FEASIBILITY STUDY ON HYGIENIC PRODUCTION OF ICE FOR THE SMALL SCALE FISHERIES SECTOR IN TIMOR LESTE

REGIONAL FISHERIES LIVELIHOODS PROGRAMME FOR SOUTH AND SOUTHEAST ASIA
GCP/RAS/237/SPA

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ANNEXES

Annexes 01 through 15 and 20 through 25 are available as soft copies on CD format. Annexes 16 through 19 are available as hard copies at the FAO - RFLP office in Dili, Timor Leste.

TABLES & DIAGRAMS

ABREVIATURES

AECID	Agencia Española de Cooperacion Internacional e Desarrollo
EDTL	Electricidade de Timor Leste
EU	European Union
EZ	Economical Zone
FAO - FRLP	Food and Agriculture Organization, UN - Fisheries Regional Livelihood Programme for South and Southeast Asia.
FAO – IC	Food and Agriculture Organization, UN – International Consultant
FAO – NPO	Food and Agriculture Organization, UN – National Programme Officer
Lotas de Pesca	Fish landing sites
MAF	Ministerio de Agricultura e Pescas, Ministry of Agriculture and Fisheries
MED	Ministerino de Economia e Desenvolvimento, Ministry of Economy and Development
MTCI	Ministerio de Turismo,Comunicação e Industria, Ministry of Tourism, Communication and Industry
NDFA	National Directorate of Fisheries and Aquaculture
NDWS	National Directorate for Water and sanitation
PYD	Paz y Desarollo, Spanish NGO working in the rural areas of Timor Leste
UN	United Nations

1. INTRODUCTION

The TOR for the FAO – IC is listed below:

Under the overall guidance and administrative supervision of the Emergency and Rehabilitation Unit in Timor-Leste, under the direction of the Regional Program Manager in FAO Regional Office in Bangkok, under the technical guidance of the Senior Technical Advisor and under the direct supervision of the Advisor RFLP Timor-Leste and the National Project Officer, the International Consultant (IC) will conduct a feasibility study on the introduction of ice production at selected sites in Timor-Leste to assess whether the introduction of ice production systems would be cost effective for the improvement of post-harvest activities.

Specifically the IC will:

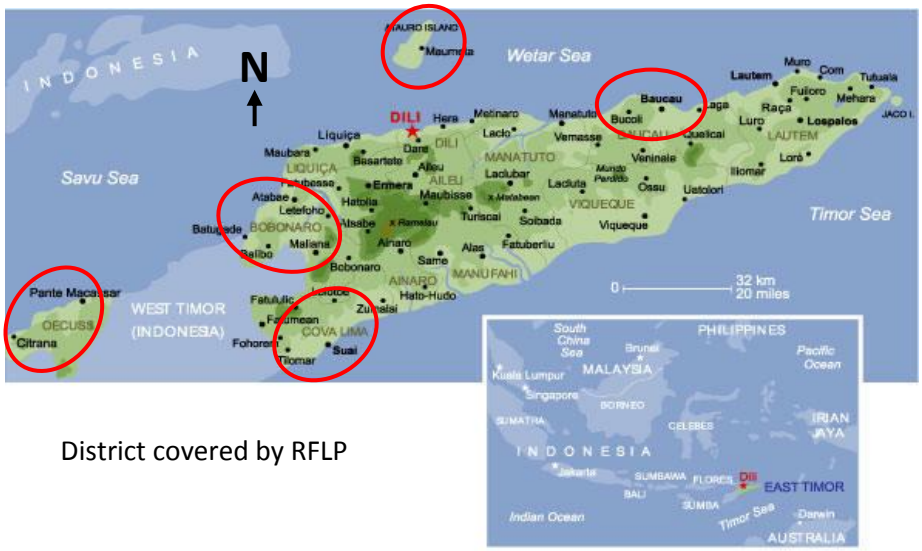
1) Travel to and review the current ice production methods and cold chain system used in Timor-Leste at Tai Besi Market and the Atauro Cooperative, both of which are in the city of Dili.
2) Develop a curriculum and illustrated training guidelines for the hygienic handling and storage of ice throughout the cold chain, covering ice plants, boats, landing sites and processors, and provide short course training for key people from appropriate organizations selected by NDFA.
3) Travel to and assess the current conditions and the required needs to establish an ice production system for the post-harvest handling of marine aquatic products in 9 selected fish landing sites (Lotas de pesca), constructed by the National Directorate of Fisheries and Aquaculture (NDFA) under the Ministry of Agriculture and Fisheries (MAF) of Timor-Leste. The selected 9 LpD are at: 1) Baucau; 2) Bobonaro; 3) Liquiçá; 4) Suai; 5) Atauro; 6) Manatuto; 7) Manufahi; 8) Viqueque and 9) Oecussi. The location of the LdP's are indicated on the map below.
4) Analyze the current volumes of fish landed, the current demand for aquatic products and the minimum quantity of ice production necessary to supply ice to the fishermen and/or middlemen in each of the 9 selected LdP and determine the technical possibilities.
5) Analyze the available power supply and identify the power needs at each of the 9 LdP.
6) Analyze the quality of currently available potable water, as well as the water supply system (in terms of availability, capacity and storage), at the selected 9 LdP.
7) Assess the potential for fisher or community groups to successfully and sustainably manage the 9 LdP.
8) Conduct a financial analysis (cost of materials, installation, ice production costs and maintenance of proposed ice production facilities) of the different technical solutions given to make ice in light of the different conditions encountered at each of the 9 selected LdP.
9) Highlight any of the 9 LdP where the installation of ice production plant would be uneconomic.
10) Based on the above survey findings and analysis give recommendations on the most suitable technical and financial solutions for the production of ice at the selected LdP.
11) Where ice production in-situ is not considered technically or economically feasible, provide recommendations for alternative cold-chain marketing approaches and recommendations for minimal equipment required by fishing vessels, boats, fish landing sites and processors.

12) For each recommended technical solution, provide information on the logistical and equipment needs necessary to set up an ice production system which provides hygienic quality ice for use by fishers.

13) Recommend suppliers that can provide RFLP Timor-Leste and NDFA MAF with all the materials needed to set up ice production systems.

14) Develop guidelines on the type training needed by NDFA technicians NDFA, who will be in charge of system maintenance.

15) Perform other related duties as required.



