# Final Technical Report

## Building Cost Effective Control into the Fishery Chain

### Improving Livelihoods Through Better Control

## NRI Contract N$^{o}$: ZD011
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**Adaptation of a predictive cost model to determine the cost of control in identified critical loss areas within the fish processing chain**

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# Contents

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Members of the fishing community

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# Section 0 – Summary of Project Impact

## 0.0 Executive Summary

The purpose of the project was to develop the local capacity to adapt and implement cost effective control measures targeted at critical loss areas within defined fisheries chains. The survey work and predictive software tools have provided relevant technical and cost information for decision makers. Informed advisors and policy makers have therefore promoted effective strategies to control loss and maintain quality. Commercial decision-makers, local advisors and fishing communities also benefited through the provision of tools which enabled cost analysis of relevant control options which encouraged adoption of better practice.

One of the most significant outputs of this project has been the development of capable local teams respected by stakeholders throughout the chain. The improvement in the quality and profitability of the sector in Uganda is a clearly demonstratable output of this project. The usefulness of the approach is demonstrated by the application of the tools in further projects supported by UNIDO[1] and incorporated into the policy and planning process in country e.g. the Ugandan 5 year medium term research plan.

## 0.1 Did it work? - Economic Impact

At the outset of the project, average reject rates recorded at Ugandan landing sites were between 9 to 12% for Nile Perch. The adoption of icing and better handling practices in earlier stages of the chain has subsequently reduced this reject rate to below 5% and often nearer 3%. A 9% increase in quality material for export on the annual 100,000 ton fishery industry added $2.7 million dollars to the country revenue with fish valued at $3/kilo.

The cost impact of the closure of the fisheries in 1998 (Bagumuire 2000)[2] was estimated to be $30 million per annum. The export association (UFPEA) reported a major impact on the fisheries livelihoods of 500,000 dependants throughout the chain as fish prices were reduced by 70% when fishery was denied access to major market. The re-opening of the market was based upon demonstratable effective control within the primary and factory segments of the chain, which were supported by this project and recognised by the sector. Factory gate prices have now been seen to rise by 50% as the market has re-opened

The project outputs provided the participating factories with formally documented cleaning controls and a cost estimate for their revised cleaning programme. The advisory service (NARO) have designed procedures for validation of cleaning controls and produced a national guidance document on best practice for food factory cleaning. The work in Ghana resulted in economic gains for the fishermen, fishing mummies and the captains as the quality was seen to rise.

## 0.2 Has government re-acted? - Policy Impact

The Ugandan law applying to the fish factories now requires that every factory use these sanitation controls. Validation of cleaning programmes has also been required by government policy and is now verified during routine Government Inspection[3]. The need for proper icing and handling has been included as an Ugandan policy requirement within the primary end of the chain and will be increasingly scrutinised by the inspection service. The regulatory authority in Ghana is also planning to make the intervention (lining of the hold) a policy requirement for vessels wishing to supply the export market.

## 0.3 Has the sector improved? - Technical Impact

The initial project reports documented economic, technical, social and environmental constraints within Uganda and Ghana. These reports defined the existing control systems and costs and were produced by the local teams guided or led by MDA. Factory operators in Uganda had no formally documented systems of cleaning did not know the cost of their cleaning and were unaware of the effectiveness of the existing control measures. The country had also experienced closure of their fisheries during the project by the EU claiming failures in factory sanitary control. Ghana had similar problems in relation to icing and handling controls on board the artisanal fleet

The fishermen in Uganda have largely adopted icing as routine practice. The factories have also adopted all of the necessary sanitation protocols including regular checks to make sure their control system works. The Ghanaian fishermen are also interested in adopting the modified holds and have modified their capture practices to avoid excessive time for fish in the sun.

The modified Ugandan icing and sanitation controls have recently been evaluated by the EU[4] and found to meet their international export requirements thus enabling re-entry into the market. The handling, icing and cleaning controls were reported to have significantly improved since 1997.

## 0.4 Has the local team developed –Capability Impact

This project was designed to enable the local advisory and research groups to provide advice and guidance to their industry and fisheries sector. The local team in Uganda expanded to 4 members and is now capable of supporting the development of cost effective controls throughout the food sector. The project team adapted and documented the operation of specifically designed databases, which estimated or predicted the cost to achieve given control. The databases were then modified and tested by the teams under field conditions. Predictions were verified theoretically and practically in the field.

The team in Uganda have used the experience of this project to successfully bid for UNIDO projects in the same area. The current UNIDO projects have, and will continue to build on the DFID icing project. (UNIDO Project Ref. No XA/UGA/98/617 and US/UGA/98/106)[1]. The Ice-IT and Log-IT databases are now being used within the UNIDO projects to measure the micro-economic impact of new boat design and operation to the factories.

## 0.5 Can the approach be transferred – Changes in Ghana and Morocco

The Ghanaian team leader visited Uganda to review the approach in 1999. The approach to auditing factory-cleaning control was then successfully undertaken and tested at Divine Seafood in Ghana. The existing protocols for undertaking technical audit, trials and cost calculations were repeated and modified. The Ghanaian team focused on the icing work, which had begun in Uganda. They then reviewed the existing controls present in their fisheries chain and selected handling, better insulation, and improved icing as a focus of their intervention work.

The modified boat holds were then produced after testing of different designs using mini-holds.
The prototype hold was found to be subject to rusting and the metal lining became separated from the wooden base. The next version was of a better construction and has been welcomed by the local

fishermen. The economic benefits of the lined holds has been demonstrated in trials with gains of at least 15% being recorded (Akrofi and Sanchez, 2000)[5]. The Ghana team also documented the controls in fish handling and icing activities through an extensive technical survey executed throughout Ghana based on the Uganda approach.

This project was linked through associated research to other activities. The Director of Fish Inspection (Tangiers) has been closely involved in the approach and has employed the tools and techniques to significant effect in Morocco. The methodology has also been demonstrated to target groups in 1998 (Namibia)[6], 1999 (Denmark)[7] and 2000 (Ghana)[8] at a series of practical workshops. Finally the tools and approach are currently being taught and employed within the MSc in Food Standards based at the University of Hull by the MDA team.

### 0.6 Has the knowledge been disseminated - Changes in the Stakeholders

The local stakeholders have been routinely kept informed in each country through the project team and their agreed activities. The Ugandan team have held regular meetings with their stakeholders and have modified their work programme in line with comments from fishermen and factories. This approach was also reflected in the team in Ghana were fishermen and fishing mummies were part of regular steering group discussions. The international team and local project groups have also resented at local, national and international meetings and workshops. The final event planned for Ghana involved presenting an overview of the tools and approach to an interested regional group

# Section 1 – Background and Preliminary Research

## 1.0 Background

World-wide production of fishery products is around 100 million tons per annum. A proportion of this fish is used for industrial purposes (e.g. fishmeal) and the rest for human consumption. Of the fish destined for human consumption, there are significant "losses" at various points of the marketing and distribution chain. These losses are of most importance to the developing countries; of the top 40 nations, which derive animal protein from fish, only one is a developed country (Japan).

Post harvest losses occur at every point in the marketing chain, from catching to consumption. The losses can be in terms of volume, quality or value. Although post-harvest losses are believed to be a major problem in many less developed countries, there is very little reliable or detailed information available. This presents a problem for policy makers in determining priorities for research and intervention. Appropriate methodologies for identifying and addressing post-harvest losses in fisheries have long been recognised as a key research priority.

A major research effort was started in 1993 to develop systematic methodologies to measure the losses, focusing in terms of value in a range of artisanal fisheries in one sub-Saharan African country, Tanzania and to use that information to generate effective methods for loss assessment in other fisheries systems and in other countries.

The main part of this complimentary project work has focused on investigating and costing control measures. Quantitative and qualitative survey methods were developed and used with the subsequent production of a considerable amount of technical and economic data. This enabled modelling of the cost of intervention to provide advisory agencies, industry and government policy makers with a tool to allow a prediction, at the macro and micro- level, of cost interventions in the chain.

Clearly, once a loss has been identified, the most important question that arises is "What do you do about it?" In nearly all cases, the major factor in determining the type and level of intervention was economics. Thus, decision-makers need a tool to assess the "cost" of recovering the lost "quality" of the fish resource. Once this information is available in a useable format, an appropriate, and very likely sustainable, intervention can be implemented.

In the genesis of this Quality Costing Model, it was decided that the widely adopted quality assurance and Hazard Analysis Critical Control Point (HACCP) approaches lent themselves to the development of this model (WEFTA ,1995)[9].

The project therefore developed methods to identify, document and cost appropriate control methods within the fisheries chain. The first phase of the project was planned to investigate, document and cost sanitation control systems in fish processing plants in Uganda. Previous work had been completed in this area and the related loss prediction area by NRI under project no. R5027. This project built on the losses work, which demonstrated a need for effective control systems. The economic engineering team based at FAO in the Department for Fisheries had also completed significant investigations over 20 years and collaborated with the project team (Lupin et al Technical Manual 351)[10].
They assisted in the design and testing of the models and the validation of the field -work.

The project helped to resolve the problem of losses of fish and fish quality in Ghana and Uganda. This was shown to directly benefit the fisherfolk and the processors through better yields, so making better usage of resources available. FAO had estimated that a significant shortfall (19 million tonnes) in fish protein by the millennium, with low income groups facing the severest deficit.

This project adopted a systematic approach to the selection and analysis of key control measures within the fisheries chain. A HACCP based approach was employed within the early phase of the project whereby a systematic analysis of key control points within the fisheries chain was undertaken in collaboration with the local partner. A review of previous approaches to control at these points and why they had been unsuccessful was also included. Cause and effect analysis techniques were used to determine the reasons why given control strategies were unsuccessful and to select the best control strategy.

The critical control measures were identified and the key performance indicators selected to ensure that controls were effective technically and financially. The performance indicators were also tracked and validated through formal audit procedures. The accuracy of the cost predictions was also checked and the data sets reviewed to assess the project impact.

Unlike other research activities the micro-economic barriers to adoption of controls was a major focus of this work The resulting software tools enabled the local advisors to provide cost estimates of a given change in control to be made. The control measures targeted the major sources or reasons for loss at a given step in the chain.

### 1.1 Project Purpose

The purpose of the project was to develop the local capacity to adapt and implement cost effective control measures targeted at the critical loss areas within the defined fisheries chain. The understanding and practical development of methods and utilisation of the predictive costing software enabled the policy makers to promote effective strategies to control loss and maintain quality. Commercial decision-makers, local advisors and fishing communities also benefited through cost analysis of their relevant control options, which encouraged adoption of better practice.

### 1.2 Project Summary

Project teams were set up in Uganda and Ghana and operational methods put in place. The teams collected data from pilot sites and using the data collected a preliminary predictive database was designed. During the project the Ugandan team was expanded to include a microbiologist, a fisheries management member and a food scientist. All members received training in the software tools and in technical audit skills. Successful review meetings were held throughout the duration of the project involving a wide range of stakeholders.

The icing work in Uganda and Ghana continued to promote the use of cost-effective practices, which led to significant reductions in landing site and factory rejects. Software tools were developed to manage and capture information from the icing trials and cost the benefits.

The Ugandan team completed the documentation of the factory cleaning controls and published a booklet to support industry in building better controls [11]. The temperature control and handling work in Uganda resulted in the team being contracted by UNIDO to investigate further aspects of improved control. Both the Ugandan and Ghanaian members made presentations at FAO expert meetings; this highlighted their confidence in the programme and the practical nature and benefits of the project to their countries[7].

Full-scale sea trials in Ghana and the installation of software in three operational factories in Uganda provided positive feedback. Further factories in Uganda have requested software tools and fishermen in Ghana are now asking for lined holds. Subsequent trials have been designed to offer the level of validation necessary for technical publication. This trial data and other feedback from users has therefore enabled the final refinement of the software products to be undertaken prior to the closing meeting which took place in Ghana in September 2000[8].

# Section 2 – Research Activities

## 2.0 Research Work Phase One

The objectives of the early phase of the work between 1995 and 1997 was to (WEFTA, 1995)[9]:

- Establish a standardised protocol for costing control and monitoring options, and costing internal and external failures in a given fisheries chain
- Utilise existing information to cost these parameters and construct a database
- Develop a questionnaire and interview approach to effectively survey small fish processors to assess quality system understanding and costs
- Construct a database of hazards, controls and failures from pilot companies
- Evaluate software packages to assess nature of customer complaint and cost of complaint
- Evaluate existing HACCP based systems to assess the effect of internal and external failures

## 2.1 Development of the Costing Approach

The 1990 British Standard, BS 6143 "A Guide to the Economics of Quality"[12], was employed as the reference standard for costing prevention, appraisal and failure (PAF) in the project. BS 6143 provides the following definitions:

- **Prevention cost** - The cost of any action taken to investigate, prevent or reduce the risk of non-conformity or defect.
- **Appraisal cost -** The cost of evaluating the achievement of quality requirements including e.g. cost of verification and control performed at any stage of the quality loop.
- **Internal Failure Cost -** The costs arising within an organisation due to non-conformities or defects at any stage of the quality loop, such as costs of scrap, re-work, re-test, re-inspection and redesign.
- **External Failure Cost -** The costs arising after delivery to a customer/user due to non-conformities or defects, which may include the cost of claims against, warranty, replacement and consequential losses and evaluation of penalties incurred. The prevention element of the PAF cost model has been related to the seven HACCP principles in the development of prevention based HACCP plan (Table 1).

Table 1 Comparison of HACCP Plan Principles Vs BS6143 Cost Definitions

| *HACCP Definition* ☞ | **Control Measure.** | | **Monitoring Method** | | **Corrective Action** | |
|---|---|---|---|---|---|---|
| *BS6413 Definition* ☞ | **Preventative Cost** | | **Appraisal** | | **Failure** | |
| | Development Cost | Operatin g Cost | Development Cost | Operating Cost | Development Cost | Operating Cost |
| **HACCP Principles** | | | | | | |
| 1. Conduct analysis. | ✓ | | | | | |
| 2. Identify CCP's | ✓ | | | | | |
| 3. Establish and operate target levels & critical limits | ✓ | ✓ | ✓ | ✓ | | |
| 4. Establish and operate monitoring system. | ✓ | | ✓ | ✓ | | |
| 5. Establish and operate corrective action. | ✓ | | | | ✓ | ✓ |
| 6. Establish and operate verification. | ✓ | ✓ | ✓ | ✓ | | |
| 7. Establish and operate documentation | ✓ | ✓ | | ✓ | ✓ | ✓ |

### 2.1.1 Practical Costing of HACCP Systems

Specifically, the cost of planning, developing and implementing a particular control measure, including any relevant investment, is one cost. Additionally, the ongoing cost of the resources to operate and maintain the control is also categorised under the prevention cost label. The appraisal element of HACCP was categorised and costed under the HACCP principles 3, 4, 6 and 7. The initial cost of establishing the target values and critical limits for specific control measures - e.g. control of temperature will be the basis of the monitoring activity. This approach was used by the team to undertake the cost survey of the Canadian fisheries sector between 1997 and 1999 (Dillon et al, 1999)[13].

The development and implementation costs of the monitoring system are therefore noted along with any associated investment costs. The cost of operating, maintaining and verification of the monitoring system are categorised as running costs. HACCP Principle 6 - corrective action, encompasses the activities, which will be measured as failure cost- both internal and external failures can be related to this principle. Again, the initial setting up cost is measured and ongoing running costs recorded.

### 2.1.2 Costing supporting control systems – Cleaning Controls

The cost to achieve "verified " cleaning plans was a key outcome of this programme. Early ancillary work was reported in the benchmarking activities undertaking in Canada (Dillon, et al Benchmarking food Safety, 1998)[14]. Spencer-Garrett (1991)[15] has previously reported and discussed many of the stages in properly developing, implementing and operating seafood HACCP systems, but little published data has been reported on aspects of economic benefits of HACCP. This has been partially resolved by the publication of Unnevehr (2000)[16] which has explained the economic impact but provided little useable methodology for field workers. Casswell and Collatore[17] had clearly reported on the cost benefit work undertaken in the American seafood sector. FAO had been involved in two main publications – one by Cato, J and Dos Santos[18] reviewing impact of closure of

Bangladesh Shrimp industry and the other by the leading Argentinean research group (Zugurraurdi et al, 1999)[19] involving Hector Lupin.

Specific US data described the systematic measurement of the economic impact of HACCP employing a standard protocol (Spencer-Garrett, 1989,1991)[20,15]. The reports detail the cost of correcting deficiencies identified during plant audits under both sanitation and process control critical control points. The UK work adapted the US approach to costing as follows.

