the ITV station in the city. It is thought that a relevant location would be Banda Beach fish market in the city.

Radio broadcasts and newspaper articles are other mediums through which the findings could be disseminated. There were several freelance reporters at the workshop and it is hoped that they will write articles for local newspapers.

Schools are another target. Producing posters and pamphlets aimed at educating children about better fish handling was discussed. These could be distributed to schools in the regions where fisherfolk are concentrated.

Presenting the findings to fisherfolk will serve two main purposes: it will provide feedback results to people who have participated in the research; and will present current and relevant information to fisherfolk on post-harvest fish losses in Tanzania.

The second, wider audience, that of international fisheries researchers and planners, will be the target of a "yet to be compiled" training manual in fish loss assessments. It is expected this will be ready for publication in 1996.

Not much has been published on the use of informal data collection techniques in fisheries research. The informal methodology work of the project could form the basis of papers and articles for publication in relevant periodicals.

**Workshop Participants**

| | |
|---|---|
| T W Maembe | Director of Fisheries Tanzania |
| L K Lutakumwa | Fisheries Officer, Mbegani Fisheries Development Centre |
| A T Mahatane | Regional Fisheries Officer, Mwanza |
| E Japhet | Fish Technologist, Mbegani Fisheries Development Centre |
| E O Hemile | District Natural Resources Officer, Mafia Island |
| G R Mokoki | District Fisheries Officer, Mafia Island |
| F M D Ntima | Fisheries Officer, Dar es Salaam Region |
| W V Haule | Senior Fisheries Officer, Fisheries HQ |
| Y Mgawe | Fish Technologist, Mbegani Fisheries Development Centre |
| B A Maige | Fisheries Officer, Fisheries HQ |
| C D E Ntungi | Fisheries Officer |
| J M Pungwe | Fisheries Officer, Coast Region |
| Z S Kazula | Fisheries Officer, Mara Region |
| K P C Kauswa | Municipal Fisheries Officer, Mwanza |
| E S Kilosa | Regional Natural Resources Officer, Mara Region |
| M Ng'ombo | Fisheries Officer, Kunduchi Fisheries Training Institute |
| G Msumi | Fisheries Officer, Mbegani Fisheries Development Centre |
| J P M Mairi | Municipal Fisheries Officer, Mwanza |
| E Nkondola | Fish Technologist, Mbegani Fisheries Development Centre |
| M Ndagala | Regional Fisheries Officer, Dar es Salaam |
| P O J Bwathondi | Director General, Tanzania Fisheries Research Institute |
| N S Jiddawi | Assistant Director, Institute of Marine Science, Zanzibar |
| E F B Katunzi | Director, Tanzania Fisheries Research Institute, Mwanza |
| S N Makame | Director, Fisheries Zanzibar |
| J Maziku | Tanperch Ltd |

## Appendix 4 - Post-harvest Fish Losses in Tanzania - Dissemination of Research Findings, a Project Proposal.

Globally, there is recognised to be a growing imbalance between fish production and demand, the latter increasing, the former stationary and possibly reducing. Post-harvest losses have long been recognised as something that if reduced can help alleviate this imbalance. Historically, there has been a lack of accurate quantitative data on post-harvest fish losses. There had been little attempt to develop fish loss assessment methodologies that are accurate and can generate the sort of data on losses that policy makers and fisheries planners can use to make informed decisions for control and reduction.

The aim of the Natural Resources Institute/Tanzania Post-harvest Fish Losses Project has been to develop post-harvest fish loss assessment methodologies in Tanzania for use in fisheries in Tanzania and other countries. The project worked in two fisheries in Tanzania, Lake Victoria and Mafia Island, for a period of two years. The research generated data on post-harvest fish losses in several fishery sectors including fishing, processing, transport and retail.

For example the project has identified that fishermen in the Lake Victoria Nile perch gill net fishery lose an estimated 260 million Tanzania shillings in income annually because fish is physically lost or sold for low prices.

The Fisheries Division of Tanzania has identified there is a need to disseminate the information on losses to fisherfolk who have participated in the research and to inform communities in general of the levels and reasons behind post-harvest fish losses. While NRI has financially supported the research it does not have additional funds to support any dissemination work.

Project Outline

The research results will be disseminated by a series of seminars/meetings conducted by fisheries staff with fishing communities at key sites in the Lake Victoria, Dar es Salaam and Mafia Island areas. The sites chosen will be those where research has shown losses are significant.

A video presentation highlighting the fish handling and distribution practices that lead to fish spoilage and loss, and ideas for technical improvements to reduce spoilage, would be shown during the seminars for discussion.

A major output of the dissemination exercise will be a strategy, where applicable, to reduce losses. This will have been designed by the Fisheries Division with the assistance of the fishing communities.

The video equipment would be used by the extension department of the Fisheries Division for future work.

**Estimated Project Cost (Tanzania Shillings)**

| | |
|---|---|
| Video camera | 1,000,000 |
| Video deck | 300,000 |
| Television | 500,000 |
| Generator | 1,000,000 |
| **sub total** | **2,800,000** |

| | | |
|---|---|---|
| Preparation of Dissemination materials | | 1,000,000 |
| Team of 3 people | | |
| Transport & subsistence 40,000 each per meeting | | 1,800,000 |
| (2 seminars in Mwanza, Mara, Bukoba, DSM, Mafia I) | | |
| Report writing 2 days per region x 3 people @ 20,000 per day | | 600,000 |
| Transport | | 1,000,000 |
| Stationery | | 200,000 |
| Sub total | | **4,800,000** |
| Contingencies | | 760,000 |
| **Total** | | **8,360,000** |
| (@ 640Tsh = US$1) | **US$** | **13,060** |