District covered by RFLP

After consultations and advice from the Advisor RFLP and NPO the work was planned starting out with task pooling of the TOR points to address the issues in a structured and efficient manner.

With the base on a preliminary evaluation[1] carried out in 2010, it was decided to carry out the field visits to the selected sites as a small-scale feasibility study with the objective to determine the de facto situation on site with respect to location, in relation to the client base, logistics involved, human resources and utility systems, for this purpose there was elaborated a standardized questionnaire for data collection and featuring a score system incorporated to enable grading the suitability for support.

[1] **Alonso, E.** (2010) *Fish landing centers and market chains in Timor-Leste. A preliminary evaluation and a reviewed plan of action***.** Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA) Field Project Document 2010/TIM/1

2. CURRENT ICE SUPPLY SITUATION AT TAI BESI & ATAURO COOPERATIVE

This section specifically addresses the TOR point 1 under subsections 2.1 and 2.2.

There is at present not any private or public owned ice factory in operation in Timor-Leste according to information provided from both the private sector interviews, as well as information provided by NDFA.

However, MED and MTCI has purchased 04 Indonesian produced block ice machines each with a rated output of 3.840 kgs/24 hour with 12 hours harvest cycle, approximately 2 years ago.

These machines each come with a separate, refrigerated ice storage container, with an estimated volume of 18 cum corresponding to approximately 3 days production of each unit.

Negotiations have been initiated between the ministries of MED, MTCI and MAF, with representation of the FAO - RFLP and FAO -IC as to how deployment of this equipment could be done in a cost efficient manner.

These machines, if installed correctly, would cover the present needs for hygienically produced ice for the TL fisheries sector as well as for the envisaged consumption for the next decade.

2.1 Current Ice production and cold chain situation at the Tai Besi market

The NDFA has still not officially inaugurated this installation where the completion of the market infrastructure and utilities supply situation still is not resolved by the contractor.

The installation is found in an inactive status with no concrete signs of activation date being set by NDFA, who have informed that applications to EDTL and DNWS has been made with respect to connecting the installation to the public utility systems.

There are still outstanding issues with respect to security fencing and driveways as well as a general clean –up of the compound to be considered and addressed before the installation can become operative.

2.2 Current ice production and cold chain situation at the Atauro cooperatives

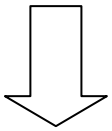
The situation for the 02 cooperatives at Atauro Island is remaining the same as previously reported.

The cooperatives produce their ice domestic chest freezers operated by solar panels and still have to supplement their requirement for ice with local purchases in Dili.

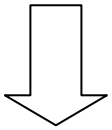
There is reported a private sector interest at Atauro Villa by a citizen, who is interested in investing in an ice factory and produce ice for public sale. This information has not been confirmed.

The typical cold chain procedure in place for the Atauro cooperative has following steps:

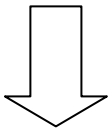
PREPARATION
THE GROUP PREPARES THE ICE /CATCH STORAGE COMPARTMENT BY CLEANING THE COMPARTMENT WITH CLEAN WATER. THE ICE/CATCH COMPARTMENT IS AN OLD REFRIGERATOR BODY, ACTING AS A COOLER BOX. THE COMPARTMENT IS LOADED WITH ICE FROM OWN PRODUCTION AT THE COOPERATIVE



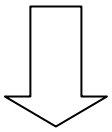
HARVEST
THE GROUPS SET OUT TO THE FISHING FIELDS WHICH MAY BE AS FAR AWAY AS OECUSSI OR NEARBY FISHING GROUNDS AND THE TRIP MAY LAST SEVERAL DAYS DEPENDING ON THE MELT RATE OF THE ICE AND THE HARVEST.



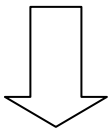
CHILLING
THE CATCH IS CHILLED IMMEDIATELY AFTER HARVEST, HOWEVER WITHOUT USING PROPER FISH HANDLING TECHNIQUES CONSISTING IN GUTTING AND CLEANING OF THE CATCH.



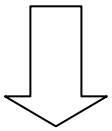
COLD CHAIN START
THE STARTING POINT OF THE COLD CHAIN IS INITIATED ABOARD THE FISHING VESSEL, WHERE THE CATCH IS ICED USING CHUNKS OF BLOCK ICE AND THE DIRECT ICING METHOD.



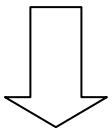
TRANSPORT
THE CATCH IS AFTER HARVEST AND TRANSPORTED BY SEA, PRINCIPALLY TO DILI AFTER THE END OF THE CAMPAIGN FOR SALE. THE COLD CHAIN INTEGRITY IS FREQUENTLY COMPROMISED DUE TO RESTRICTIONS IN THE AVAILABILITY OF ICE IN QUANTITY
FREQUENTLY THE COLD CHAIN IS BROKEN DUE TO INSUFFICIENT AMOUNTS OF ICE WITH THE FRESH FISH AND THE CATCH IS NOT SUITABLE FOR HUMAN CONSUMPTION. IN SOME OF THESE CASES THE CATCH WOULD STILL HAVE BEEN CATAGORIZED AS FIT FOR HUMAN CONSUMPTION PROVIDED PROPER FISH HANDLING TECHNIQUES HAD BEEN TIMELY APPLIED, ESPECIFICALLY GUTTING



HANDLING
THE CATCH IS HANDLED EITHER INDUVIDUALLY OR IN BINS OR DRUMS FROM THE VESSEL TO THE SHORESIDE MARKETS FOR SALE



SALE
THE SALE OF CATCH IS EFFECTUATED BY MEMBERS OF THE GROUP, WHILE OTHERS PROCURE ICE AND OTHER NECESSITIES FOR THE RETURN TRIP TO ATAURO



PREPARATION
THE ICE/CATCH STORAGE COMPARTMENT IS CLEANED IN PREPARATION FOR STORAGE OF PROCURED ICE FROM SMALL SCALE MANUFACTURERS IN DILI

DIAGRAM 01 TYPICAL COLD CHAIN PROCEDURE FOR ATAURO COOPERATIVE

2.3 Current ice production in Timor-Leste

The plastic bags are filled with water from the drums and placed inside a domestic chest freezer for freezing.

The photo below shows a typical small-scale home industry for making ice.

Fish and ice stored together inside a domestic chest freezer.