### 2.1.3 American approach to costing controls at CCP's

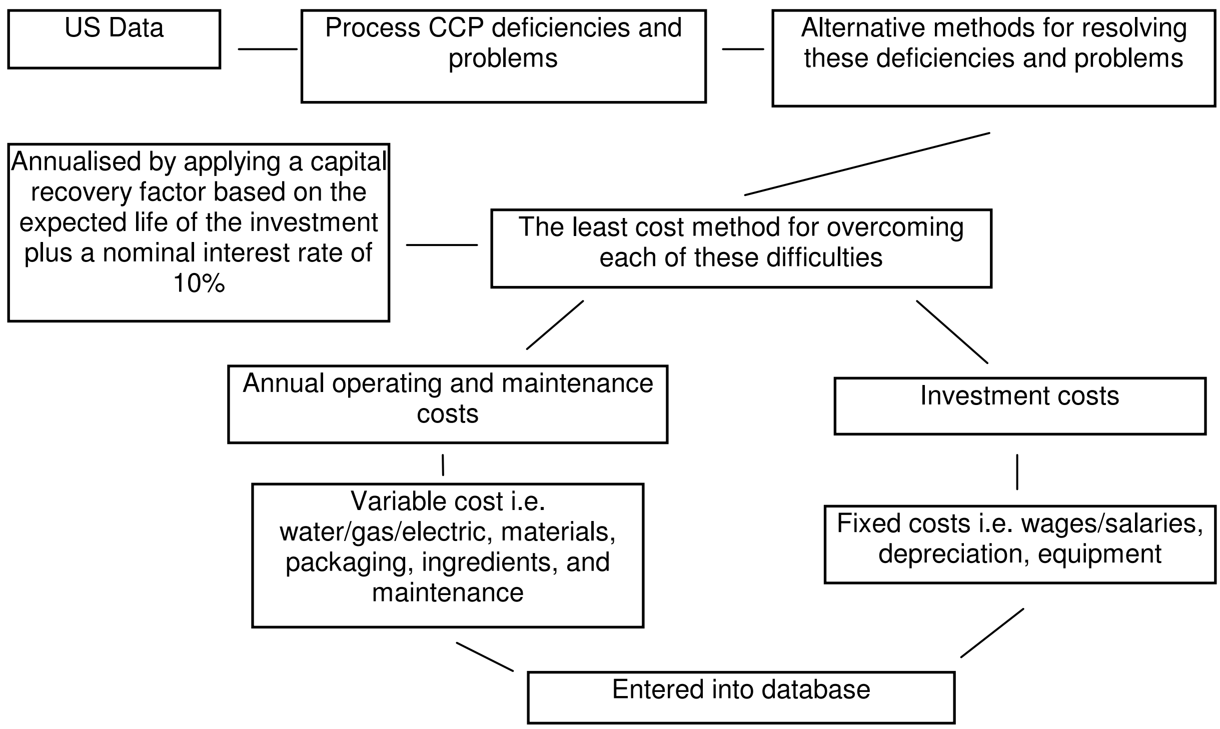



*Figure 1. Standard Costing Method*

### 2.1.4 Use of American data for the model

Further data was obtained to develop the model by applying the standardised costing methodology for published seafood HACCP plans or HACCP plans supplied by operating companies. The validity of the data was assessed by cross referencing with selected pilot sites who were involved in measuring the costs of specific aspects of the HACCP plan over the duration of the planning, development and HACCP implementation cycle. The validity of the data sets for small businesses has again been addressed by the design and use of a questionnaire and interview programme to both assess the existing emphasis of their quality assurance programme and the typical costs of control and failure.

### 2.1.5 Development and testing of the Questionnaire /Survey approach

The questionnaire adopted in this work was also applied in Canada and modified and used by the Welsh research group in their review of HACCP in Butchery sector. The UK team also designed a modified database to capture and analyse the costs to this sector (Mortlock, Griffith et al, NSF 2000)[21].

## 2.2 Research Work Phase Two

The preliminary research work undertaken in Phase 1 had enabled the design and testing of the approach. The following discussion describes the building and testing of the initial databases. These have been significantly modified for field use, see Appendix 2, but it is important for the reader to understand the process by which the final databases (Cleanse-IT, Ice-IT and Log-IT) [22] were created.

### 2.2.1 Step 1 Establishment of a standard protocol for costing controls and monitoring options.

A review of existing costing approaches was undertaken, which initially highlighted the research and applied work of the National Fisheries Education and Research Foundation in America from 1989 to 1991. This work had established costing protocols and standardised a basic methodology for assessing the costs in implementing specific controls within a wide range of fishery operations. This was adapted and used, after analysis against an established costing standard (BS 6143) which describes the Costing of the Economics of Quality[12].

The relationship between British Standard BS6143, which describes economic cost of controls, and the recognised food control systems i.e. Hazard Analysis Critical Control Point Systems, was established, and this became the focus of the development of the database.

### 2.2.2 Step 2 Construction of a Pilot Database

Data collected in America in conjunction with other secondary data was used to develop the initial pilot database. This was based on a control system, which followed the internationally recognised HACCP approach. Modifications were made to the standard HACCP approach, so that significant loss causing hazards could be analysed. Such hazards were typically associated with the quality and safety of products. Dillon et al (1995)[9] had reported on the early progress of this database. Further modifications were again reported and discussed at the Washington Fish Inspection Conference in 1996[23].The loss assessment work in Tanzania by Ward et al[25] also focused on the collection of control cost data and the design of the database. The outcome was a software package that could be used to determine relevant costings, but could also act as a focus for the implementation and measurement of the potential economic benefits of a control system.

The database had two fundamental sections. The first allows the user to choose the control that requires costing. The second section allows the costings to be defined, using a series of lookup tables, allowing customisation of the cost model for the chosen control, which is covered within the generic cost of control route, or the specific applications route of the predictive cost model.

### 2.2.3 Development of predictive capability

The work on developing an information database (basically Stage 1) was transformed into a predictive cost model within Stage 2, where the relevant cost or technical equations were embedded within the programming of the database. The user defines the Unit operation, Hazard, Hazard Source, and Control Measure, and then evaluates the relevant cost options, by entering the specific data into the generic control costing route or by specifically using a developed application e/g sanitation or ice calculator. These cost options allow the user to define a range of costings for a control measure to reduce a given critical loss - i.e. capital, labour, materials and training, either generically or specifically. For example, if sanitation was selected, then effective control could be achieved using more labour, or alternatively by using specific cleaning equipment or chemicals. The user can vary these options according to the availability of resources, materials and equipment, therefore using specific knowledge to cost an appropriate control.

### 2.2.4 Step 3 Collection of cost data

Data was initially collected using a questionnaire and interview technique, to further refine the framework by agreeing the major cost centres and allocating monitoring activities as an option for selected control measures. The questionnaire was modified significantly to capture both qualitative and quantitative data, and eventually employed the framework from the manual of the Canadian Quality Management Programme[24]. Information was collected from the UK fish processors at two levels - level 1 indicated where existing control was placed and where failure typically occurred, and level 2 involved the processor completing costing tables for specific control or failure scenarios.

An example scenario described the failure of a physical hazard control point, which resulted in glass breakage in a cold store. The company then costed the materials, labour and loss of product within the recall and disposal of the fish in this particular failure scenario.

### 2.2.5 Step 4 Refinement of the Database

Over a period of two years the database engine was developed through information from NMFS in America, pilot companies, and discussion with key staff at the Natural Resource Institute. A significant development in focusing the project occurred towards the end of 1995, when the data from FAO was provided in the Fisheries Technical paper 351 (Lupin et al, 1995)[10]. The FAO group had adapted economic engineering, which requires knowledge of engineering and microeconomics, and applied this to the fishery sector covering the rationale for the selection of the technical options for control systems in relation to commercial feasibility.

#### 2.2.5.1 Separation of the Database into the Sanitation Calculator and Ice Calculator

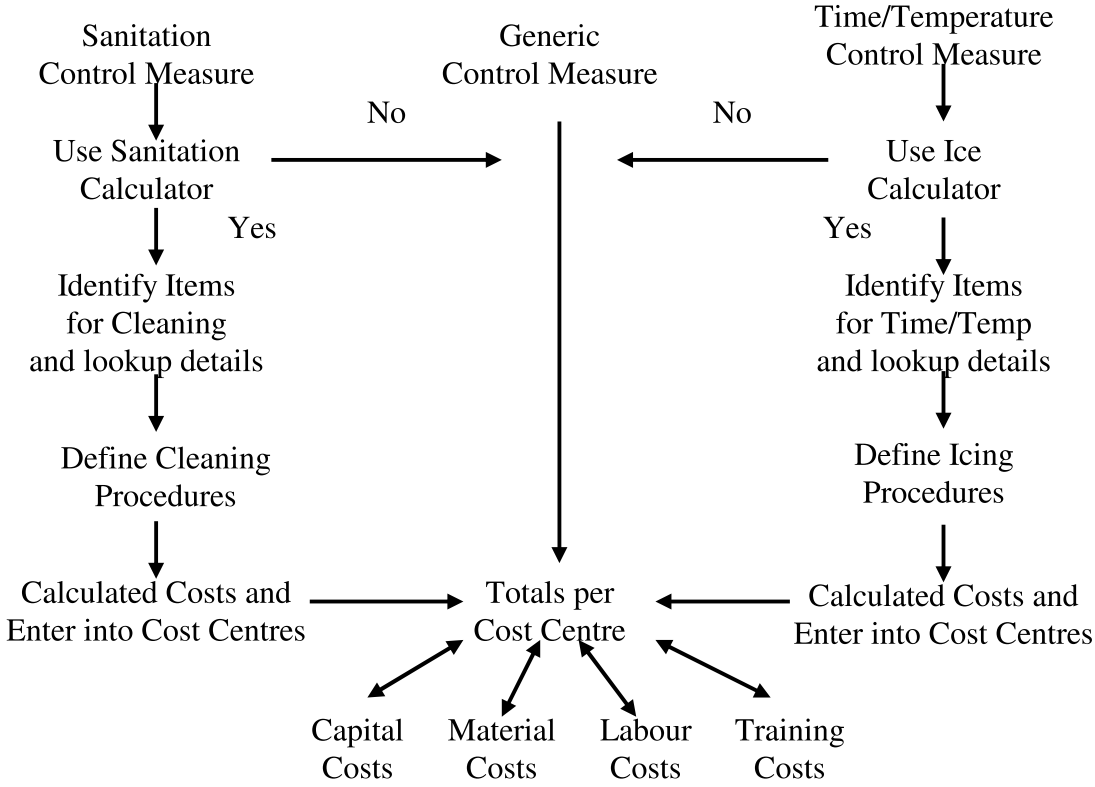
The FAO work led to the development, initially within a single database, of a specific predictive cost calculator for ice usage. This was used to cost the control options for icing fish and became a stand-alone application for the fish sector in general. Ward (1996)[25] shows an example of the importance of proper icing in loss reduction in a cause and effect relationship between prawn losses and icing, with losses associated with poor ice at specific points in a given chain. The Ice Calculator database has been developed, allowing the costing of the amount of ice required to keep fish at the optimum temperature. This allows the transfer of information into cost figures. Figure 2 – gives an overview of the system.

Full details are provided on the CD (see Appendix 3), which contains an overview of the early manual and worked examples

All relevant data was entered to produce a calculation. Once this has been entered the *View Calcs* button will bring up the details of the calculation.

The user was able to quickly evaluate the effect of various changes on the final outcome.

***Figure 2 Overview of Previous Software***




***This tool calculated the amount of ice required to cool the fish stated and the amount of boxes needed to transport the ice and fish. These totals were then transferred to the cost of control screen and the appropriate cost centres.***

Ancillary costs were entered for equipment; environment, labour, materials and training courses were entered, providing the information for the costings calculated later. The user entered data on the set-up screen, allowing the definition of temperature of product, external temperature, weight of product, storage container description, ice type and the product species.

The inclusion of all this information is required by the ice calculator to cost a given icing option before an overall costing is done.

The original ice calculator programme allows the user to evaluate the effect of types of fish box, transport time, ice type, external and product temperature, and the type of fish, on fish-to-ice ratio and the number of boxes.

Then, by selection of given variables, the cost options for the investment in ice boxes, quicker transport or other variable can be determined to reduce current losses - up to 40% in some factories.

### 2.2.6 Step 5 Verification of the accuracy of cost predictions

Once costs were calculated they were verified for accuracy. This verification of the accuracy of predictions was divided into 3 stages- not all are relevant for every prediction. We will use the ice prediction as an example, although similar verification is necessary for sanitation or general costings.

#### 2.2.6.1 Stage 1 Theoretical

The ice consumption in icing fish can be divided into three terms
The theoretical consumption calculation was verified and discussed with the FAO team for accuracy during a visit in 1997

Total Ice = (1) Ice to cool to 0ºC +
(2) Ice melted for Thermal Loss +
(3) Ice handling Loss

**Ice to cool to 0ºC**

| Fish Species | Specific Heat of fish (kcal/Kg C) = *[Fish SH Value]* |
|---|---|
| Lean Fish | 0.80 |
| Medium Fatty | 0.78 |
| Fatty Fish | 0.75 |

[Fish Temp] = Temperature of the Fish before icing (Taken as an Input)
[Total Fish] = Total amount of fish for transporting (Taken as an Input)
[Latent Heat of Fusion of Ice] = usually taken as 80 kcal/Kg

Ice to 0°C = ( [Fish SH Value]*[Fish Temp]/[Latent Heat of Fusion of Ice] )*[Total Fish]

#### 2.2.6.2 Stage 2 Applied

A spreadsheet (Table 2) was developed to perform similar calculations and match with the answers produced by the database. This was also used for the sanitation data sets that held a high level of unknowns. Reasons for errors were noted, and the method of data capture or entry modified, to prevent similar mistakes occurring

***Table 2 Spreadsheet***

| Ice Req. | Fish Type | Fish Specific Heat Value | Fish Temp | Latent Heat of Fusion (Ice) | Total Fish |
|---|---|---|---|---|---|
| Kg | | kcal/Kg °C | °C | Kcal/Kg | kg |
| 150.00 | Lean | 0.8000 | 15 | 80 | 1000 |
| 146.25 | Medium | 0.7800 | 15 | 80 | 1000 |
| 140.63 | Fatty | 0.7500 | 15 | 80 | 1000 |
| 200.00 | Lean | 0.8000 | 20 | 80 | 1000 |
| 195.00 | Medium | 0.7800 | 20 | 80 | 1000 |
| 187.50 | Fatty | 0.7500 | 20 | 80 | 1000 |

#### 2.2.6.3 Stage 3 Pilot sites

Data from pilot sites in the UK were matched with predicted costings e.g. amount and cost of cleaning chemical used, and anomalies were then reviewed and the software appropriately modified. Issues which were highlighted through live assessment of pilot sites included; omitted capital equipment, inaccurate amounts of material or labour usage, and changing cleaning procedures throughout the week. This information resulted in review and programme modification.

A recognition of the wide variation in approaches adopted by companies in operating a similar effective control measure e.g. cleaning a piece of standard equipment, has been reflected within programme flexibility. However the ability to "predict" an accurate cost was questioned – industry believed provision of the least cost for effective clean could be a better option

The accuracy of completed questionnaires in collecting costing data has been verified through telephone discussions and specific site visits. Data entry was also checked for accuracy, and the predicted costings agreed to be reasonable in nature. The initial verification steps were completed and the software was passed to the field team for validation in Uganda and Ghana (Tuna 97)[26]

## 2.3 Sanitary Control

Initially, five companies were involved in the Ugandan project work. All of the companies were involved in producing frozen and fresh Nile perch fillets for the European market. The initial focus of the work was sanitary control although, both control at the landing sites and time/temperature controls were subsequently investigated. The work commenced in July 1997.

Initial data has indicated the following:

- Verification visits demonstrated that all of the plant does not operate effective cleaning systems
- Awareness and understanding of cleaning is poor and therefore cleaning is often ineffective

Primary costing data was collected and the cost of a standard cleaning procedure defined to enable prediction. Reject losses in the chain were a major concern in Africa and the implementation of better time/temperature control was previously reported by Ward (1996)[25] to offer cost benefits to both purchaser and supplier.

The reject rates of Nile Perch in 1997 varied between 3% and 30 with an average of 12%. The use of ice at $1 / kilo should prove to be cost effective and will be the focus of the work undertaken in Ghana from early 1998 but undertaken in Uganda to develop the protocols

## 2.4 Effective Sanitation

The initial stages of data collection in Africa demonstrated the variety of different ways standard procedures can be interpreted. The general method for assessing cleaning was visible; the procedures between factory only vary slightly. Large differences existed between dilutions, amounts applied and dwell time.

The areas of potential cost saving and improved effectiveness currently revolve around doing it right and in the right sequence. The method of sanitising during production, more often than not, involves containers (buckets, bowls etc) with several litres of pre diluted solution. This is thrown over the surfaces to be sanitised, and production continues. Initial tests showed that the dwell time was minimal and, due to the oily surface, tended to be ineffective. Other techniques involved soaking in a dip tank, however it was also observed on several occasions that the surfaces ended up dirtier after sanitising due to the irregularity of changing the solution in dip tanks.