The current ice production is basically a home industry, where ice is produced from public tap water. The water is frozen inside plastic freezer bags, which are stored inside a chest freezer until frozen. The ice produced is classified as block ice with an average size ranging from 0.3 up to 1.0 kg each.

Ice can be purchased in some general merchandise stores from display chest freezers and also by individuals, whom have invested in this informal business activity.

The fish traders, also called middlemen, are in some cases better organized. Some have seen the benefits from establishing the cold chain by using ice. The catch handling is still not perfected and gutting is still not introduced.

Some traders/middlemen have invested in a bank of chest freezers for this purpose.

This is also the case for the progressive cooperative at Atauro, in fact the only real fishers centre in TL, where solar panels and inverter technology powers normal domestic chest freezers to produce ice for their fisheries activity. The co operative is producing ice, albeit not to sufficient to cover the ice requirements, but has to rely on available supplements from purchases from the informal sector in Dili in combination with their sales of the catch.

Some middlemen are using small trucks for collecting the catch from previously contracted fishers and they often have their own production of ice, again consisting of a bank of domestic chest freezers and may top up their ice needs by purchasing additional ice from the informal market, depending on the amount of catch there is available and the local ice sales market

supply situation.

The smaller middlemen, which generally operate at sub district level are not using ice and also principally sell the surplus low cash value species such as sardines, needlefish, mackerel and flying fish. This group generally distributes their products using motorbikes or bicycle for transport.

2.4 Water used for domestic ice production

In the city of Dili the informal ice producers generally use tap water for ice production. This water can be considered a trusted source, deriving from the municipal water reticulation system. The water capitation is done from the mountain water sheds and consists of rain water and condensate. The Dili water quality from the above mentioned source is periodically is tested for bacteriology and chemical contamination by NDWS, the competent authority. This institution has a full first world equipped water analysis laboratory in daily use by the NDWS for routine water quality control nationwide.

The water quality is also monitored periodically at district level in coordination with the above mentioned national laboratory and the treatment and conditioning of the public water is ordered, when it is deemed necessary by the competent authority, based on the results of the periodically analyzed water.

The frequency of sampling is increased during the wet season, where chlorination is the most frequent conditioning used to maintain the drinking water quality within safe limits for human consumption.

3. SURVEYS & TECHNICAL ASSESSMENT OF THE LOTAS DE PESCA

The terms of reference points 3 through 7 includes conducting surveys and collecting technical, human resource and other related fisheries data for determining the most appropriate technical solution to the establishment of a cold chain from the Lotas de Pesca data from each of the 9 Lotas de Pesca by introducing hygienically produced ice. In addition, the Com Fisheries port, the Teno quality control laboratory and the AECID supported Baucau villa located fish processing plant were included in the work plan. The work was conducted during a period of 8 weeks, where the all sites were visited and interviews were carried out with the stakeholders invited by the NDFA through contacts made by the FAO – NPO.

3.1 Survey methodology

The surveys were performed with the character of a small scale feasibility study for each LdP to gather the necessary information. To facilitate the field work and data collection and compile it in an organized manner, a form was produced for recording the local data obtained.

Please refer to the annexure section, annexes 1 through 14 for detailed information on the LdP site surveys. The completed forms are compiled in a file format, of which a copy will serve as a quick reference guide for updating the actual status of the site and their use and acceptance stored at the FAO office at NDFA in Dili another is available under volume 2 to this report for further reference. Each technical evaluation topic was given a numeric score on the form in order to make a qualified evaluation of the site.

Based on the subjective evaluation of the FAO –IC, a parameter meeting the requirement scores 5 points and the unacceptable score 0 points. Any other encountered circumstance or explanation would release an in-between 5 to 0 score, subjectively observed.

3.2 LdP technical assessment surveys

The focus of the survey and technical assessment was made on following topics:

- Water quality and quantity,
- Electricity supply,
- Access road condition,
- Site location seen in relation the concentration of the majority of fishers, actively involved with the small scale fisheries.
- Other data was also recorded for providing a broader perception of the issues of management of the centers and identifying possible use of the investment made.

The inspected Lotas de Pesca infrastructures are identical in design. There were noted minor differences in the choice of construction materials.

3.3 Survey and technical assessment of each inspected facility

In order for the reader of this report to get a general overview of the de facto situation at the time of the technical assessment the information describing the situation at each LdP is compiled in a table format as illustrated in the following.

3.3.1 Liquica

PHOTO 01 LIQUICA LDP

LIQUIÇA – Villa Lota de Pesca	
Parameters	Value
Water	Operative
Electricity	Public supply
Location of Lota de Pesca	Excellent
Logistics issues of Lota de Pesca	Excellent
Fisheries data from Lota de Pescas	Good
Market and community data	Good
Total evaluation %	82.5 %
Recommended use of the facility:	
Ice supply from NDFA central ice factory and catch collection /training center. Alternatively own ice production and storage in domestic chest freezers.	

TABLE 01 SURVEY RESULTS FOR LIQUIÇA LDP

3.3.2 Bobonaro -Atabae

PHOTO 02 ATABAE LDP

BOBONARO – Atabae Lota de Pesca	
Parameters	Value
Water	No water
Electricity	No electricity
Location of Lota de Pesca	Unacceptable
Logistics issues of Lota de Pesca	Acceptable
Fisheries data from Lota de Pescas	Good
Market and community data	Good
Total evaluation %	52.6 %
Recommended use of the facility:	
No potable water on site. Ne electricity on site.	

TABLE 02 SURVEY RESULTS FOR ATABAE LDP

3.3.3 Suai - Loro

PHOTO 03 SUAI LDP

SUAI - Loro Lota de Pesca	
Parameters	Value
Water	Poor water
Electricity	No electricity
Location of Lota de Pesca	Unacceptable
Logistics issues of Lota de Pesca	Unacceptable
Fisheries data from Lota de Pescas	Poor
Market and community data	Poor
Total evaluation %	32.8 %
Recommended use of the facility:	
<u>Discontinuation of direct support</u> No potable water on site. No electricity on site. Boat building facility for fiber glass vessels	

TABLE 03 SURVEY RESULTS FOR SUAI LDP

3.3.4 Same Betano

PHOTO 04 SAME LDP

SAME – Betano Lota de Pesca	
Parameters	Value
Water	Poor
Electricity	No elecricity
Location of Lota de Pesca	Fair
Logistics issues of Lota de Pesca	Good
Fisheries data from Lota de Pescas	Good
Market and community data	Good
Total evaluation %	58.1 %
Recommended use of the facility:	
No water or electricity on site. NDFA catch collection and training center	