A basic calculation was undertaken to estimate usage, taking a processing area of 10 stations, approx. 4 litres of 20ppm used 5 times per hour per station. This adds up to 10 x 4 x 5 = 200 litres per hour. The dilution is made from 4% chlorine solution, which equates to 100ml per 200 litres. Over a shift (usually 8-10hrs) and accounting for spillage, normally 2,000 litres were used. This is about 1 Litre of 4% chlorine (approx. $2 a litre). Using sanitiser in this way, tends to be wasteful, inaccurate and often in effective, with splashing on to the product not uncommon. The worker also stops what they are doing to perform this ritual.

# Section 3 – Research Activities - Uganda

### 3.0 History of the cost predictive methodologies used (Bagumire, 2000)[2].

The Uganda component of the project began in early 1997. This was after wide consultations among the local stakeholders and experts that commenced as early as 1995. Previously, similar work had been done in Canada and United Kingdom. Therefore it was thought that the methodologies employed in UK and Canada would be applied in Uganda.

### 3.1 Chronology of events.

| | |
|---|---|
| Before 1995 | Predictive work in UK and Canada. |
| 1995 - 1997 | Consultations in Uganda (stakeholders involved). |
| 1997 - 1998 | Trial of methodologies based on protocols used in UK and Canada. (Protocols simplified). |
| 1998 – 1999 | Revision of methods (included validation of cleaning and cleaning manual production). |
| 1999 – 2000 | New methods used to collect data at key item, area and factory levels |

#### 3.1.1 Progress and Methodologies

The project progressed in five major steps that included: -

1. Documenting the existing controls.
2. Capturing existing costs.
3. Measure the effectiveness of the controls.
4. Providing feedback on performance.
5. Providing tools for costing, predicting and monitoring the various control option.

1,2 and 3 were carried out as part of methodology of the study and 4 and 5 were outputs.

### 3.2 Methodology

#### 3.2.1 Documenting Existing control systems.

This data collection also involved defining fixed and variable costs and recording the amounts used in standard cleaning procedures. The following key activities were carried out to document the existing control systems.

- Factory details were recorded by establishing the location and contacts of the factory and taking measurements for dimensions of factory area and key items.
- Environment and key items that were cleaned within each factory and area were identified; and then audited to document and confirm their cleaning procedures.
- Detailed audits involved observation and recording of key variables affecting the cost and effectiveness of the control e.g. chemical dilutions, quantities and labour time for cleaning each item, area and factory. (See Cleaning Benchmarking audit)

- Audit details were entered onto the database and key control variables were then monitored e.g. chemical dilution, labour time and chemical quantities.
- Log-IT software was provided to pilot factories to monitor the variables mentioned

- Table 3 indicates one section of a protocol that was used to collect this information. For illustration purposes the filled forms using data collected from Greenfields Ltd one of the factories are included.
- Existing costs were captured by establishing the frequency of cleaning and total resource usage per item, area and factory; resource costs (i.e. cost of different categories of labour, chemicals and water) and determine cost of cleaning daily, monthly and annually. Most of this information on cost was also collected using blank forms provided in the database.

***Table 3 Data Collection Sheet***

| | |
|---|---|
| **Company:** Greenfields | **Frequency of Cleaning:** 04 times a day |
| **Area in the factory:** Filleting/skinning | **Cleaning observed by:** Ananias Bagumire |
| **Key Item:** Conveyor | |
| **Description of the Cleaning Operation:** General cleaning | ________________________________________ _______ |
| **No. of similar items in the area: 01** | **Time:** 1:00 pm |

**Resource utilisation during cleaning an item**

| **Date** | **Time spent while cleaning** | **Labour type** | **No. of people involved in cleaning the item.** | **Resource type (Chemicals, water, soap etc.)** | **Quantity** | **Remarks** |
|---|---|---|---|---|---|---|
| 27/10/98 | 14.5 minutes | Filleters and skinners. | 02 | Labour time<br>$Ca(ocl)_2$ (100PPm)<br>Water<br>AK detergent (15%) | 29 min<br>01 litre<br>50 litres<br>08 litres | Satisfactory cleaning. |
| 28/10/98 | 15.5<br>- | As above<br>- | 02<br>- | Time<br>-Ca(OCL)2<br>Water<br>AK Detergent (15% | 35 min<br>01 litre<br>55 litres<br>08 litres | Satisfactory clean (visual) |
| 29 /10/98 | 16 | As above | 02 | Time)<br>Sanitiser - 100 ppm<br>Water<br>AK Detergent - 15% | 40 minutes<br>01 litre<br>70 litres<br>9 litres | Satisfactory clean – visual |

### 3.2.2 Measure the effectiveness of the controls.

The team were trained in how to execute validation tests for cleaning. Every factory requested these.

- Carry out validation tests (Microbiological, ATP and Visual Inspection).
- Establishing statistical controls charts.

## 3.3 Validation Tests

Bacteria accumulate on the work surfaces during processing and, given the right conditions, their numbers increase rapidly with time. Effective cleaning reduces the number of bacteria on the surfaces to acceptable levels. This demands that a cleaning plan be consistently followed and resources well utilised to ensured thorough clean. Validation was carried out to ascertain the effectiveness of cleaning procedures. Validation would involve confirming a given method will achieve a defined cleaning output by the following methods: -

- Visual inspection (seeing and confirming cleanliness)
- Touching to feel cleaned surface to ensure no biofilm or grease build up
- Rapid tests (using ATP Unit) to ensure organic material was removed – i.e. detergent was working
- Confirmation Bacterial load tests- to confirm disinfectant was effective

All validation involved microbial assessments (for determining bacterial load) and to rapid testing for ATP on the cleaned surface when equipment was available. The validation protocol was taken from the publication by Dillon and Griffith (1999)[27].

### 3.3.1 Microbiological assessment

This was done by use of Standard Microbiological techniques to determine numbers and kinds of organisms (bacteria). In most studies, it is sufficient to know total numbers, as was done in this study; but at times it is also important to know what kinds of organisms are present, especially those of pathogenic importance.

### 3.3.2 ATP tests

The method relies upon presence of ATP in bacterial cells. All bacteria contain ATP (Adenosine Triphosphate), which is the primary energy store of all living organisms. The ATP is measured by use of fire fly luciferin – luciferase system that emits light. This light is measured by a luminometer and units given as Relative Light Units (RLU).

Although there are different methods for microbial sampling, this study used swabbing, in which an area for which the bacterial status was required, was consistently swabbed and microorganisms picked suspended in diluents for counting by standard plate counting. It is important to note that, irrespective of the methods, the purpose was to confirm that the cleaning procedures achieved acceptable microbiological results. Therefore validation studies were carried out with the following objectives.

- validate the applied cleaning methods by microbiological tests.
- identify the effective cleaning methods and recommend them.
- advise on corrective action or adjustment for those methods that were not valid.

- identify valid cleaning methods that could apply across a range of items.
- develop a cleaning guide with a collection of manuals, to be used by quality and hygiene managers as well as cleaning crew in fresh food factories.

## 3.4 Validation Methods

Initial data were collected, along with cost data, in forms from the database. Key areas and key items were identified. Key areas are essentially halls/rooms/sections in the product flow line and includes: reception area, filleting/skinning section, trimming section, bagging area, packing rooms, dispatch areas etc. Within key areas, key items were identified. These included equipment used in processing and those that come into contact with the product during processing; for example items e.g. conveyor, filleting units, trimming tables, weighing scales, walls, floors, aprons etc.

Swabs were taken from the item surfaces before the cleaning. Cleaning was observed and cleaning procedures documented. Thereafter, swabs were taken from the cleaned surfaces. Rapid tests by use of ATP Unit were carried out on swabs immediately; and for microbiological tests, swabs were analysed in the laboratory.

### 3.4.1 Establishing Statistical Control Charts

This method was originally planned to monitor the resource used in cleaning in the factory and hence setting controls in the cost systems. This is one of the protocols adapted from previous studies conducted in Canada and UK. This required that a monitoring system for chemical quantities, water and labour time be put in place to ensure that monitoring was regular. This would result in regularly collected data that could provide graphical information, which would enable extrapolation and modelling. The method was thought to provide a predictive model for the costs of cleaning.

However, this failed because it required more resource than the project had available. The vigilance and dedication required for this method was not supported by the NARO team as they had insufficient budget to work with the cleaning crews to ensure that all the resources used were recorded accurately. Logistically, it became expensive and the results were far fetched. This method was later abandoned, and the focus was put on the development of the electronic diary to enable the factory team to record information directly.

### 3.4.2 Results on Cost Predictions

As mentioned earlier, data collection protocols involved establishing resource costs from the purchasing personnel and carrying out of inventory of all items in areas and whole factory. Cleaning labour costs were obtained from personnel managers and top management. Monthly salaries for salaried staff and wages for other workers involved in cleaning were established. Calculations to determine hourly cost of labour for each category were done to ease costing the cleaning operations. This was done to reach a more reliable/accurate method of predicting costs. Table 4 provides the average method costs calculated from costs of cleaning the items in Greenfields Ltd., Gomba Fishing Co (U) Ltd and Marine & Agro Export Processing Co. (U) Ltd and used to predict the Cost of Cleaning in Greenfields using the software; at key item level for data collected between 16/02/98 to 30/04/98. The predictions given are daily and monthly cost of cleaning the factory by totalling up cost of cleaning all items in the factory.

*Table 4 Cost of Cleaning Predictions*

| Area where Item insulated. | Description of Item | Cleaning method | Method Cost(Ushs) | Size cleaned | Frequency cleaned |
|---|---|---|---|---|---|
| Filleting/skinning | Floor | Floor A02 | 26.7/sqm | 150 sqm | 1 per day |
| Filleting/skinning | Wall A01 | Wall A01 | 47.5sqm | 55 sqm | 1 per day |
| Filleting/skinning | Filleting Unit | FlfTb1A01 | 545.4/sqm | 21.6 sqm | 4 per day |
| Filleting/skinning | Conveyor | Convyr A02 | 409/M | 11M | 2 per day |
| Intake area | Floor | Floor A02 | 26.7/sqm | 167 sqm | 1 per day |
| Intake area | Wall | Wall A01 | 47.5/sqm | 86 sqm | 1 per day |
| Intake area | Table | Table A02 | 365.2sqm | 12 sqm | 2 per day |
| Trimming/Bagging section. | Floor | Floor A02 | 26.7/sqm | 154 sqm | 1 per day |
| Trimming/Bagging section. | Wall | Wall A01 | 475/sqm | 120 sqm | 1 per day |
| Trimming/Bagging section. | Conveyor | Convyr A02 | 409/M | 6 M | 2 per day |
| Trimming/Bagging section. | Table | Table A02 | 365/sqm | 6sqm | 2 per day |
| **Summary of the Cost as Calculated and predicted.** | | | | | |
| **Actual Cost of Factory calculated** | | | **Predicted cost of factory by software** | | |
| **Cost per 89,928 Sh.**<br>**Cost per month 1,798,560 Sh.** | | | **99,154 Ush.**<br>**1,983,080 Ushs.** | | |

### 3.4.3 Changes in Costs

The resource costs changed frequently within the project because: -

- Ugandan fish industry was undergoing drastic changes during the course of the project
- Many new items for the areas in the factory were purchased changing resource needs.
- Salaries of staff were unstable.
- In some factories, workers doing same work were paid differently.
- Dilutions of chemicals were changed according to demands of different inspectors.
- Frequency of cleaning items and area were changed by inspectorate.
- The cleaning methods were changed due to inspection pressure.

This rendered the process of monitoring difficult, as the base method changed between visits. Hence, in the final predictive calculations based on averages of the methods costs, there was a big variance between the predicted cost and the actual cost even within a company. In order for this variance to be reduced, a larger amount of data needed to be obtained. This data, of relatively greater accuracy, was beginning to be collected by the time the project was coming to the end. The size of sample on which the prediction average was to be derived was small. This was so because the cost predictive software went through a series of modifications and at each stage, and would require specific information. By the time the final version, which provided better methods of prediction, was developed, there wasn't enough time and logistics to collect more information to widen the size of data.

Table 5 shows the variance between predicted and actual costs for cleaning a whole factory, before and after methods were validated. The predictions were made based on the cleaning methods from Greenfields factory.

***Table 5 Prediction Variances***

| | Greenfields | Gomba | Byansi | Hwan Sung | Masese |
|---|---|---|---|---|---|
| Before | 9.42% | 51.56% | -0.23% | -23.67% | 135.67% |
| After | -11.8% | -15.57% | -46.98% | -26.58% | 24.32% |

However, the methods used and the software developed has proven to be good and reliable in the field, but during rapid change it is difficult to keep information updated without on-line monitoring. The move to use Log-IT attempted to overcome these problems and would also assist with measuring the impact of the associated icing trials

One strategy to reduce the variance between actual costs and predictions, is to obtain more data based on the new methodologies. Hygiene managers have been persuaded to complete "verification" questionnaires. This method will provide data for a longer period and provide a basis for finalising the development of the software.

### 3.5 Cleaning trials

During verification and validation of cleaning in Uganda, it was found that in some cases, that results of a cleaned surface were poorer after cleaning than before cleaning; implying that some workers in the factories actually spread dirt instead of removing it. This emphasises the importance of training cleaners. Workers of two companies were interviewed. In company A, it was discovered that training sessions were held once in a week, and in company B it was discovered that no organised training was available other than a few instruction circulars. To demonstrate this, swabs were taken from one spot on the surfaces of items to be cleaned in the two factories before and after cleaning and thereafter microbiological tests were carried out. This highlighted that the untrained staff were not cleaning properly.

Before this project, the factories rarely documented their cleaning procedures. For those factories where cleaning procedures existed, they were documented only for inspection purposes. This was considered, as a defensive formality among Hygiene managers to present methods to the authorities when demanded by inspectors. Most ordinary workers who cleaned did it their own ways. As long as the managers had not queried, the workers continued trusting their methods of work. Experience has shown that most factory workers typically used existing methods in factories.. They have adopted these methods and they consider them much easier no matter how costly and effective they are.

However, research in companies has proved that some methods are cheaper, more convenient, and most importantly result in an effective clean that can be applied to several items. For instance, work was done to establish the cost of cleaning methods of individual items.

In order to do this; several cleaning methods were costed. Before and after cleaning, surface swabs were taken. Although effectiveness of the method of cleaning may be influenced by the expenditure on cleaning, some methods can be expensive and still ineffective. Conversely, some methods are cheaper and more effective than others.

Since all cleaning involves almost following the same cleaning procedure (i.e. cleaning sequence), at times a more expensive laborious method may be used even when other methods would work. For instance, a streamlined method for cleaning a non-food contact surface could be applicable to many such surfaces. The method for a floor, once validated in one low risk area, may be applied to another low risk area and can save a company resources in labour, chemical, water or even effluent. This is why validation of cleaning should be a regular practice.

A study was conducted to determine universal methods of cleaning that could work across the range of items in the factory by applying a cleaning method for food and non-food contact surfaces e.g. conveyors, floors, tables, filleting units etc, and those of others likewise on all items. The challenge therefore is to establish the cheapest and convenient one for each item.

## 3.6 Ugandan Achievements

### 3.6.1 Providing feedback on performance

Cleaning practices of three fish companies were documented in detail and the effectiveness of cleaning selected areas or items validated. Cleaning manuals, were produced and provided to Hygiene Managers of six processing plants. In two companies, training sessions were conducted for all the cleaning staff and in others cleaning managers were invited for at least 3 workshops in which effective cleaning was explained.

#### 3.6.1.1 Project contribution to the Industry

- Cleaning manuals were produced and given to factory managers, which have standardised the code of conduct in cleaning of all fish factories.
- Factory workers (cleaners) in some companies were directly trained by the project team. Those who were not trained by the team have acquired skills through instructions from their managers who were trained.
- The project carried out validation of cleaning to ascertain the effectiveness of cleaning practices in the factories on the request from the managers and directors.
- The project team acted as a link between management and staff of factories to ensure proper controls in cleaning and icing. This was through regular consultation at all levels of management and provision of technical advice on investment options.
- The project worked with the managers to improve and maintain the quality of raw material fish received. This was through ensuring the cleanliness and sanitation of all fish handling containers and vehicles and contact surfaces within the factories.
- The project co-operated with fish suppliers to advance better and affordable alternative handling and hygiene practices in pre-factory supply chain.
- Through workshops, shows and exhibitions, policy makers, fish/food administrators and other stakeholders, were sensitised about the need for cost analysis of options in approaching sanitation, hygiene and quality issues.
- The awareness and training provided by the project to managers as well as the introduction of the software tools in hygiene/sanitation management has streamlined operations in factories through proper documentation and increased effectiveness.

#### 3.6.1.2 Contribution to NARO

The members of the local team, who comprised the National Agricultural Research Organisation (NARO) researchers and technicians, attended several training sessions organised by the UK counterparts (MD Associates Ltd) to equip them with necessary research and project management skills to manage the project properly.

The training sessions included:

- Auditing food safety systems.
- Use of software tools to cost food safety controls.
- Socio-economic evaluation of research projects.
- General skills such as filing system, protocol development and technical reporting.

The project brought together the Fish Industry and the Food Science and Technology Research Institute (FOSRI) in solving identified problems. This should enhance future participatory research through teamwork involving stakeholders in the fish industry.

- The introduction of cost predictive software tools in research has widened the scope of understanding of the team this will in future enhance cost analysis of research activities.
- The project has exposed some members of local team to international and national scientific for a through attending workshops/seminars; this will enhance informed research.

### 3.6.2 Projects Impact

- Before the project only one company had records and documented cleaning methods to guide workers on routine cleaning. Now it is a common practice in the seven exporting factories.
- As a result of the project, cleaning/sanitation chemicals are now being made up to the correct
- Many companies have recruited more trained and qualified staff.
- All hygiene managers have instituted calibrating methods for liquid measuring containers.
- All companies now have laboratories and do cleaning validation.
- Sanitation awareness has triggered numerous modifications in companies, e.g. un-washable wall and floor claddings have been replaced to facilitate easy cleaning; some changes to factory layout to facilitate easy cleaning
- Management teams have now realised the need to have own controlled landing sites as opposed to communally controlled ones where it is difficult to institute controls.

## 3.7 Icing Trials

The above research activities were modified and used for the icing trials work undertaken since 1997 and reported by Bamwirie et al. (1999)[29]. The icing trials work is discussed in detail within the Ghanaian section of the report but it should be noted that the survey method and “at sea” protocol were largely based on the Ugandan approach. The icing software tool contains details of the early trials for the reader’s interest. It is also worth noting that the Log-IT tool and the ice management tool is being used in Uganda by the NARO team within UNIDO projects

The Ugandan team linked the trials work very closely with the pilot project plants and tried to track impact within the factories. The need to obtain relevant factory data resulted in the building of the “electronic diary” system to encourage factories to provide the information. Ice plants have also been installed as well as improvement of transport facilities to maintain cold chain therefore reducing potential for fish to spoil and pathogens to grow

# Section 4- Research Activities – Ghana

## 4.0 Background of Project (Mensah, 1999)[30]

The Project was aimed at developing the capacity within Ghana to identify and measure critical loss areas and to select and implement cost efficient control measures, to minimise or prevent losses. This called for developing tools and standardised methods to measure the effect of the controls. The tools could then be used to bring improvement in the operations leading to better economic returns and production of good quality and safe fish for consumption. The Ghanaian group would build on the icing trial methods already developed by the Ugandan group. A project team was then selected representing key stakeholders and possessing appropriate skills and authority to execute the project and influence future policy.

The team identified the artisanal fisheries as the area of major loss and specifically the canoes which fish the demersal stocks using hook and line. Attention was focused on the 'LAGAS' fleet, which are canoes, which go to sea with insulated boxes carrying ice to preserve the catches, and stay at sea for about 3-7 days for their fishing operations. Most of their produce ends up in the hotels, restaurants and the export markets. This group had been banned from the export market, especially to the EU, as they could not meet the new directives to control the quality and safety of fish imported to the EU. The team reported that this EU ban effectively reduced the income of the 400 Lagas canoe fleet. The intervention designed must meet the Ghanaian Standards board hygienic requirements to enable fish from this source to be exportable

## 4.1 Methods Adopted

The following activities were planned to study and understand the operations of the 'LAGAS' fishing fleet, to identify the critical loss areas and produce cost effective interventions:

- A technical and a Socio-economic survey of the Lagas fleet.
- Sea trials, to cover temperature recording, quality and price assessment.
- Investigation into box construction methods- lined and unlined.
- Melting rate trial documenting ice type, sun or shade etc
- An economic assessment including trial data on variable costs e.g. ice, bait, food, labour etc

## 4.2 Technical Survey

An extensive technical survey was designed to establish the extent of the existing controls used to preserve the quality of the fish from capture to landing. A detailed questionnaire and interview process was designed based on the established approach from Canada, UK and Uganda. (The CD contains report and survey tool) The survey (Mensah, 1999)[30] reported that the existing holds used were of different designs and often of poor functionality. The practice of the fishermen was only to place the fish in the hold when sufficient was available to fill a section. The number of sections ranged from 1 to 3, which resulted in fish staying on deck for as long as 5 hrs after capture. Tvilling (Danida)[31]had also reported the practice of leaving fish on deck, which was related to the crew's perception of the high value of the ice. The survey work by Akrofi and Sanchez (1999, 2000)[32,5] had established that the ice was supplied pre-purchased by the fishing mummies and was therefore often used conservatively by the crew. One experienced member was given responsibility of managing the ice and would break the ice block over the fish as sufficient fish to form a layer was established.

These practices meant that the physical design of the hold to enable easy access, allow for minimum holding of the fish on deck, and also be of a structure, which had appropriate insulation capabilities, was a focus of investigation. The cost, repair time, and effectiveness of the existing hold structure was reviewed by questionnaire and also through trials. The engineering member of the team (IT Ghana)[33] supervised the construction of model holds, which were used by the factory team (Divine Seafood's) to investigate melting rates. The existing hold structures were found to be effective at initial manufacture in terms of melting rate but had the following drawbacks

### 4.2.1 Limitations of the existing holds

- Unhygienic structure meant that the holds did not meet EU sanitary requirements
- Single compartment holds resulted in fish staying on deck for unacceptable amounts of time
- Hold lifetime was variable – physical damage required repair normally within 1.5 yrs
- Construction was not standardised – i.e. Tema holds were manufactured with locally available material by one carpenter, in other areas of the country e.g. Takaradi holds were built locally and had no insulation layer.
- Fishermen reported that the holds could become "smelly" and the ice would not last long during trips even before any significant physical damage to the hold was noted

### 4.2.2 Discussions with the Fishermen

After the technical survey the fisheries department held meetings with local fishermen and emphasised the need to ice fish quickly and place within the hold. Initial trials demonstrated the effect on quality and yield of "sun boiled " fish- this fish was not suitable for the better markets and a significant reduction in price was recorded. The team identified better hold manufacture as the first phase on upgrading the artisinal fleet handling and preservation quality.

### 4.2.3 Selection of the modified control option for study

The team reviewed the following improved control options and selected item 4 for further investigation because of the reasons listed in Table 6.

***Table 6 Possible Improvements***

| Intervention | Team View |
|---|---|
| **1 Strip plank canoe**<br>Danida project team member invited to discuss option. Environmentally friendly, meets EU standards, cheaper to operate. | ❖ Not practical economically to purchase<br>❖ Unable to be beached in rough weather<br>❖ Only two landing sites available in Ghana<br>❖ No available maintenance skills |
| **2 Modified Hold - Stainless steel lined**<br>Standards Board preferred option initially<br>Skill/ equipment and access to material | ❖ Difficult to obtain material<br>❖ Different thickness still too expensive<br>❖ Material was too expensive |
| **3 Modified Hold - Fibreglass**<br>This was viewed as possible but could cause difficulty in remote areas were tradesmen would not have skill for repair. Toxicity of chemicals and handling of material not believed suitable | ❖ Not available locally<br>❖ Price would be high<br>❖ Repair was raised as a major issue in all areas<br>❖ Toxicity/ problems in handling materials |

| | |
|---|---|
| **4 Modified Hold - Aluminium**<br>This was recommended option as first stage of development to assist market access. Improved sanitary standards and fewer repairs than wooden hold. The Department also believed that this hold construction would result in better quality fish, as the hold would be cleaner, less susceptible to damage and quicker to fill. | ❖ Available locally<br>❖ Acceptable to Standards Board- meets EU sanitation needs –e.g. easier to clean<br>❖ Price believed to be achievable – but accurate costing should be made<br>❖ Reduced repair bills<br>❖ Standardise hold construction |

### 4.3 Socio-Economic Survey

To study the effect of the lifestyle of the operators on the operations of the fleet and find out how willing they are to accept any innovations or new changes. The survey covered boat owners, captains, and fishermen and fish mummies from selected locations, covering 10-20 canoes depending on the number of canoes identified by the Technical Survey.
A questionnaire was prepared covering the following five areas: Identification, Individual characteristics, and Household characteristics, Livelihood, Resources. This has been reported by Akrofi and Sanchez (1999, Regional workshop[30], 2000, closing conference[5])

### 4.4 Costing Survey

This built on previous work - DANIDA, World Bank, IDAF in collaboration with Directorate of Fisheries (MOFA), Ghana. Existing Departmental Publications were examined; the economist involved provided advice on collation and analysis of socio-economic data, and the FAO statistical monitoring guidelines and other papers[34,35] were also referenced.

This survey covered cost and earnings of the 'LAGAS' fleet and other artisanal fleet using different gears. The IDAF study had established the viability or the profitability of the different types of the fleet in terms of investment (Yeboah, 1999)[32].

A separate Danida study was just being completed by Tvilling and Quansar (1998)[31] as this project was beginning. This project team had investigated the potential of utilising strip plank canoes and the resulting economic data was also made available to the UK team.

FAO supported the linkage between the DFID work and the existing Danida project. The initial development of the at sea trial protocol was partially funded by FAO (1999, Hirshals)[7.]
The review of the findings from these studies indicated a return on investment as 38% and opportunity cost of capital (26%) as ¢2,275,000 thus the 'LAGAS" proved to be the most profitable fleet. However this fleet was no longer able to supply the export market because the Standards board did not approve the existing sanitary controls in the traditional hold

Table 7 Annual Income and Return on investment by Canoes

| | **Purse Seine** | **Bottom Set Gill nets** | **Hook & Line 3-7 Days** | **Hook & Line Day Trips** | **Beach Seine** |
|---|---|---|---|---|---|
| **Avg. Annual Turnover** | 41,645,325 | 1,948,320 | 32,098,736 | 4,250,000 | 22,118,800 |
| **Avg. Invested Capital** | 19,356,000 | 2,250,000 | 8,750,000 | 2,700,000 | 12,500,000 |
| **Return on Investment** | 31% | -31% | 38% | 1% | 35% |
| **Payback Period (Months)** | 38 | 49.9 | 30 | 144 | 34 |
| **Opportunity cost of Capital (26%)** | 5,032,560 | 585,000 | 2,275,000 | 702,000 | 3,250,000 |

A table summarising percentage gains from fish sold from the modified holds is given below (Sanchez et al, Tuna 2000)[28]. This was obtained employing interview technique which was linked to the ice trials management programme

***Table 8 Market Prices per crate - February 2000***

| | Without Intervention | With Intervention | Price Premium |
|---|---|---|---|
| Grouper | 180 -190,000 | 220,000 | 16 - 22% |
| Pandora | 85 -90,000 | 100,000 | 11 - 18% |
| Snapper | 80,000 | 90,000 | 12.5% |

The sharing system used by the group is also reflected in Figure 3 which indicates where financial benefits actually go.

*Figure 3 – Lagas Share System*

**Lagas Share System**

| **Capital Items** | | **Cost** | **Lifespan** |
|---|---|---|---|
| Canoe: | Mawaamo No2 | 12,000,000 | 10y-11y |
| Machine: | ??hp | 10,000,000 | 4y-6y |
| Box: | Lined | 1,500,000 | |

| **Pre-finance per trip supplied by Fish Mother (direct costs / variable costs)** | | | | | | |
|---|---|---|---|---|---|---|
| Total: | 400,000 | to buy → | Fuel | 150,000 | Quantity (gal): | 50 |
| | | | Ice | 30,000 | Quantity (kg): | 100 |
| | | | Hooks | 180,000 | | |
| | | | Other | 40,000 | | |

| **Fishermen land quantity and determine price** | | | |
|---|---|---|---|
| Total Price: | 2,000,000 | Species: | Snapper |
| | | No Boxes: | 20 |
| | | Quantity (Kg): | 400 |
| | | Kg per box: | 20 |

| **Fishermen and Fish Mummy agree contribution to welfare fund** | |
|---|---|
| Welfare: | 100,000 |

**Market Sales and Share System**

| | |
|---|---|
| **Fish Mother buys at fishermens price:** | 2,000,000 |
| Deducts pre-finance: | 400,000 |
| **Sub-total** | 1,600,000 |
| Deducts welfare fund: | 100,000 |
| **Total to be shared** | 1,500,000 |

| | |
|---|---|
| **Sells at market price per box:** | 125,000 |
| Total selling price: | 2,500,000 |
| Price per kg: | 6,250 |
| **Profit:** | 500,000 |
| 2% of profit to fishermens wifes: | 10,000 |

| | |
|---|---|
| **50% to crew members + fish mothers:** | 750,000 |
| Number of crew: | 8 |
| Share each based on crew + fish mummy | 83,333 |
| Captain's crew share + 10% from owners | 158,333 |

| | |
|---|---|
| **50% to capital item owners:** | 750,000 |
| Payment to captain 10%: | 75,000 |
| **Remaining:** | 675,000 |
| Share to machine: | 400,000 |
| Share to canoe: | 250,000 |
| Share to ice box: | 25,000 |

## 4.4 Trials Work - Development of At Sea Trial Protocol

The Project Manager and staff met the Chief fishermen, the fishermen and the fish mummies to discuss the whole project. Their expected roles within the study were agreed and the benefits to them were explained. On agreement to undertake the studies, they were asked to nominate people of their choice and those who were willing to undertake the studies.

Three canoes offered to participate in the initial development of the methods - they were Sea God, VC 2 and Mowaamo. Discussions were held with the fish mummies and the captains on these canoes as to how the trials could be carried out. They were offered 10 blocks of free ice as an incentive. A series of trials using an initial trial protocol (Mensah, 1999)[32], were then undertaken to investigate logistics

### 4.4.1 Description of the Method

The temperature probes were set and delivered to the crew who had been instructed in their use. The crew then set off to sea. When the fish were captured the probes were inserted into one fish each day. They were advised to take note of the catches on a daily basis to allow the analysis of samples from each day fish. On landing, samples of the fish were collected with directives from the captain.

A ten step trial protocol was devised, and is shown below:

All trials have been planned and agreed by the project team.
1. Meet with the boat crew/owner and discuss trial e.g. VC2, Mowaa mo - discuss with mummy, approve with chief fishermen.
2. Purchase and deliver ice to boat - 10 blocks, price noted.
3. Set temperature probes for trial - instruct on use - reading.
4. Crew hook fish, insert probes separate daily catch, return (3-7 days) weigh and record at landing.
5. Collect fish samples from the boat - organisation of landing with captain.
6. Delivery of samples to factory for filleting/scoring/pricing Standard Board - or scoring, analysis
7. QA Assessment by Factory

| **Part of Fish Inspected** | **Skin** | **Mucus/ Slime** | **Eyes** | **Gills** | **Odour** | **Flesh Texture** | **Flesh Colour** |
|---|---|---|---|---|---|---|---|
| **Grade** | 2 | 2 | 2 | 2 | 2 | 0 | 1 |

| | | | |
|---|---|---|---|
| Total Score = | 11 (52%) | Scale Used 0,1,2,3 where 3= | Best Quality |
| Total Score | >19 | x>90% | For Export |
| | 15-19 | x>70-90% | Local consumption |
| | <15 | x<70% | Reject |

8. Yield on 20 Kilo sample?
9. Standards Board - TVBN, Micro, Scoring
10. Project Manager = Download Time/Temp - write up Trial - Review by Team

Some of the fish were purchased for commercial assessment by the factories for taking records of weight, scoring on sensory basis to determine the quality of the fish. They then filleted the fish and determined the yield. Samples were then delivered to Ghana Standards Board to make sensory assessment of the quality and to conduct chemical analysis, TVB, on the fish.
Overall trial results were collected, compiled and discussed with the project team at a technical meeting held periodically with or without the external consultants. Final conclusions were drawn in consultation with external consultants who assisted in the processing of the data collected. This initial work resulted in the production of a standard at sea protocol, which was then used for the aluminium-lined boxes on the trial boats.

Examples of time/temperature data from at sea trials can be seen in figures 4 and 5. The first graph shows a situation where the temperature probe has been misused, and has been placed into the ice giving a dramatic drop in temperature. The second graph shows a more gradual decline. Information about trial costs, as entered into Ice-IT software, can be seen in figure 6.