TABLE 04 SURVEY RESULTS FOR SAME LDP

3.3.5 Com Fisheries Port

PHOTO 05 COM FISHERIES PORT

COM – Fisheries port	
Parameters	Value
Water	Excellent
Electricity	Excellent
Location	Excellent
Logistics issues	Very good
Fisheries data	Very good
Market and community data	Very good
Total evaluation %	61.3 %
Recommended use of the facility:	
Industrial, semi-industrial and small scale fisheries port. NDFA ice depot / catch collection and training center. Own ice production and storage in domestic chest freezers	

TABLE 05 SURVEY DATA FOR COM FISHERIES PORT

3.3.6 Viqueque

PHOTO 06 VIQUEQUE LDP

VIQUEQUE – Baturek Lota de Pesca	
Parameters	Value
Water	Poor
Electricity	No electricity
Location of Lota de Pesca	Poor
Logistics issues of Lota de Pesca	Poor
Fisheries data from Lota de Pescas	Good
Market and community data	Good
Total evaluation %	52.8 %
Recommended use of the facility:	
No water or electricity on site. NDFA catch collection and training center	

TABLE 06 SURVEY RESULTS FOR VIQUEQUE LDP

3.3.7 BAUCAU - Vemase

PHOTO 07 BAUCAU LDP

BAUCAU – Vemasse Lota de Pesca	
Parameters	Value
Water	Good
Electricity	Not installed
Location of Lota de Pesca	Excellent
Logistics issues of Lota de Pesca	Excellent
Fisheries data from Lota de Pescas	Very good
Market and community data	Very good
Total evaluation %	66.8 %
Recommended use of the facility:	
Water and electricity in proximity of Ldp applications for connection are made. NDFA central ice factory and catch collection and training center	

TABLE 07 SURVEY RESULTS FOR BAUCAU Vemasse LDP

3.3.8 Manututo

PHOTO 08 MANUTUTO LDP

MANUTUTO – Balak Lota de Pesca	
Parameters	Value
Water	Unacceptable
Electricity	No electricity
Location of Lota de Pesca	Unacceptable
Logistics issues of Lota de Pesca	Unacceptable
Fisheries data from Lota de Pescas	Poor
Market and community data	Poor
Total evaluation %	53.7 %
Recommended use of the facility:	
No further direct LdP support recommended. Selection of alternate site in proximity of Manututo villa due to the number of clients	

TABLE 08 SURVEY RESULTS FOR MANUTUTO LDP

3.3.9 Oecussi

PHOTO 09 OECUSSI LDP

OECUSSI – Lota de Pesca	
Parameters	Value
Water	Excellent
Electricity	Excellent
Location of Lota de Pesca	Excellent
Logistics issues of Lota de Pesca	Very good
Fisheries data from Lota de Pescas	Good
Market and community data	Good
Total evaluation %	79.7 %
Recommended use of the facility:	
Own ice production with storage in chest freezers. NDFA catch collection and training center	

TABLE 09 SURVEY RESULTS FOR OECUSSI LDP

3.3.10 Atauro

PHOTO 10 ATAURO LDP

ATAURO – Vikele Lota de Pesca	
Parameters	Value
Water	Poor
Electricity	No electricity
Location of Lota de Pesca	Acceptable
Logistics issues of Lota de Pesca	Poor
Fisheries data from Lota de Pescas	Fair
Market and community data	Fair
Total evaluation %	63.0 %
Recommended use of the facility:	
No electricity on site. Water supply disconnected. NDFA marine repair workshop and training center utilization option	

TABLE 10 SURVEY RESULTS FOR ATAURO LDP

3.3.11 Tai Besi fish market

PHOTO 11 TAI BESI FISH MARKET

TAI BESI –Fish market	
Parameters	Value
Water	No water
Electricity	Public supply
Location	Very good
Logistics issues	Very good
Market and community data	Very good
Total evaluation %	56.1 %
Recommended use of the facility:	
NDFA central ice factory, potential auction complex and training center	

TABLE 11 SURVEY RESULTS FOR TAI BESI FISH MARKET

3.3.12 Bidau Fish Market

PHOTO 12 BIDAU FISH MARKET

BIDAU – Santa Cruz Fish Market	
Parameters	Value
Water	Not connected
Electricity	Not connected
Location of market	Good
Logistics issues of market	Very good
Fisheries data from market	Poor
Market and community data	Poor
Total evaluation %	71.1 %
Recommended use of the facility:	
Dedicated fish market and ice & catch storage facility	

TABLE 12 SURVEY DATA FOR BIDAU FISH MARKET

3.3.13 Baucau processing plant

PHOTO 13 BAUCAU FISH PROCESSING PLANT

BAUCAU – Fish processing plant	
Parameters	Value
Water	Connected
Electricity	Connected
Location of processing plant	Good
Logistics issues of processing plant	Good
Fisheries data	Under elaboration
Market and community data	Under eleboration
Total evaluation %	84.0 %
Recommended use of the facility:	
EU licensed fish processing plant	

TABLE 13 SURVEY RESULTS FOR BAUCAU FISH PROCESSING PLANT

3.3.14 Teno Fisheries quality control laboratory

PHOTO 14 TENO FISHERIES QC LABORATORY

TENO – Quality control laboratory	
Parameters	Value
Water	Connected
Electricity	Not connected
Location	Good
Logistics issues	Depentent
Fisheries data	Poor
Market and community data	Poor
Total evaluation %	51.2 %
Recommended use of the facility:	
NDFA central fisheries quality control laboratory and joint venture training center	

TABLE 14 SURVEY RESULT FOR TENO QC LABORATORY

3.4 Summary of surveys

The construction of the Lotas de Pesca is not completed in general with respect to establishing operational conditions. However, most importantly:

- The lay- out of the structures bears no clear sign of what the intended purposes are of the building. Specifically, what activities the premises should host.
- The approximate number of persons, who would be using the facility, in terms of sanitary facilities etc, is not clear.
- The premises and compound is not fenced, meaning free roaming animals enter into the buildings, defecating and causing large breaches to the production hygiene.
- The design flaws are not only limited to the unsafe water supply and lack of stable public electric supply, but also to selection of construction materials, such as GMS pipes and use of wall tiles on floor surfaces.
- The solar panel electrical supply system is in principle a proven, known and reliable technology, however the actual dimensioning of the system with respect to demand for

electric energy was not carried out correctly, leaving the premises in some cases without any possibility for operation of the shallow well pump for water supply to the installations.