***Figure 4 Sea trial with rapid temperature drop in lined hold***

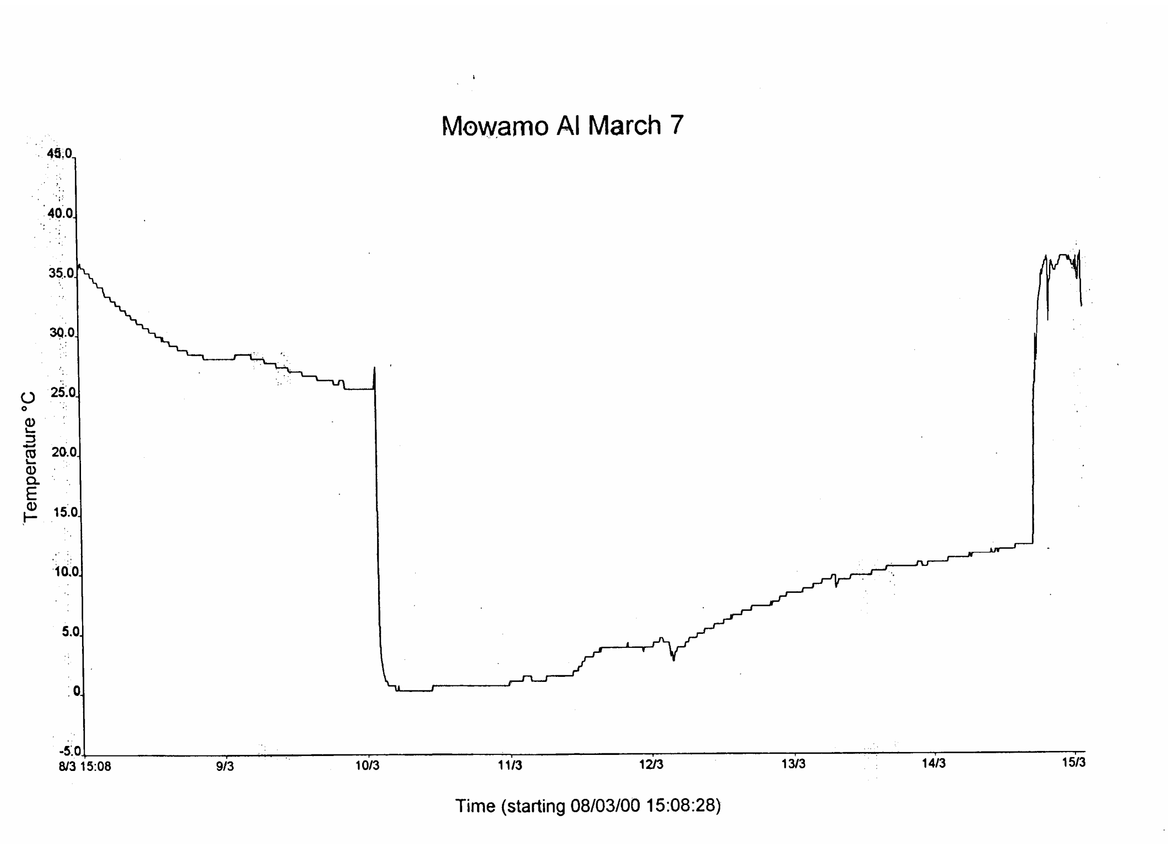



***Figure 5 Sea Trial with Gradual Temperature Decline***

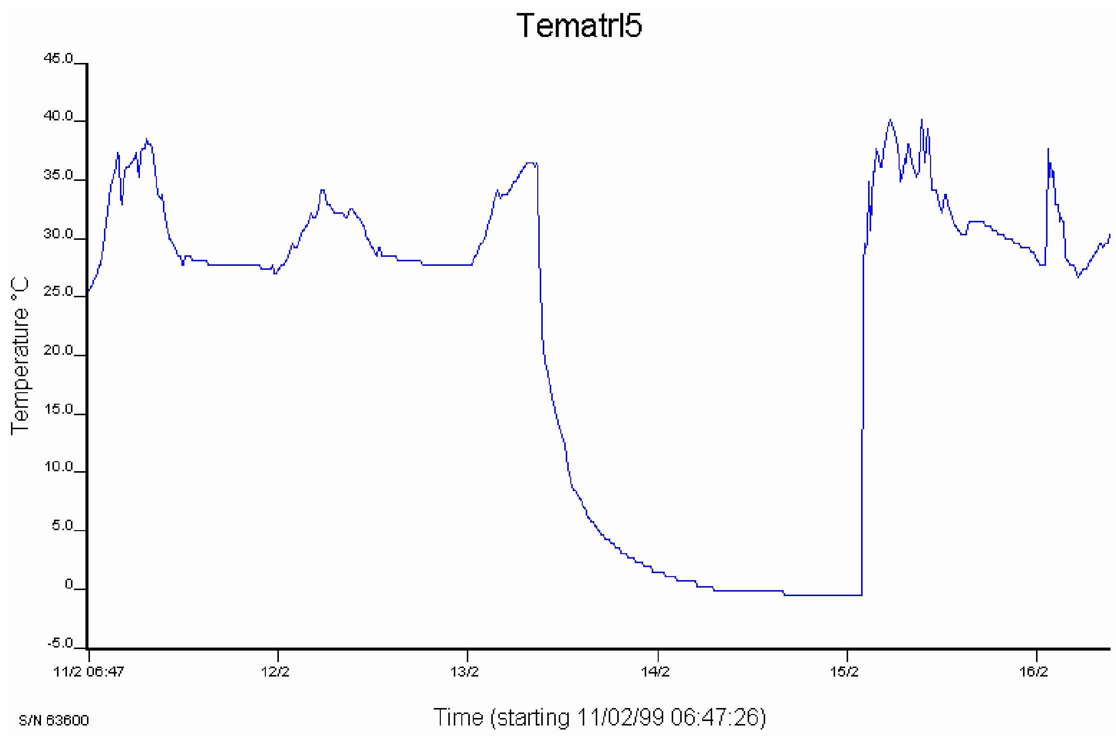
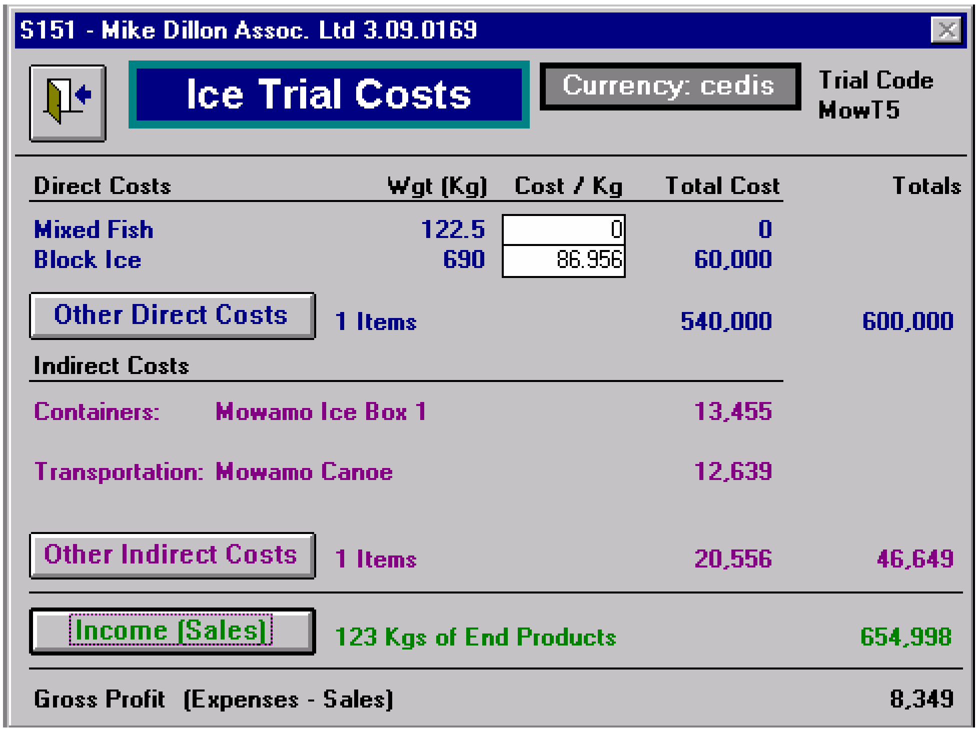


*Figure 6 Example trial costs*




## 4.5 Modified aluminium lined hold

Observations indicated that the size of the canoes vary and the sizes of the fish boxes also vary to the extent that it was difficult to build a standard box which would fit all canoes. More importantly, the depth of a fish box affected the stability of the canoe. This led to the modification of the existing fish box, instead of introducing a new one made from other materials such as plastic or fibreglass. The aluminium lining was acceptable and easily available in Ghana.
It was also noted that the three compartment boxes are ideal as the number of compartments limits the volume of each compartment. The smaller the compartment the more it favours better handling of fish resulting in better quality. A bigger compartment requires more fish to fill one layer to alternate with a layer of ice. Thus fish caught stay on deck longer to get the required quantity to fill a layer.

Observations and interviews with fishermen using existing holds revealed that the holds were often saturated at the end of trips and needed to be left in the sun to dry. It was then recognised that the insulation properties of the hold would be badly affected by the water seeping into the insulation layer through damaged areas of the hold. The ice melting rate trials described in the next section were used to model expected use of ice at sea by establishing melting rates.

Figure 7 Modified box designs

### 4.6 Ice melting rate trials - Existing boxes and new boxes

Prototype of the existing boxes and the new aluminium lined boxes were built, see figure 7. The ice melting rates in these two types of boxes were studied using a defined ice melting rate protocol (IT Ghana Report)[33]. IT Ghana previously reported on the construction of the existing boxes providing details of materials used and their thickness. The same box construction was used for the lined hold with the addition of the aluminium layer. The initial lined mini "hold" faced problems as nails, which rusted, fixed the lining.

The trials were conducted between the engineering team and the factory which weighed the boxes at defined times. Boxes were stored in sun/ or shade and the melting rates recorded. The initial box that was built was one third (or one section) of a normal hold but took 4 men to lift on and off of the scales. The next set of boxes was smaller and easier to manage. The box construction was standardised and the trial protocol used to investigate differences between the different types of ice and the different type of construction

Lupin (Pers Comm. 2000.) recommended the modification of the software tool to record the theoretical melting rate in relation to the melting rate recorded on the model holds. This data would then be used to predict the box use under ideal conditions at sea. An example melting rate trial report is included below in Figure 8.

*Figure 8 – Melting Rate Trial Report*

## Box Melting Rate Trials

| Container | Volume (Litres) | Surface Area (Sq.Metres) | Selected Empirical | Theoretical |
|---|---|---|---|---|
| **Plastic** | **17** | **0.32** | **0.041000** | **0.042338 (Kgs/°C Hr)** |

**Type of Ice: Crushed Ice**

| Trial ID | Date | Temp. (°C) | Humidity | Time Elapsed | Ice Remaining | Melting Rate (Kgs/°C Hr) | Variance from Theroetical |
|---|---|---|---|---|---|---|---|
| Trial 1 | 15/05/2000 | 30 | 50.0% | 0.0000 Hrs | 4.0000 Kgs | *0.035257* | -16.73% |
| | | | | 0.5000 Hrs | 3.2850 Kgs | | |
| | | | | 1.0000 Hrs | 2.4090 Kgs | | |
| | | | | 1.5000 Hrs | 1.5140 Kgs | | |
| | | | | 2.0000 Hrs | 1.1460 Kgs | | |
| | | | | 2.5000 Hrs | 0.6530 Kgs | | |
| | | | | 3.0000 Hrs | 0.2980 Kgs | | |
| | | | | 3.5000 Hrs | 0.7070 Kgs | | |
| Trial 2 | 15/05/2000 | 30 | 60.0% | 0.0000 Hrs | 4.0000 Kgs | *0.043589* | 2.95% |
| | | | | 0.5000 Hrs | 3.0270 Kgs | | |
| | | | | 1.0000 Hrs | 2.1790 Kgs | | |
| | | | | 1.5000 Hrs | 1.3690 Kgs | | |
| | | | | 2.0000 Hrs | 0.8360 Kgs | | |
| | | | | 2.5000 Hrs | 0.3950 Kgs | | |
| | | | | 3.0000 Hrs | 0.0770 Kgs | | |

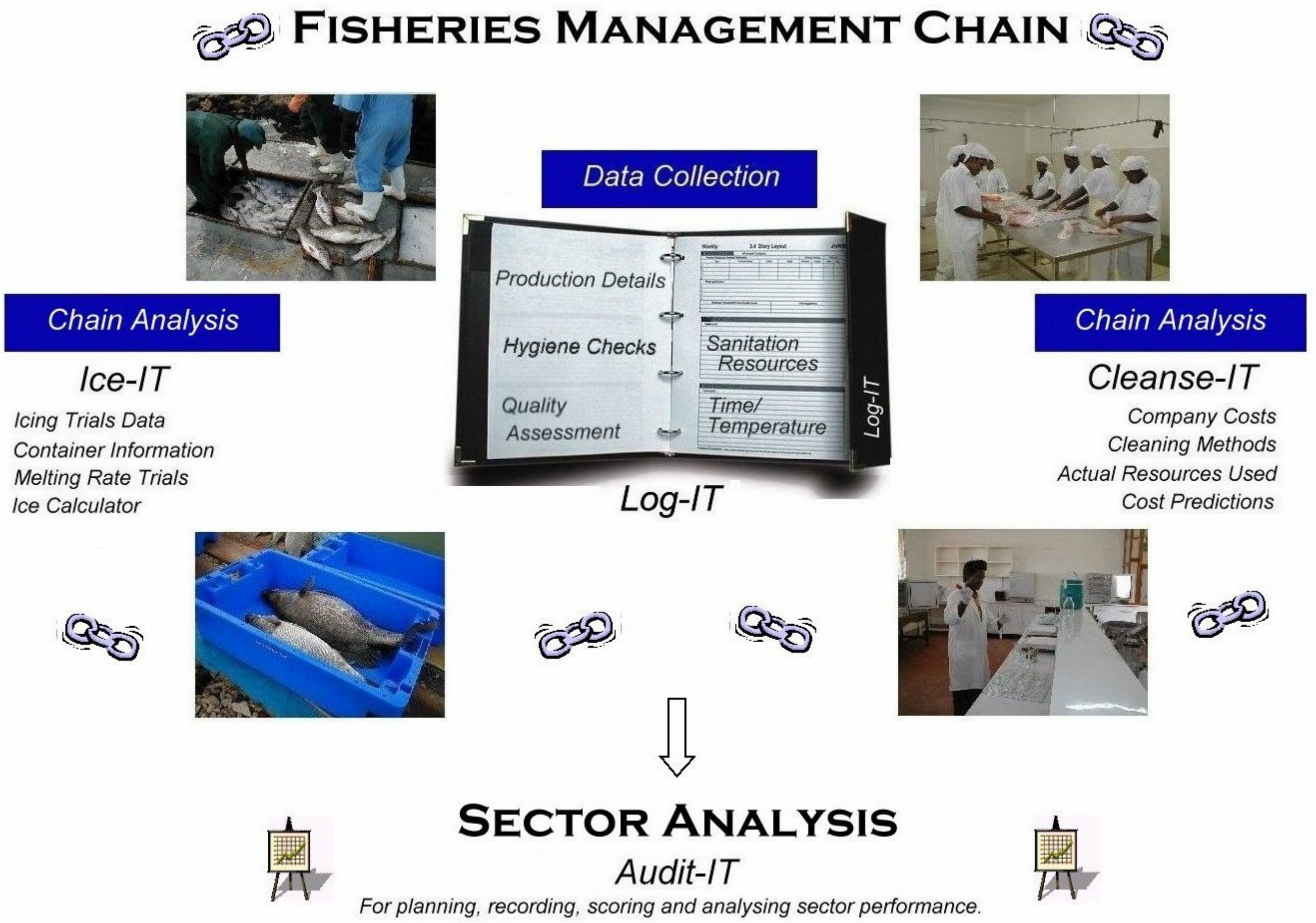
### 4.7 Ghana Achievements/Outputs

- Aluminium lined box was more hygienic and easy to clean
- New box met with Ghana Standards Board requirements
- Modified holds were safe and could be constructed locally
- Melting rate trials demonstrated that wooden and aluminium boxes should require similar ice levels
- Differences in melting rate must be due to changes in insulation capability through water permeation
- Sea trials showed that the temperature of the fish drops much faster to zero in the lined holds
- Sea fish in lined holds are better quality
- High quality fish fetched a better price and had better filleting yield
- Fishermen and fish mummies likely to adopt the aluminium lined boxes
- Financial barriers still existed.
- Initial Ugandan methodology was successfully adapted and used
- Fisher folk wanted the modified holds as they provided better quality fish and used less ice
- Trials demonstrated that better quality fish provided higher income for the fisheries chain
- Software tools were modified and used to manage and support field team

# Section 5 – Software Tools Review

## 5.0 Current Toolkit

The original single database which was the beginning of the toolkit, has now been developed into three separate programs namely, Ice-IT, Cleanse-IT and Log-IT. A history of their development can be seen in Appendix 3 and was reported in (1997, 1998, 1999).




## 5.1 Ice-IT

Ice-IT consists of three main data sections, icing trials database, container information and an ice calculator. The icing trials data section of the program acts as a trials management system where all data recorded in trials can be collated and reports produced.

Using all parts of the program, it is possible to compare the experimental melting rates recorded from the trials with the theoretical melting rates calculated by the software. It is also possible to design and test different insulated containers without the need to physically construct them. The containers can be defined in the library where a theoretical melting rate can be calculated for each container. A typical scenario can then be entered in to the ice calculator and a report produced showing how well the containers should perform

Full details are given in the manual included in the CD, and an overview is shown in Figures 9 and 10. Ice-IT is being used in Ghana, Uganda and Morocco.

*Figure 9 Ice-IT Main Menu*

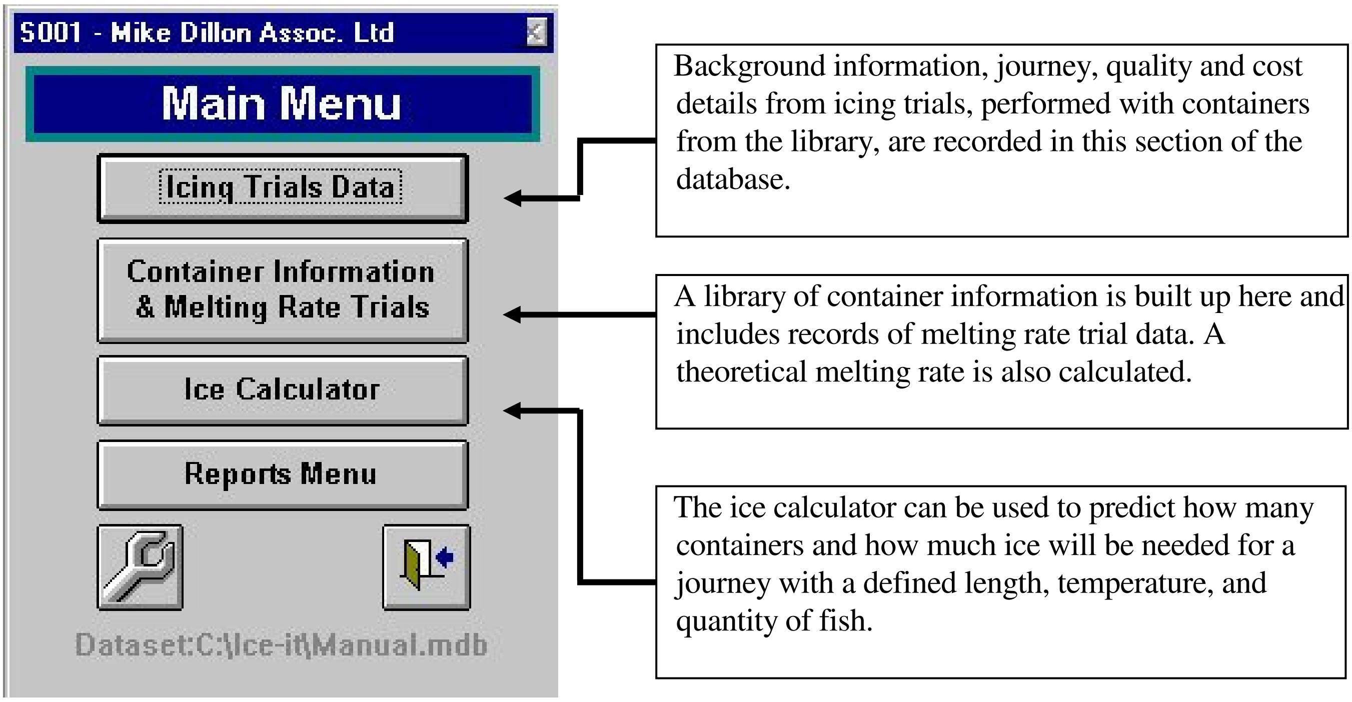
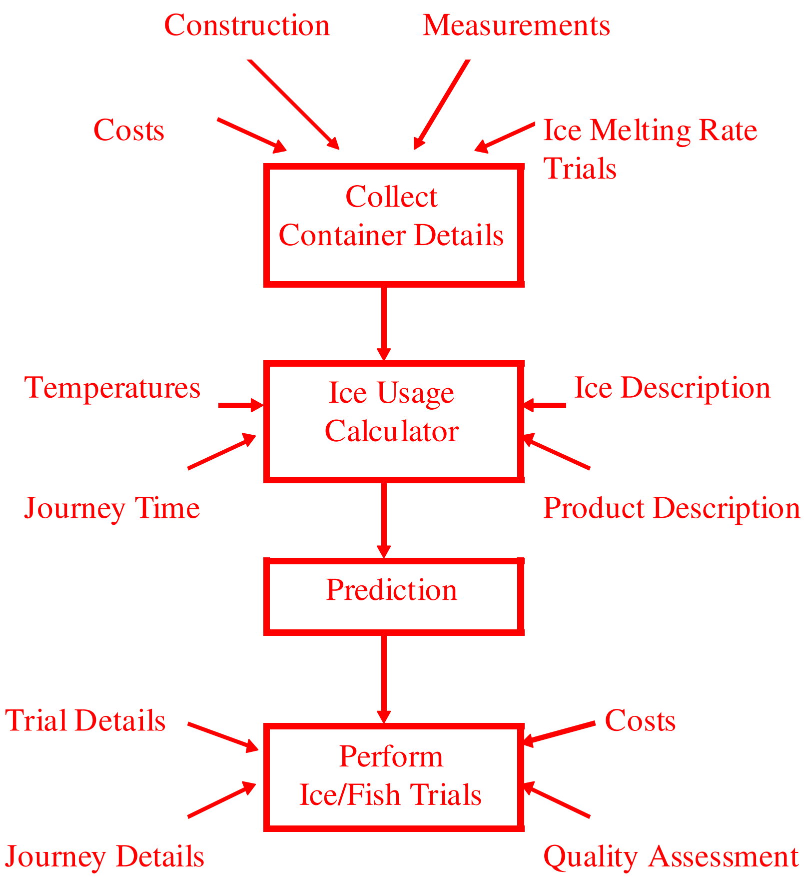



*Figure 10 Ice-IT Program Overview*



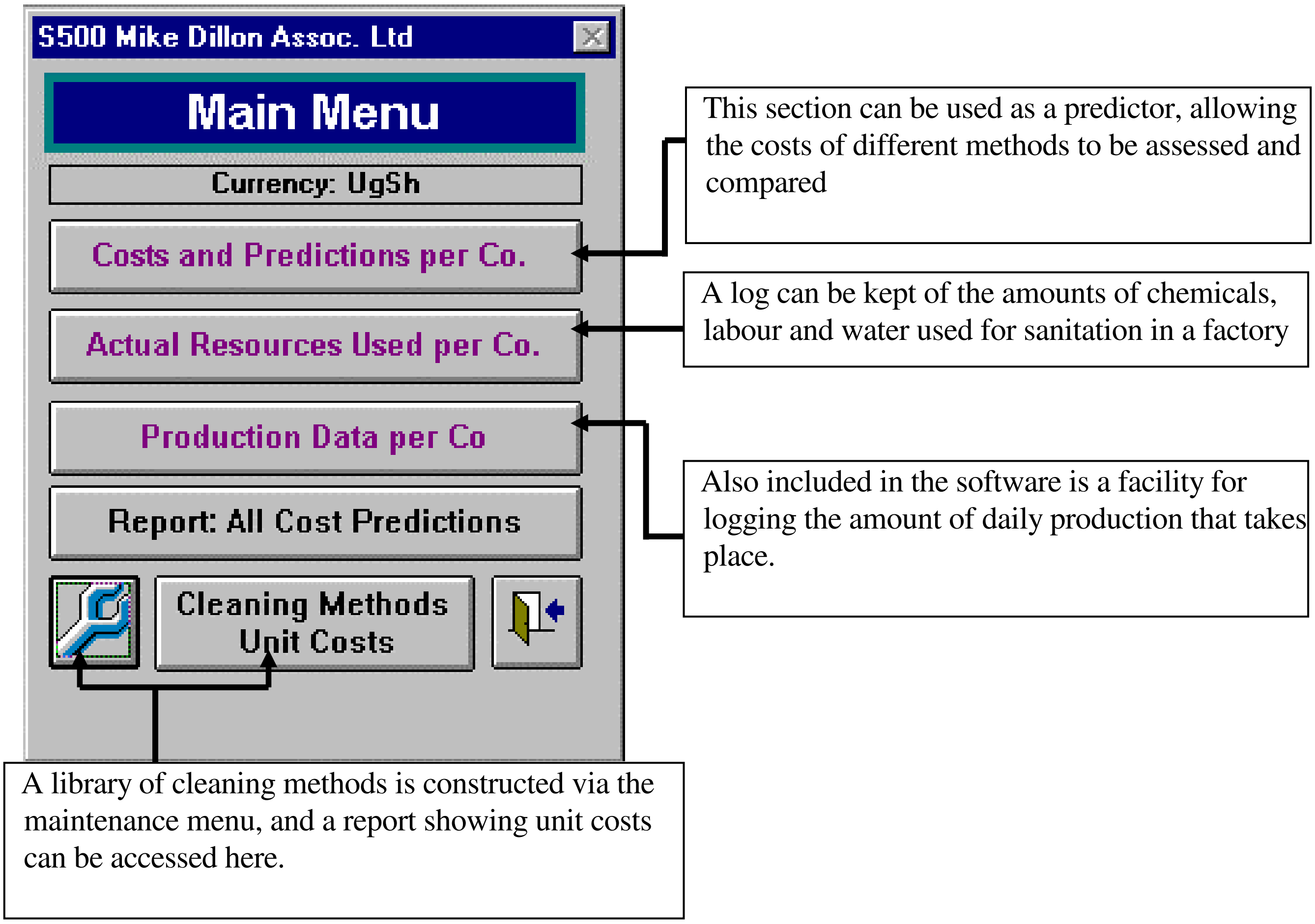
## 5.2 Cleanse-IT

This is a tool for collating records of factory cleaning information and is designed to perform several functions (Figures 11 and 12):

1. Document standard cleaning methods and required resources.
2. Predict cost of cleaning based on standard cleaning methods.
3. Document actual cost of cleaning to validate predictions.
4. Document changes in cleaning methods or practices.

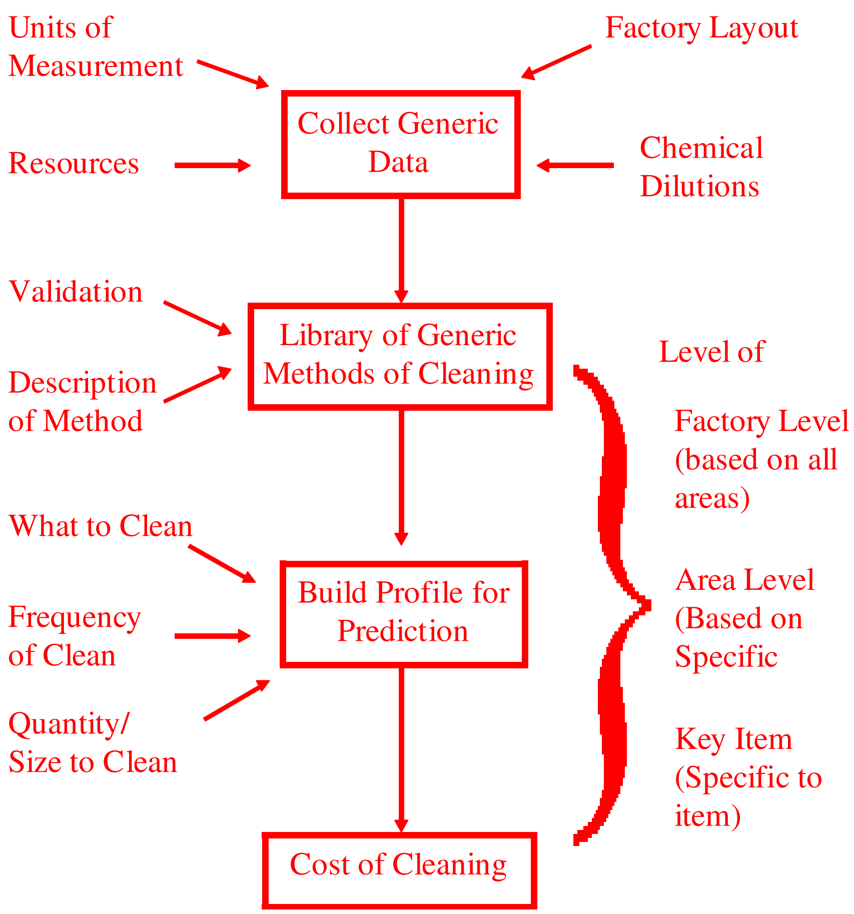
All cleaning methods and predictions can be documented at three different levels; Factory, Area or Key Item.
**Factory:** Used for global predictions based on factory area.
**Area:** More specific prediction based on factory area.
**Key Item:** Specific prediction based on factory itinerary and size of key items.

***Figure 11 Cleanse-IT Main Menu***



The prediction section of the program (Bagumire, 2000)[2] can be used to allow a change in cleaning procedures to be investigated before they are actually implemented in the factory.
The production log can be used to compare the amount of cleaning required when production is at different rates.

***Figure 12 Cleanse-IT Program Overview***



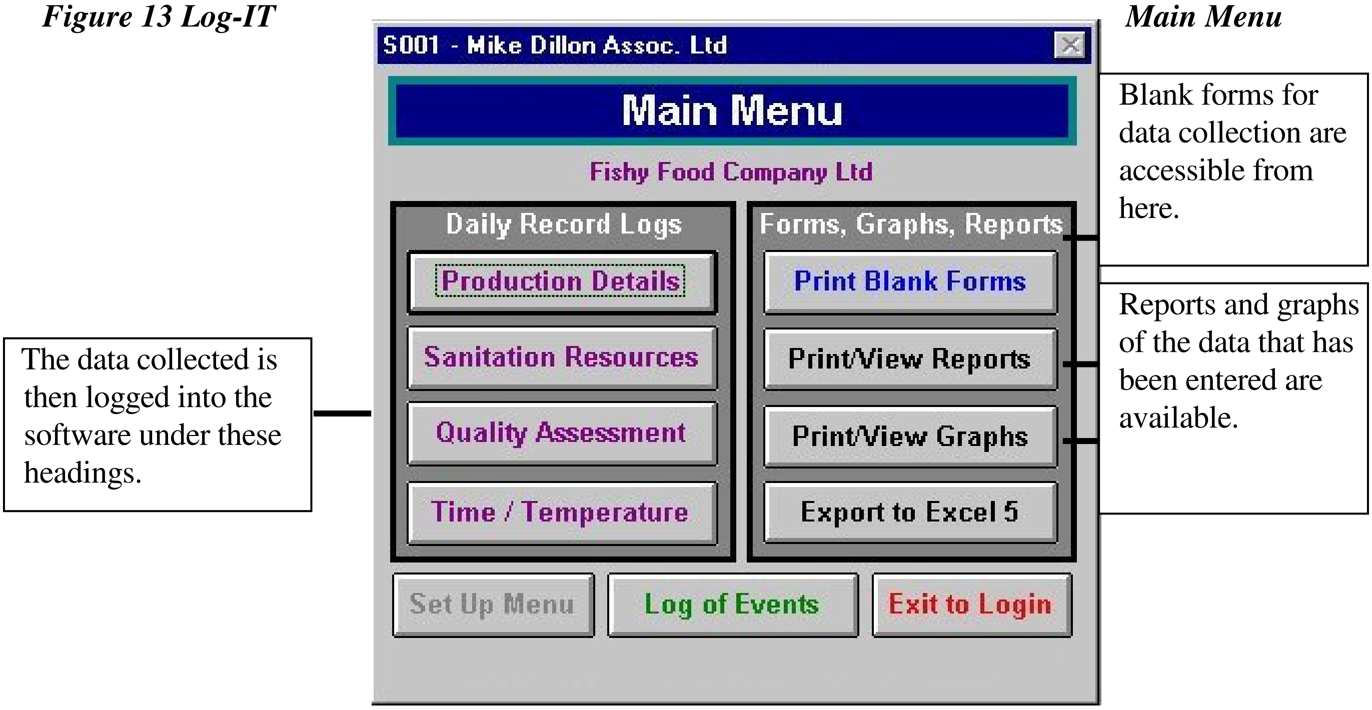

## 5.3 Log-IT

Log-IT is designed to capture different types of useful factory information on a daily basis, providing a diary of production details, such as quality and quantity.
It can be used to log the quantities of resources used by a factory for sanitation on a daily basis. The costs of resources are also entered and a cost of sanitation then calculated.

Other information relating to quality and yield can also be logged in the program, including time/temperature and assessments of the product through the chain.