- The access road condition is another issue, which will be very costly to rectify at Manututo and at Suai Loro, whereas the access situation in Viqueque has reportedly improved vastly and will improve further in nearby future due to on-going repairs.

3. 5 Recommended discontinuation of support to Lotas de Pesca.

Referring to the terms of reference point 9, regarding assessment of the Lotas de Pesca, where it would be un-economical to produce ice, the below mentioned locations are at present considered non-viable locations:

3.5.1 Manututo – Balak

This site is recommended to be discontinued for support due to access road deficiency, required to establish approximately 1100 meters new erosion proof road, electricity and potable water supply. Further, there exists an identical, abandoned structure from the Indonesian era next to the new building, which should have been a clear signal to not start construction at this location of the new Lotas de Pesca.

3.5.2 Suai - Loro

This site is recommended for discontinuation of support due to access road deficiency, required to establish approximately 1500 meters new erosion proof road, electricity and potable water supply.

3.5.3 Set-back for these locations

There is not any significant number of fishers, less than 10 families, in the proximity of these 02 installations. Further support for these infrastructures is therefore not recommended. It is recommended to find an alternative use for these as further investment at the present is not recommended for viability reasons.

3.6 Recommended support model for the Lotas de Pesca

Instead of giving dedicated support to each individual Lota de Pesca, which even under the best of cases would serve less than 30 % of the fishers at the sub district level, it is recommended to NDFA to adopt a different support model for supply of hygienic produced ice to the target group.

The recommended model consists of 4 key elements:

- Central ice production at a location where there are reliable public utility systems already in place and is close to the existing road system.
- Sub-district and district level based ice and catch storage facility / depots with a selected strategic location, where it will benefit the largest number of potential users, close to routes of public transport.
- Utilize existing infrastructure for road transport and ferry service to distribute the ice and surplus catch.

- At Oecussi and Liquiça Lotas de Pesca, can if desired, immediately be supported by installation of 02 x ice machines SCOTCHMAN MV 600 with large size, 05 off 360 liters chest freezer storage space for buffer production, all equipment to be backed up with a diesel generator.

The premises could alternatively be used as Marine Police Rescue Stations or Fisheries Inspection Services Fiscal centers.

3.7 Recommended management model for LdP

This point is specifically mentioned as point 7 in the terms of reference and addressed in the following.

The FAO – IC sensed during the interviews and surveys there are cultural and other local custom aspects involved with the concept of the Lotas de Pesca, for which reason, it is recommended that the installations remain under NDFA control until the situation has become clearer. There is at present no apparent or simple management solution or model, which will uniformly fit all Lotas de Pesca; each will have to be analyzed separately and over time, preferably by a specialist with background in contemporary community and social studies.

The most suitable management structure is therefore very difficult to identify, because management always comes with a price tag. In this particular case, the small scale fisheries sector income generation is in general low and the ad hoc human resource base is extremely limited to meet the requirements for management of the Lotas de Pesca.

Seen in the light that there exists a huge demand for training within the small scale fisheries sector, the facilities in most places could be used for future, programmed NDFA training, where the local fishers and interested groups are invited in turn to participate in NDFA course activities.

The Lotas de Pesca in general are ideally suited for use as general training centers, maritime mechanical workshops, some as community fisheries centers, common activities, which through serving a larger number of fishers, could gain an enhanced degree of acceptance by the community.

At present at none of the Lotas de Pesca has there appeared any person or cooperatives with visions and apparent skills to manage such a facility.

4. CURRENT SITUATION OF THE TIMOR-LESTE FISHERIES

This section is dedicated to the concerns expressed under TOR points 3 and 4 and provides background data and information on the marine aquatic resource base. Sub point 4.2.1 will provide estimated data for the landings, and fish consumption in Timor-Leste, which is directly responding to the concerns expressed under TOR point 4.

4.1 Status ultimo 2010

At the time of elaborating this report, ultimo 2010, there has been no development of significant amplitude in the TL fisheries situation since the latest FAO- FRLP reports dated 2007 and most recently in 2009. The challenges, which the TL fishers face, remain the same.

4.1.1 Institutional shortcomings

On the institutional level at NDFA the progress is not as advanced as could be wished for. The major hurdle experienced is a top level vision for the fisheries sector and activation of the functionaries and staff at all levels. The major difficulties are seen as lack of skills, both on a technical, as well as on a managerial level and a non-productive personal attitude and spirit towards introduction of changes at the professional and personal level. The registered poor attitude causes frustration amongst the proactive staff members at the divisions of NDFA, with whom the FAO – IC has been in contact.

4.2 Description and findings of the inspected TL fishing fleet

The fisheries fleet in TL consists exclusively of dugout canoes with and without outriggers ranging in length from 3.5 up to 9 meters with very few topping out at approximately 12 meters.

4.2.1 Existing assets

There exist 13 modern designed, larger fiber glass vessels, best classified as semi- industrial fishing vessels with inboard engines and fish holds/bait tanks, located at the island Atauro. These were provided by the Indonesian government in the past occupation era, and is now under the control and ownership of the 02 cooperatives. Out of 13 vessels, only 1 is operative, the remainder of the fleet is found with main engine break downs. This fact is interpreted by the FAO -IC as a sign of lack of trained, skilled human resources, managerial skills on behalf of the vessel owners.

Attempts have been made by NDFA and MAF to have donors supporting the rehabilitation of the vessels, latest reported with contact on behalf of the Thai government, but so far without any result. Even if donor support was granted, it is in all likelihood only a temporary measure, as this will not address the underlying problems, only temporarily remedy a defect.

Provided this fleet was a part of a well managed structure, it would represent a significant improvement on the possibilities of expanding the TL fisheries not only in larger volumes of catch, but also enabling the fisheries in conducting fisheries with other selective fishing gear types utilizing other fish species than at present, with all likelihood performing better and conducting more cost-efficient fisheries.

4.2.2 Fleet renewal initiative launched by MAF for the small scale fisheries sector

The Timor-Leste government has through MAF introduced canoes produced from RPG to the rural areas with a varying degree of success. The vessels are generally in use, but do not really change the situation in which the sector finds itself, because it merely replace a canoe made from wood with one made from fiberglass. The vessel design and operative area is basically the same as using the traditionally designed canoes. Only at Atauro there is seen a different design based on the Indonesian Sulawesi mono hull vessel type.

4.3 Stock assessment and planning of future fisheries

In the opinion of the FAO – IC there should without any further delay be performed fisheries research programs to create a general view of the available marine aquatic resources in Timor-Leste EZ and attempt to determine the TAC for the migrating and stationary species and time their appearance in the Timor-Leste national waters, in order to introduce a planned fisheries, based on the principle of sustainable fisheries.

At this time the most suitable vessel types and present as well as future training needs for, but not limited to:

- Suitable fishing vessel types for Timor-Leste,
- Fishing vessel operation,
- Fishing gear operation and maintenance,
- Marine technical support services,
- Catch handling and
- Establishment of cold chain for the catch.

The above points are easily identified, quantified and qualified in this process and could be addressed in a practical on-hands fashion and a long term vocational education system could be set-up covering the future needs for training in the national Timor-Leste fisheries sector.

At present the vast majority of fishers mainly catch fish using gill net and hand line in the rainy season and spear guns in the dry season.

Alternative fishing gear such as purse seining is seen at one location Manututo and fish trapping at Atauro, but is these are exceptions rather than the rule.

4.4 Lack of database for fisheries

One set back in the FAO –IC investigation and fact finding is that the NDFA, despite having set up offices at district level, does not have a reliable, readily accessible central database, neither with respect to the number of active fishers, nor to the catches landed.

The FAO - IC included this topic in the questionnaire form, which was elaborated as part of the LdP survey work performed. The data is important to dimension the ice requirement at each LdP. After commencing the survey work, it became obvious that the general information, which was provided by the DFOs and Fisheries extension service officers' was somewhat inaccurate, as f. ex., the number of canoes reported did not correspond with the numbers, which could be verified both on land and engaged in active fisheries.

4.4.1 Annual catch estimate

The available, recorded catch data and mass is therefore estimated, because the vast majority of the catch is neither inspected, nor weighted before being traded to the middlemen or used for local consumption.

The average observed daily catch of a fisher is approximately 5 to maximum 10 kgs. The daily catch is generally divided into 2 fractions, the needlefish, sardines, mackerel and flying fish, which is principally entering into the daily diet in the local fisher communities and only sold to middlemen, when the catch is in excess. The 2nd class part of the catch is estimated in a daily catch of 5 – 10.000 kgs.

The second fraction, the cash catch, derives mainly from line and spear fishing. This fraction consists of high cash value species such as snappers, groupers, trevally, sweet lips, caranx, etc. This fraction is almost exclusively reserved for middlemen, trading on the Dili spot market. It is estimated the average daily production, marketing and sale of 1st class fish is approximately 3 - 8.000 kgs in Timor - Leste landed over approximately 180 to 200 days of weather dependent, active fishing. Since there is no current fish export taking place from Timor-Leste, the estimated volume of fish is assumed to be consumed ad hoc.

4.4.2 Registration of catch

The concept of quantifying the catch by weighting is generally not introduced or used in the Timorese fisheries sector. Quantities are measured in buckets of different sizes and cause ample grounds for confusion.

There has already been elaborated catch log books as a result of previous efforts by FAO. These log books are generally not used, because the lay – out is too complicated to use in the day – to – day work for both fishers and fiscals at the fisheries officers at the district level.

During the Lotas de Pesca interviews, the local fishers were not present in representative numbers; however the information collected provides a general overview of the actual and current catch situation, although with a margin for err.

4.4.3 Recommended solution to registration of catch

It is recommended to introduce a far easier manageable solution to collect much needed catch data. If introduced, it becomes the responsibility of the middlemen and traders to obtain a transport permit from the DFO for the purchased catch, prior to transporting it from the sub-district or district level. This form of auto control is practiced in other countries with success, like for instance in Mozambique.

Prior to leaving the district any batch over say 6 kgs must be accompanied by a permit, which is obtained for a symbolic value at the DFO office. This is made public knowledge over a period of say 6 months through public announcement in the mass media and by posters.

Most important in this context is that the catch is quantified in kgs, prior to leaving the district. The price for a permit is symbolic, approximately 1 USD and the key issue is that the lot is inspected in this process and estimated.

If the catch is not accompanied or covered by a permit, it will be confiscated at any police control point and the transporter liable to be fined and in repeated cases conficastion of the vehicle used for the illegal transport.

Due to the fact that the price for the transport permit is so low and independent of the declared quantity to be transported, and is issued in an instant, it is in principle not a major point of importance, inconvenience or concern to the industry and is accepted as small, added cost to be passed on to the consumer.

4.4.4 Estimated annual per capita fish consumption and demand

Fish is a treasured commodity, which is not within the financial means for the general population to consume as frequently as desired.

The average annual consumption of fish per capita is in the region of 2 to 4.0 kgs nationwide, which is very low, but well in line with the general observation and perception of local fish consumption pattern in the capital and larger concentrated areas of population. The constellation of general relatively high fish prices is interpreted as a signal of the market demand for fish has not met the saturation point in the centers of larger populations in Timor-Leste.

The fish consumption is by far higher in the local fisher societies and communities, where fish is consumed almost on a daily basis.

The fish consumption is lower and less frequent in Dili, due to the high market price seen in relation to other available protein sources, such as imported, frozen chicken and meat.

There are non - confirmed signs indicating that the fish spot market in Dili is a controlled business because the sales prices are considerably higher here for the same fish species, as can be found on the nearby Indonesian fish markets, with a factor 2 to 3. This observation leads to the unconfirmed deduction that a non-reported import of high cash value fish species is taking place, possibly from the foreign owned, off-shore fishing fleet and perhaps from the Indonesian fishing fleet operating in the bordering waters. The recent house arrest of 32 foreign fishers on the south coast of Lautem district indicates that this activity might indeed be practiced and is on-going at present.

The interviewed fishers generally comment that the fish stocks are dwindling and the average size as well as the catch volume is becoming steadily smaller.

Another general remark observed was that the fishers in unison reported the local weather pattern is changing, reducing the available number of fishing days with the present available equipment and canoes, which is used for fisheries inside the reef basically.