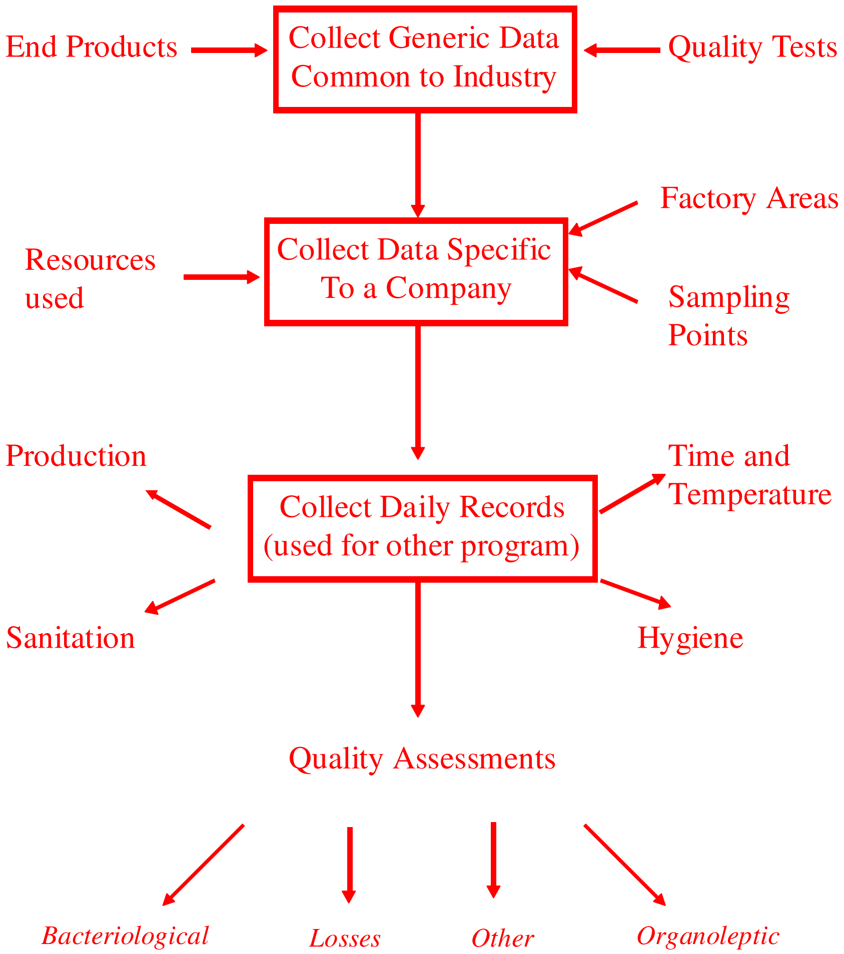
Daily record sheets can be generated by the program and used for data collection, or in-house data collection systems can be used. Log-IT is currently being used by several Ugandan factories and an overview of the program can be seen in figures 13 and 14.

***Figure 13 Log-IT Main Menu***




Reports can be printed which give a summary of information entered into the program. It is possible to keep track of each batch through the factory if a traceability system is in place, so allowing performance of quality and yields to be monitored.

***Figure 14 Log-IT Program Overview***



# Section 6 Contribution of Outputs

## 6.1 DFID Output – Reducing Extreme Poverty

This project assisted the target fisheries sectors in reducing losses within their fisheries chain through selected cost -effective controls. This has improved many poor people's livelihood's dependent upon income from fish related industry. Estimates of those dependent upon the Lake Victoria fishery sector have been as high as 500,000[29]. Ghana also reported the importance of fishing in their poverty alleviation strategy, with a 9,000 strong artisanal canoe fleet and 100,000 fishermen.

The earnings of the fishermen at landing were observed to drop when the European market was closed, to less than 40% in Uganda. The contribution of the project in improving sanitary, handling and icing practices has assisting re-entry to the market and has therefore raised fishermen's income which feeds the network of associated dependent industry and family.

## 6.2 National Government Strategy – Poverty Alleviation

The project has supported the Ugandan and Ghanaian Government's individual poverty alleviation strategies. The Directorate of Fisheries in Ghana specifically selected and aligned the DFID R6959 terms of reference with the Ghanaian Government 20/20 vision. This vision of improving the livelihoods of their country's poor was assisted by the project through improved control in the fishery sector enabling re-entry to the European market by the artisanal sector. This achieved a reduction in losses and a greater income for the 275 strong Lagas fleet and their dependants as reported [28,30,32].

Improved icing and handling has also been adopted within the Ugandan Government's 5 year medium term research plan. Over the 5 year period regular discussions on income and profitability issues were held with factory owners and with transport boat operator's who confirmed the positive impact of this project. The Ugandan team have already reported [29] that this project has assisted the fishery sector in country to increase or optimise income.

## 6.3 Data for Strengthening Policy – Improving Livelihoods

The project manager's and stakeholders in both countries recognised the need for an approach, which enabled them to identify and encourage the adoption of better control in their fisheries chain. A systematic approach to analysing the cost and the benefits of control options reduced the economic barriers to change. The methodology and tools therefore provides data for policy intervention or facilitates appropriate investment in control by the members of the chain.

The policy impact in Uganda (Section 0.2) has also been reported with the adoption and enforcement of improved sanitary and temperature controls. The Ugandan Government also funded a publication [32] based on this project disseminating better sanitary practice throughout their food sector. This was done by appropriate leaflets, workshops in the local language and by demonstration and discussion of the approach at National Trade Fairs to support the development of better livelihoods.

These key output's therefore address DFID's wider goal of improving poor people's livelihood by providing an approach, tools and teams who encourage the adoption of cost effective control

### 6.4 What further market studies need to be done?

The approach and software tools are designed to assess the cost of improving controls. Associated market studies should be undertaken to investigate the impact on livelihoods of the poorer people. The socio-economic work initiated in Ghana needs to be linked to the tools to form a platform for further work.

As highlighted in the FAO visit reports [36,37] , there is a need for further work in Ghana and Uganda to ensure that the improved controls and the tools are fully utilised. Lupin recommended the extension of the trial programme in Ghana to 10 vessels

#### 6.4.1 Future Ghana Actions

A tentative work plan for further actions to be taken in Ghana can be seen below in table 9.

***Table 9 Ghana Action Points***

| Action | |
|---|---|
| 1 | ***Field Work*- Validation of existing tools**<br>• Test the protocol for investigating melting rates in new containers (this considers theoretical values and experimental values)<br>• Evaluate scope of tools by examining further fishery chains e.g. tilapia grills<br>• Extend number of containers to 10<br>• Produce picture diagrams of box building protocols with key steps<br>• Capture standard at sea trial data using diaries/ or recording sheets<br>• Extend the work to policy makers<br>• Deliver workshop to potential user group<br>• Encourage adoption by developing and deliver workshops in local language |
| 2 | *Policy and Planning:*<br>• Development of field manual<br>• Deliver workshop to Policy and planning group<br>• Review existing tools and modify for their needs<br>• Review alternative tools under development |

#### 6.4.2 Uganda Future Actions

Looking at the case in Uganda, it was also noted by FAO, and the project discussion group in Ghana, that further projects focussing on sanitation, icing and handling of fish are needed to validate the approach and strengthen the tools. Table 10 gives a key points of action in future projects.

***Table 10 Uganda Action Points***

| Action | |
|---|---|
| 1 | *Development of software:*<br>• Adapt software to assist stakeholders to meet pre-requisite conditions of EU regulations (or equivalent)<br>• Provide further training and support to install software at key points in chain<br>• Deliver workshop to potential user groups |

| | |
|---|---|
| 2 | *Further field work to cover:*<br>• Education of fishermen in handling practices and their benefits<br>• Micro-economic studies of chain e.g. developing appropriately sized insulated containers / practices for use in Ugandan boats/transport<br>• Electronic co-ordination of trials and development from UK **<br>• Further validation of protocols and approach e.g. investigating melting rates in new boats, that considers theoretical values and experimental values |
| 3 | *Higher level focus*<br>• Development of field manual<br>• Deliver workshop to Policy and planning group<br>• Review existing tools and modify for their needs<br>• Review alternative tools under development *e.g.* Introduce Audit-IT software to the policy makers for sector review<br>• Role of log-IT in data capture and improving robustness of policy data |

## 6.5 How will the outputs be made available to intended users?

Important information from this project has previously been widely disseminated to target stakeholders at agreed points in the project. (See Appendix 2). The final project report and associated CD will be distributed a target group after discussion with the Programme Manager.

The outputs will be made available to intended users through reports and CD ROMS, which describe the approach and provide the tools. Previous reports have been circulated or presented at conferences. Regional workshops in West Africa, India and East Africa have also been planned or discussed to enable intended users to access information. It has also been suggested that a web-based support network be set up, to allow co-ordination of projects from the UK.

### 6.5.1 Dissemination

The research work was disseminated to the commercial sector, Government and relevant NGO's as described in the log-frame activities. Initial workshops were held with relevant organisations and users to identify and document their process and agree appropriate control measures. Workshops were held at the mid-point of the project to review progress in Uganda, which involved a selected representative from the Ghanaian team to share experience and facilitate planning in Ghana. A final seminar was then planned which involved discussion of the results from the Ghanaian and Ugandan elements of the project. Draft reports of findings were circulated prior to the workshops and seminars to relevant target institutions and users

Papers were published and presented at International conferences to disseminate the outputs to a wider International audience. Selected outputs were translated and were used for specific workshops or discussions for wider local fisher-folk group

| Publication | Date |
|---|---|
| Infofish International, No 4, , Production of Quality Seafood -the cost effective way , (Dillon, et al) | 1997 July/August |
| International food Hygiene Vol. 8, No 2, , Benchmarking quality programmes (Dillon, M and Hannah, S) | July 1997 |
| Cost effective approaches to the production of profitable quality seafood products, 5th Infofish World Tuna Trade Conference, , Bangkok, Thailand, (Dillon et al) | 25-27th October, 1997 |
| Costing Change -A practical approach. FAO/DANIDA Workshop for English Speaking African Countries. Walvis Bay. Dillon, M, Hannah, S, Ryder J, Garrett, S, McEachern,V, and Ssali, W | February 1998 |
| Amsterdam, Practical costing of food safety systems- an African approach | June 1998 |
| Washington, Benchmarking food safety systems- | July 1998 |
| Copenhagen, A systematic approach to investment decisions for food safety | Nov. 1998 |
| Seminar in Uganda, Attended by 25 participants from various interest groups | Dec 1998 |
| Vancouver, Economics of Food Safety | February 1999 |
| Seminar in Ghana attended by over 30 participants from various interest groups | March 1999 |
| Technical excellence- Finland Hygienomics Conference | May 1999 |
| DTI- Network North Africa ' Economics of Food Control' London | July 1999 |
| Leatherhead- National Benchmarking Meeting ' Cost Effective Food Control' | July 1999 |
| FAO Workshop<br>Economic approach to improving quality in the Ghanaian artisinal canoe fleet (Mensah et al)<br>Costing, monitoring and predicting controls in Post Harvest Fisheries Chain in Uganda (Ssali et al)<br>Review of Software tools – Workshop (Hannah and Dillon) | August 1999 |
| Denmark<br>Workshop: Review of software. Ice Calculator & Ice Trials Data Log. 24 delegates reviewed the software as discussed in the following papers:<br>Paper: - Economic approach to improving quality in the Ghanaian Artisanal Canoe Fleet – Mensah, Akrofi, Yeboah, Dillon, Hannah, Sanchez.<br>Paper:- Costing, monitoring, predicting controls in the Post Harvest Fisheries chain in Uganda – Ananias Bagumire | August 1999 |
| Presentations by project team within British council workshop on Fish Analysis. 'What COSAP Is About' 'Poor & Improved Fish Handling & Sanitation Process' | September 1999 |
| Conference of the International Association of Fish Inspectors, Canada. Cost, Benefits and impacts of HACCP (Dillon, M, Hannah, S, Sanchez, j and Powell, F)<br>Paper and Poster: 'Practical HACCP in Artisanal Fisheries', Mensah, E., Akrofi, J. and Yeboa, D. (DoF, Ghana), Dillon, M., Sanchez, J. and Hannah, S. (MDA Ltd, UK), Diei, Y. (FAO, Ghana) | October 1999, |
| How To Clean ISBN No 1 900134 11X Dillon and Griffith | October 1999 |
| Project Newsletters, research Africa – copies left forwarded to Universities, Colleges and Local Authorities (UK).<br>Copies left with The Department of Fisheries, FAO, DFID, The British Council, Ghana | |
| Improving Profit in the Fisheries Chain. Sanchez, J. Bangkok, Thailand, Infofish Tuna 2000 | May 2000 |
| 2nd NSF International Conference on Food Safety: Preventing Foodborne Illness Through Science and Education, Savannah, Georgia, USA. Cost of Food Control – Building Profitable Business, Dillon, M. Hannah, S. James T. and Thompson M. | October 2000 |

6.5.2 Other Dissemination of Results:

- August 1997 – Presentation to Uganda Fish processors and exporters Committee
- 2-6th June 1998 – Attended WHO expert consultation on the role of Government in Assessing HACCP/Food safety systems. Discussions on project progress and demonstrations of predictive cost model were held with FAO and other countries e.g. Cuba, Morocco and S.Africa
- April 1999 - Team meetings and briefings were held in Uganda and Ghana
- June 1999 - Team meetings and steering committee meetings held in Uganda
- August 1999, Denmark - Workshop: Review of software. Ice Calculator & Ice Trials Data Log. 24 delegates reviewed the software
- November 1999 – Evaluation visit by H. Lupin (FAO, Rome) to Mike Dillon Associates Ltd (UK)
- September 2000 - Ghana, Closing meeting attended by team members from UK, Uganda and Ghana. - Our part of this meeting will be circulated through the programme manager.

## 6.6 What follow up action/research is necessary to promote the findings of the work to achieve their development benefit?

A series of regional workshops and activities have been designed and scheduled to promote the findings of the project:

- Regional workshop- West Africa- List
- Regional workshops in E.Africa/ India
- Distribution of CD ROMS to target groups
- Future publications planned – NSF Conference – October
- Our own web-site with material available

Further research is necessary to finalise the validation of the existing methodology (see 6.7). Research is also required to extend the scope of the current approach and tools and to further employ them in the policy and planning area (see 6.7.2). Proposed future projects can be seen in Appendix 4.

## 6.7 What further stages will be needed to develop, test and establish the manufacture of a product?

### 6.7.1 Stage 1 - Existing tools

The current range of products have been aimed at the "technical advisory" market. Table 7 and 8 in Section 6.1 outline recommended steps to develop, test and increase uptake of use of the existing products for target group. A field manual is a key accessory for the software tools and approach and FAO have agreed to support publication at a recent meeting in Rome, and previously by FAO Regional office in Africa. The need for a field manual has been recognised and support will be provided by DFID for its development.

### 6.7.2 Stage 2 - Policy Tools/Further Research

A further research project would be necessary to extend range of tools or modify the existing product to gain uptake by the policy makers. The potential content of this further work has been discussed with FAO/ UNIDO and representatives of the Tanzanian and Ugandan Government who recognise the need and welcome this as the logical next step

## 6.8 How and by whom, will the further stages be carried out and paid for?

Further stages of the work will be carried out by a range of field teams using the tools supported by a number of agencies. Currently field work is being undertaken, planned or executed, e.g. UNIDO project work in Uganda, DANIDA funded work in Vietnam (SEAQIP) [38], or National Government initiated work in Uganda and Morocco. Discussions have also been held with representatives of the Kenyan and Tanzanian Government who wish to begin work in their countries employing the approach and the tools. Interest in the tools has also been expressed by organisations in India.

### 6.8.1 Interim Support

These further stages are currently un-co-ordinated and valuable information may be lost by not linking the work. Both FAO and the current project manager believe that interim support should be sought to enable the co-ordination of these fledgling projects and other projects which will arise as a result of the regional workshops. Both UNIDO and FAO have offered to link regional activities in East Africa to dissemination activities. Finally UNIDO have suggested the development of a substantial project proposal from East Africa targeting EU funding, using these tools and approaches.

# Section 7 Conclusions

## 7.0 Overview

To recap, the purpose of the project was to develop the local capacity to adapt and implement cost effective control measures targeted at the critical loss areas within their defined fisheries chain. The specific control measures that were focussed upon, were icing of the fish during transportation from the fishing grounds to the factories (the importance of which was emphasised in FAO technical papers 331 and 340)[39,40] and cleaning and sanitation practices within the factories (Huss, 1995)[41].

## 7.1 Outputs

### 7.1.1 Analysis of Social, Economic, environmental and technical constraints

Social economic surveys were conducted in Ghana and Uganda, and reports were completed. The socio-economic survey has been fully implemented and the data processed. Training has been given on data analysis and interpretation. The technical element of this survey has also been completed and IT support has been arranged for the teams to assist in the data processing. The teams have also undertaken some basic analysis and the results have been published.

### 7.1.2 Analysis of existing costing structures

The operational cost and revenue element of this survey was completed and protocols for the cost collection have been fully documented. Sanitation cost surveys were undertaken and data collected covering the costs of inputs, typical catch levels and the market prices during peak and slack seasons. Both teams processed the data and the results have been published. The economic survey data from the 1997 “Use of Capital Income in Artisinal Fisheries” was used to examine the annual income and return on investment in Lagas fishing.
Sanitation cost surveys were undertaken and completed by the in-country teams and a specific cost survey of canoes which were supplied with lined iceboxes in comparison to unlined canoes was designed and implemented. The Ugandan team has also produced a cleaning manual, which is being finalised prior to publication.