4.4.5 Increase of fish protein consumption in the TL population

As proteins deriving from marine aquatic species are essential for good growth and mental development in humans from the fetus stage and later throughout the adult life, it is recommended to investigate the possibility of importing affordable, low cost, frozen fish species, such as sea frozen Horse mackerel, which has been done successfully in developing countries in East and West African regions.

Such a political move, would besides from being daring would take away some the strain off the national resources.

This would allow for the aforementioned stock evaluation and following regulations to have a positive effect, before irreversible damages are done to the indigenous fish stock.

It would almost with immediate effect, improve the livelihood of the general population without having significant negative effect on the existing small scale fisheries, which under the normal circumstances would not market their 2nd class fish catch anyway. This postulate is factual, because the buyers in the market for the 1st class fish would typically not purchase fish from the 2nd class fish group. The imported, frozen Horse mackerel would be classified as a 2nd class fish species.

The above recommendation would address the concerns expressed under point 4 under the terms of reference.

4.5 Fisheries support structure in Timor Leste

At present date, the fisheries sector has no firm, formal support structure for developing into an industry.

- There exists not any vocational education available for the fisheries industry.
- There exists no readily available, reliable, large scale, ice supply.
- There exists no dedicated fishing gear/materials stores locally in Timor- Leste; almost every article is imported from principally Indonesia.
- The marine/mechanical repair and maintenance workshop facilities are located almost exclusively in Dili, and are more general than specifically fisheries orientated.
- The only existing fishing port facility available with a potential for development is located in Com, Lautem district, but for unknown reasons the installation is neglected and found in a state of disrepair. (The Com port, was constructed by the Indonesian armed forces, is still today in a reasonable condition and could with minor efforts and investment become an important base for development of the TL fisheries industry.)
- Another facility, albeit in use for the public ferry service at present, is the port of Beloi on Atauro Island, which also could become a central local fisheries port, at a location, where the fisheries forms an integrated part of the existence for the local population.
- A third installation is found at Oecussi, which is a former Japanese army camp used up to approximately 2004, still has a serviceable concrete pier and deep water port facilities. It is also found abandoned and the remaining infrastructure and containers being scavenged and destroyed by unknown parties.

4.6 Future prospects for the TL fishing industry

As mentioned above, there exists no institutional or formal vocational training facility of the fisher. An interviewed, older Indonesian trained fisher explained, quote: "*Any young boy, who borrows a canoe and set out fishing on the reef, and has the luck to catch a fish calls himself a fisher!*" unquote.

In the opinion of the FAO - IC the potential for fisheries in TL is not yet developed fully. Although the current situation seemingly is bleak, it only requires for MAF to demonstrate a positive change in approach, attitude, and declaration of a clear vision for the Timor-Leste fisheries industry to open

the road ahead. This will include utilization of existing assets, new-thinking, investment in human resource development at all levels in both the public and private sector.

The Com fishing port berthing facilities are excellent with + 15 meters water depth alongside the 85 x 15 meter pier surface. The inner port area has the potential for establishing a small fishing craft, with floating piers. The port area could easily host facilities such as, slipway, repair and construction yard facilities, water, fuel and oil storage, cold storage and fish processing facilities. This facility would be the ideal setting for a new era in the TL fisheries sector.

The Oecussi port complex is in an identical state of affairs. The official ownership of this facility could not be clarified by the NDFA representatives during the survey. This installation, which is believed to be the property of the Ministry of Defense, could form an additional base for the future expansion of a diversified fisheries industry in Timor-Leste.

In Dili the commercial port does not allow fishing vessels to operate from their berths, principally due to congestion problems, but the bay area offers other alternatives, which is the existing floating pier located close to the Marine Police Station, which would serve even better than the commercial port for an emerging fishing industry. This installation is found in a poor condition, and requires extensive repairs to the metal structure catwalk and flotation chambers before it can be safely used again.

The south coast of TL will unquestionably soon have its first pier constructed in the Suai or Same area to cater for the new 130 MW heavy fuel oil electrical power station and the emerging oil and gas industry, which of lately has been very active in this part of the nation. This would with all likelihood result in a population migration to this area, due to the jobs generated for the oil and gas industry, which will have a synergy effect on the fisheries sector, provided the MAF is prepared to become an active stake holder in the process by providing a national support base for the small-scale fisheries.

The inshore marine fisheries are today utilized to, if not beyond the sustainable limit, and the need to diversify and use other and larger vessel, to operate off-shore with selective fishing gear is eminent and should be seriously considered. The Timor-Leste fisheries could have an excellent future ahead of it, but a visionary approach and actions from the MAF are required.

4.7 Fish processing

Today there is no other processing taking place in Timor-Leste than occasional drying of surplus catch of smaller fish species. The dried fish is seen as an occasional item at the main market stalls in the larger towns.

There should be seasonal appearance of several of the anchovy species in the Timorese EZ, which when cured and dried are important cash value species at the Far East markets as a high cash value product. The migration of tuna in the Timor-Leste EZ waters could also be exploited sustainable, using modern vessels and shore based fish processing techniques. Fresh, chilled, tuna loins are sought after high cash value produce for selected niche markets. The few attempts of introducing the fish processing industry have been stopped through political influence, thus overruling the basic institutional technical system, which is working on technical factors and clearly defined operational

conditions. The fish processing projects Parkway at Com and the tuna processing plant at Teno are recent examples, according to information provided by the FAO – NPO.

There are other projects on the way, the AECID – Paz Y Desarrollo supported cooperative, located at the villa of Baucau. This project is an example, which has a very good potential of becoming a success story, mainly due to the visionary approach of the cooperative itself, but also due to the close ties with the Spanish NGO, Paz Y Desarrollo and its national NGO for managerial support.

5. ICE TYPES FOR USE IN THE TIMOR LESTE SMALL SCALE FISHERIES

There is a large variety of ice types available to the fishing industry today. The principal types are:

- Block ice,
- Plate ice,
- Scale or flake ice,
- Crush ice,
- Tube ice,
- Cube ice
- Slush or liquid ice
- Dry ice.

In this context dry ice is mentioned, merely to mention its existence and use in the past, but this ice type is neither a viable, nor a feasible option, due to cost of manufacture and the restrictions in use, caused by its composition. Further, the ice type is not available in Timor – Leste.

In order to provide the reader with a general view of the different available ice types and capacities the following text will provide some useful information and guidance.