### 7.1.3 Production of appropriate database containing standard costing information and programme

Software databases were developed and modified throughout the project. The software has been installed and extensively tested by both teams. Training was provided for all users of the software. Three databases have been developed Cleanse-IT, Ice-IT and Log-IT.
Cleanse-IT is a cost based database which is designed to documents standard cleaning methods and required resources, predict cost of cleaning based on standard cleaning methods, document actual cost of cleaning to validate predictions and document changes in cleaning methods or practices.
Ice-IT was designed to make cost predictions for using different amounts of ice and types of containers. This involves a trial management system capable of gathering and reporting the results of experimental trials using different types of ice and containers, recording of ice melting rate trials for containers, including their description, dimensions and construction. It enabled the teams to design and test different insulated containers without the need to physically construct them.
The Log-IT database can be used to capture different types of useful factory information on a daily basis, providing a diary of production details, such as quantity and quality. It can also be used to log

the quantities of resources used by a factory for sanitation on a daily basis. The costs of resources are also entered and a cost of sanitation then calculated
The Log-IT software was installed in several factories within Uganda, which enabled data capture. Monitoring data was produced on a continuous basis and has been analysed to compare predicted cleaning costs and actual.

### 7.1.4 Appropriate control measures implemented, monitored and predicted costing system field-tested.

Comparative trials with lined and unlined boxes have been completed and comprehensive technical and economic data relating to each trial was analysed. The data was then entered onto the icing trial database (Ice-IT) and quality improvement, ice-usage, market prices and other relevant income costs and income data were reviewed.
Data collection software (Ice-IT and Log-IT) was installed in 6 factories in Uganda which enabled the capturing of sanitation and quality data turnover. Modified controls were costed within factories and microbial validation made to ensure that they worked. The cost data was then entered onto the databases
The data collected from the trials was used to validate the accuracy of the ice usage predictions.

### 7.1.5 Workshops to promote information on programme and use of software

At various stages throughout the project workshops have taken place to inform the local in-country representatives of the work completed. A mid term seminar, December 1998 was held in Uganda which attended by representatives from Ghana, Uganda project team, factories and other local interest groups. This enabled the two teams to exchange ideas and developments. A further seminar took place in Ghana in March 1999 and representatives attended this from Uganda, Ghana project team, factories and other local interest groups. Throughout the project demonstrations of the software were provided for Quality Assurance Managers and factory representatives which led to feedback and enabled changes to be implemented where necessary.
A final dissemination conference took place in Ghana in September 2000. Over 50 participants attended this conference from industry, in-country government departments, local FAO representatives, students and UK team members. A presentation of the work carried out and displays of the software provided an overview of the project. Copies of the software and user manual were provided for interested parties.

## 7.2 Achievements and Main Conclusions

Principal achievements made by the project were as follows:

- Advisors and policy makers enabled to promote effective strategies to control loss and maintain quality.
- Commercial decision-makers, local advisors and fishing communities also benefited.
- Provision of tools which enabled cost analysis of their relevant control options, which encouraged adoption of better practice.
- The development of capable local teams respected by stakeholders throughout the chain.
- Improvement in the quality and profitability of the sector in Uganda.
- Application of the tools in further projects supported by UNIDO and incorporated into the policy and planning process in country e.g. the Ugandan 5 yr medium term research plan.

- Ugandan icing and sanitation controls have been found to meet their international export requirements thus enabling re-entry into the market.
- Significant improvements in the handling, icing and cleaning controls have been reported since 1997.
- The Ugandan team has used the experience of this project to successfully bid for UNIDO projects in the same area.
- The Ice-IT and Log-IT databases are now being used within the UNIDO projects to measure the micro-economic impact of new boat design and operation to the factories.

## 7.3 Independent Review

Independent reports were produced by FAO,[36,37] which reviewed the activities performed in Uganda and Ghana by the project. It was noted that the project had fulfilled its aims and the approach used was an appropriate one. The conclusions made by these reports included:

- The adoption of new insulated containers in Ghana is hampered by the small number (two) of fishing mummies involved in the project and also by the lack of any extension work to further expand the results.
- Facilities at Ugandan landing sites had improved, but some practices still needed further improvement.

Although it was clear FOSRI/NARO are already working within the industry, there is a need for strategic extension work to enhance the impact and continuity of results obtained

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# Appendix 2 Software Development History

**Overview of Changes – NRI/PHF01**

## Cost of Controls Database

V1 - Cost of Controls Database, Simple Costing using Cost Headings and pre defined controls

V2 - Modified to expand the Cost of Icing and Sanitation Reference to Materials and Equipment

V3 - Separate the cost of control Dbase in two – Cleanse-IT and Ice-IT.
Create New Program – Log-IT to enable data capture on site

## Ice-IT – Current Version v3.09.0168

| | | |
|---|---|---|
| May 1998 | v3.00 | Basic Ice Calculator |
| June 1998 | v3.01 | Expand to include End Product Costing and Ice Trials Data |
| Aug 1998 | v3.02 | Enhance Ice Trials Section and Modify Calculation |
| Sept 1999 | v3.03 | Introduce Indirect / Direct Cost elements, Allow Multiple dataset to be managed |
| Oct 1999 | v3.04 | Introduce Quality Log for Ice Trials |
| Dec 1999 | v3.05 | Expand Quality test for different samples i.e. Ice, Melt Water not just Fish |
| Mar 2000 | v3.06 | Introduce Defined Units for Indirect Costing (Later Abandoned) |
| Apr 2000 | v3.06 | Modify program to Log Box Melting Rate Trials |
| May 2000 | v3.07 | Expand Ice calc to include Length of Journey with no product (Later Abandoned) |
| June 2000 | v3.08 | Improve Box Melting Rates Section – include Humidity and Ice Types |
| Aug 2000 | v3.09 | Modified to Work from CD for Workshops and Dissemination |

## Cleanse-IT – Current Version v3.02.0089

| | | |
|---|---|---|
| Aug 1999 | v3.00 | Final Complete Working Version |
| June 2000 | v3.01 | Modified to accept Manually entered Unit Cost for a Cleaning Method |
| Aug 2000 | v3.02 | Modified to Work from CD for Workshops and Dissemination |

## Log-IT – Current Version v1.03.0065

| | | |
|---|---|---|
| Sept 1999 | v1.00 | Final Complete Working Version – Installed on Sites |
| May 2000 | v1.01 | Modified to Enhance Report & Graphic<br>Feedback from Factories / Fosri |
| July 2000 | v1.02 | Introduce Hygiene Checklist<br>Feedback from Factories |
| Aug 2000 | v1.03 | Modified to Work from CD for Workshops and Dissemination |

# Appendix 3 Contents of CD

**Papers and Reports**

| Ref | Title |
|---|---|
| 2 | Reporting on cleaning and costing sanitation in Uganda July 1997 – July 2000 |
| | Technical/Box Survey in Ghana |
| 5 | Economic impact of project |
| 9 | Development of quality cost models |
| 17 | The cost of HACCP implementation in the seafood industry |
| 26 | Cost effective approaches to the production of profitable quality seafood products |
| 29 | Costing, monitoring and predicting controls in the post harvest fisheries chain in Uganda |
| 30 | Economic approach to improving quality in the Ghanaian artisanal canoe fleet |
| 32 | Practical HACCP in artisanal fisheries |
| | Development of Cost of Control Software |

**Manuals**

| Title |
|---|
| Log-IT User Manual |
| Ice-IT User Manual |
| Cleanse-IT User Manual |
| Cost-IT Sanitation |
| Beginners Guide to Computing |
| Manual of standard operating procedures for fish inspection and quality (selected tables) |

**Software**

| Title |
|---|
| Log-IT |
| Cleanse-IT |
| Ice-IT |

# Appendix 4 Draft Report Of Outline Proposals

0.0 Introduction

The final meeting was chaired by Dr. Jallow from FAO African regional Head Quarters. A list of proposal options were recorded during discussion. The list was then used to create 4 themed interest groups who were charged with developing the outline proposals. The Gambian representative emphasised that the lead on following up key project areas should be allocated and these outline proposals be tracked by FAO . The groups then developed four outline proposal, .A summary of the proposals are provided below with list of countries and participants who wish to be involved. This list is not restrictive and other participants may register interest in another group project.
Please note :-
A further proposal was provided by a delegate giving emphasis to the final vendor and Consumer link in the chain and is included.
Note was also taken of the Nigerian representative who requested a specific proposal focusing on both policy and technical strengthening of countries who were exporting significant products.

1.0 Draft Proposal -

1.1 Proposal 1 Using loss assessment and cost of control tools
Dr Ssali – Direcrtor of the Food Research Institute Uganda

1.2 Countries/ participants
Interested countries from West.Africa- Ghana,Sierra Leone, Gambia, Nigeria and Liberia and from E. Africa- Tanzania, Kenya and Uganda
This team wished to use the loss assessment tools and the control tools described in the workshop.
They wished to use the methods and software tools to
Determine status of loss – make informed interventions
Determine cost of controls in factory cleaning and sanitation and handling / icing
Tools applied under 1 project with two components- view on loss and focus on costs.

1.3 Activities
Train users of tools – either research/ industry operators
Awareness of industry – to involve industry in group
Apply tools by assessors trained in co-operation with industry
Monitoring and evaluation of groups during
Dissemination and impact reports

1.4 East African group – Funders suggested
The East African group had intially discussed Lake Victoria Environmental Management Programme which has been reported to have an underspend and may have correct remit.. A bid may also be made for application of research tools in region via DFID or an alternative regional donor. Dr Ssali will draft a concept note and discuss with the LVEMP co-ordinator and the DFID in country representative

West African Group- Funders

WEDAF (Joseph Ndenne and Gbola Akande) have also expressed willingness to develop and present concept notes to EU . They feel that a dedicated cost survey tool kit and focus on export activities may be useful region wide.
Mamouda from the Gambia has also expressed willingness to collaborate on development of a West.African proposal. The suitability of this project would also be discussed with key stakeholders by West African group for potential SFLP activity.
Members of this group also emphasised the opportunity for these tools to be used within TCP projects via FAO and there was a need for central co-ordination
The W.African group have also suggested taking an outline proposal to stakeholders and gain commitment from grass roots level for an SFLP proposal.
Next step in development
FOSRI prepare outline proposal for application in Uganda /East Africa proposal. Proposal will be circulated for comment to key contacts in E.Africa.
WEDAF/ Gambia/ Nigeria to collaborate on development of concept note for discussion with potential funders e.g EU.
Concept notes will be discussed with MDA/NRI as required
FAO will be kept informed of progress and issue of possibility of incorporation of tools within TCP's was to be reported for feedback
Key Contact personnel

2 Proposal 2 Control of insect infestation-
Felix Qansar Ghana
This work was focused on surveying the existing status of insect problems in the Ghanaian fishing sector. This work would extend an existing DANIDA funded project. It can either be independently funded by another Donor e.g. linked to further field validation tests. A serious problem was identified along Lake Volta and in the Southern part of country during an existing Danida funded project on solar drying. No documentation is on the ground giving percentage of losses for this problem. The group therefore reported need for a careful study to document prevailing situation using the suggested methodology
2.1 Activities
Identify causes- types of causes
Type of blow fly and effect of season
Assess existing chemical treatments.
Plan and track modified controls

2.2 Identified Funder - DANIDA –
Extend scope of existing baseline study with Danish Technology Institute and NGO AIDT Miljo. Felix Qansar who is involved in this study has agreed to draft a concept note extending existing scope of the Danida work. Recommended further extension of pilot work to include
Cause/ effect analysis- Infestation audit
Cost assessment –and use of existing trials software or modification to manage data

2.2.1 Funder 2 DFID proposal focused on field validation of methodology
Group requested that another bid should be forwarded to DFID Programme research manager. The manager has already expressed interest in further validation trials but would await output of an existing survey team report. The bids require discussions with the potential user groups to ensure interest and uptake.

Other suggestions for inclusion in insect work were noted and include a focus on traditional control methods-e.g plant extracts. Wisdom University of Cape Coast has recommend investigating link with University and involve relevant degree students on this project

2.3 Group

J.Esser- UK, Bob Cheke- NRI, PY Atobah (G), hilda Kordu (G), Roderick Daddy- Adjei, Enoch Amah, Dorothy Oppey, Felix Qansar

Development of bid will be led by Felix Qansar in Ghana
UK collaborators Dr.Esser

3.0 Project 3 Icing Trials and software tools

Mohammed El Belkacemi Director Fisheries Inspection, Tangier, Morocco

This group focused on the specific area of icing within lake, inshore and at sea fisheries. The utilisation of existing survey methods and software tools was to be extended . The group was led by Mohammed el Belkacemi.
The group identified key areas to focus on within the scope of the project:-

3.1 Activities

Review quality of ice- purity, maturity, safety and how long it lasts
Quantity of ice- ice to fish- cost of ice and impact of use, Cost in Africa
Handling and contamination
Ice availability – easily
Storage- refrigerated room?
Cost of ice- 1 Ton = $350 Morocco, Ghana $33 /Ton
Type of ice- flake, crushed, melted ice
Use of ice /

3.2 Suggestions from group for inclusion in project

Suitability of the existing fleet to carry ice should be included. Further funding to support the extension of a previously funded DANIDA project on prototype canoes should be sought. A need for investigation of the technology issues for export was emphasised by Industry
Education of local fishermen was emphasised in terms of importance of correct ice usage-. Contamination issues of dirty beaches and inability to land fish in these areas noted.

3.3 Availability of ice and need for Government intervention

Covered in the existing project plan but should be made clearer.. The chairman noted the possible routes for indirect Government intervention through policy but agreed that Government should not get involved direct operation of ice plants. Ice should be made available

3.4 Potential Funders

Mohammed would investigate opportunity for his country to lead African wide project. His Government could seek support from possible funders for this work e.g. UNIDO/ DANIDA who have a history of supporting country in the in Morroco
Ghanaian team reported that they would look for support to extend the existing LAGAS project .

4.0 Project 4 Extension of Fish Loss Assessment and Intervention project

Gbola Akande – Nigeria

The project would be located in West Africa (ECOWAS) and co-ordinated by WIDAF. They would work as team through established connection. Project background and justification has been provided with reports from NRI team.
WIDAF reported that all 16 countries in the region wished to work together on this proposal The executive agency would be WIDAF in collaboration with NRI and MDA if required.

4.1 Objectives
To identify the sources of post harvest losses
To estimate the post harvest loss with the view to reducing the loss
To identify interventions – e.g. icing, handling etc
To improve socio-economic lives of fish processors

4.2 Workplan
Employ Project methodology- as in manual
Establish resources- using manual

4.2.1 Expected findings
Estimated loss
Successful intervention
Reduction on post harvest loss which will benefit the neconomkic operators (fish processors)

4.2.2 Outputs
Loss estimates
Restriction of post harvest losses
Successful intervention
Sustainable livelihoods of economic operators in the artisinal fisheries
The group suggested a budget of £10 Million but reported detailed costing would be undertaken at project concept stage.
Donors-
WEDAF may seek further support from EU . Alternatively the possible role of SFLP but would be discussed with stakeholders and brought back after modification if agreement reached
FLAC- Group

| Name | | Institution | Country |
|---|---|---|---|
| 1 | Momodou njie- | Fisheries Dept | Gambia |
| 2 | Johnson K | Bureau of Fish. | Liberia |
| 3 | Kolawole | /fisheries | Nigeria |
| 4 | Nyurko | Pioneer foodCo. | Ghana |
| 5 | H.A.Robbie | Fisheries Dept | Sierra Leone |
| 6 | Wisdom Akpula | Univ.Cape coast | Ghana |
| 7 | Sam Opuku | Adom Seafood Int ltd | Ghana |
| 8 | Jon Venn | NRI | UK |
| 9 | Dave Jeffries | NRI | UK |
| 10 | Henrietta Quaye | Ghana Agro Food Co | Ghana |
| 11 | G.R. Akande | Nigerian Inst. Of Ocean | Nigeria |

5 New project proposal Consumer Link in Chain
Fidelia Nelly Nazaar – Fidel Agencies

FLAC project for small entrepreneurs fish vendoring to consumers

A focus on the small entrepreneurs selling fish to consumers with an investigation of loss assessment and economics in this chain.

5.1 Objectives

Do an assessment to know where the loss really starts from and how much loss occurs

This group face loss daily due to deterioration quality of fish

The software tools could be used

5.2 Activities

Vendor group- 10 women who go from Jamestown – loadtracking – to Accra

Up to time they finish,

Need fisheries department or specialist to advise on intervention

Methodology- LT- plus trials software

Follow up workshop to educate them in individual areas

Design support for them to improve on quality of the fish

Funders..

May be linked to marketing economics proposal already prepared for DFID

Need to develop proposals further. Copies of proposals further and forward inputs to central points.

Action

Write up draft proposals

6.0 Policy proposal for Nigeria

Specific request by Nigeria for intervention to assist their export plants and inspection systems was noted. A delegation from FAO are being funded to visit both NRI and MDA over next two weeks. The suggestion will be discussed further with them and reported back to FAO network.

The Chairman has suggested that there may need to be a project focusing on policy and strategic interventions for export factories and wished to be kept informed

7.0 Other Items

Collection of data is difficult for project teams and Universities have students but no funding. They needed funding for such work. Dr Ssali reported that their own in country research activities should be channelled through these projects as this was there policy

The DFID research manager reported that there would be a call for proposals soon and interested parties would be placed on list. He also reported the need for networking and that project leaders need to know what expertise is available. Let people know that you are there and perhaps more students could become involved