5.1 Industrial ice production premises conditions

Ice for use in the fisheries industry must be produced under hygienic conditions in premises that are easy to maintain clean and disinfect and covered by a documented production hygiene program. The machines must be designed and approved to the standards set by the competent authority. In the EU the machinery directive provides guidelines of how to design machinery to facilitate the sanitary requirements. The entity responsible for the installation requirements for ice factories and their associate installations, equipment and accessories as well as regular inspection for sanitary and production hygiene control is the NDFA.

5.2 Staff health requirements

The staff must be trained in the operation of the machinery and how to clean this after use or between production batches if required. The staff would be required to possess a clean health attest, which must be renewed every 6 months, showing the carrier is free of contagious diseases. The staff health certificates must be displayed visibly at the administration area for the ice factory, for each person, who has direct access to the ice production and ice production premises, equipment and machinery. The competent authority for the staff health issues is the Ministry of Health.

5.3 Water quality for commercial hygienic ice production

The ice used in the fisheries industry must be produced from water of drinking water quality. The parameters are stipulated by the competent authority, which in the case of Timor - Leste is the NDWS in conjunction with the Ministry of Health. The latter will extract regular samples to monitor and report on the water quality. The former is responsible for the analysis of the extracted samples. The ice factory may choose to perform parallel testing of the water used inside the ice factory for ice production as well as for cleaning at more frequent intervals as part of the auto-control system for the ice factory.

5.4 Electricity supply for hygienic ice production

In order to produce hygienic ice in quantities, which will be useful to the fisher and essential for introducing and maintaining the cold chain, it is necessary to have access to stable, reliable electricity supply. As explained elsewhere in this document, the situation at present is best described as problematic, however with clear signs of improvement over the next couple of years.

Under all circumstances it is necessary to have a back-up or emergency power supply source available in order to avoid costly shut-downs and dysfunctional ice supply situation.

5.5 Different commercially produced ice types used in the fishing industry

TYPE	SHAPE	MASS	SIZE IN USE	CHILLING SYSTEMS
Block	Blocks, cubic, tapered shape	5 to 50 kgs	Approximately 30 x 30 x 30 mm	Chunks for direct or indirect chilling systems
Plate ice	Rectangular bricks	500 to 1000 gram	Broken in bits and chunks of approximately 30 x 30 x 30 mm	Chunks for direct or indirect chilling systems
Tube ice	Cylindrical shaped often found with a hollow core	10 to 50 gram	ND 25 to 40 mm	Direct and indirect chilling systems
Cube ice	Cubic shaped	10 to 30 gram	Directly in cubes of approximately 30 mm	Direct and indirect chilling systems
Crush or nugget ice	Granulate	1 to 10 gram	Approximately ND 5 to 10 mm	Direct chilling systems
Scale or flake ice	Scales or flakes	1 to 10 gram	Flakes of up to 3 mm thickness and 30 x 30 mm	Direct chilling systems
Slush ice	Liquid	Liquid	Liquid	Direct chilling systems aboard ships
Dry ice	Scales or flakes	1 to 10 gram	Directly	Direct chilling systems

Table 15 Ice types used in the fishing industry

The ice types highlighted in the table above are mostly used for fish processing or use close to the end user, because of its quick melt rate.

5.6 Type of ice recommended to be used in the small scale fisheries sector.

5.6.1 Centrally produced block ice

After careful analysis of the advantages and disadvantages of ice types seen in relation to the complexity of impacts and conditions prevailing in this context, the FAO – IC recommends using:

Large size, 10 to 20 kgs, block ice .

- Block ice has the advantages that it can be produced at very low costs.
- Block ice, besides from easily handled, it has a very high mass in relation to the exterior surface area of the block, thus is less susceptible to melting rapidly during transport or handling under less than optimal conditions.
- Further, this type of ice can be stored economically both at central depots, as well as aboard inside the fish holds of a larger fishing vessel.
- When block ice is intended for use, it can be crushed into any desired size using mechanical crushers or manually, thus making this ice type very versatile.

It is an important selection criterion to consider the mechanical construction details of the machinery to be used for producing ice during the observed ad hoc operating conditions. Other factors for determining the type of machinery to be recommended are:

- The existing realities and conditions found at the LdP sites during the recently conducted surveys.
- The performance of the public utility systems at the selected sites.
- The availability of skilled professional human resources at the selected sites.

The photo above shows a FOCUSUN direct freezing block ice machine with a rated 5.000 kgs /24 h production capacity. The machine cabinets are made from stainless steel grade AISI 304, which ensure the easy sanitation and cleaning of the unit.

The photo below shows 20 kilogram ice blocks made in a direct freezing block ice machine manufactured by the company FOCUSUN.

As can be seen from the symetrical shape of the block ice this type of ice stacks well and reduces the requirement for large cold rooms for ice storage.

5.6.2 Cube ice locally produced

Should there be a wish to produce ice at sub district or district level, this is a technically possible option, but such an activity requires formal training over an extended period of time and having access to an operational budget. In most cases the water used would have to be subject to a post capitation treatment to make it safe for human consumption. A proposed lay-out is recommended to be installed as part of the recommended de-centralized depot – ice and catch storage facility as described in further details under annex 15, description of facilities – information for contractors.

The idea would be to set up a bank of identical ice machines to match the estimated daily demand for ice and gradually build up a buffer stock of ice to take into account the few annual peak production days, which have been reported at interviews at all Lotas de Pesca.

Should the demand grow or fall, the number of identical machines and domestic chest freezer storages can be augmented and decreased as required.

5.7 General description of the different types of industrial ice production machines

The text in the following will provide the reader with a general description of the working principles of these different machines for reaching a conclusion on the selection of ice production machinery type.

5.7.1 Block ice machines

Block ice machines are generally constructed as hard wearing, simple, rigid, sturdy mechanical machines with very few electrical/electronic components and moving mechanical parts in their structure. These machines consist of very rustic and simple components, which can withstand years of rough handling.

This type of machine is therefore ideally suited for work in a developing country, where the access to a skilled, vocationally trained human resource base is a problem.

The compressor unit is typically a reciprocal piston compressor type, driven by an electrical motor in an open or a semi- hermetical configuration.

The refrigerant used is either a natural refrigerant or an approved HCFC with a very low environmental impact foot print.

The photo shows an ice factory located in the fisheries port of Thyborøn in Denmark.

The horizontal structure which can be seen on the LH side of the photo is the feeding conveyor which can deliver into the fish holds directly or into the hoppers of a road transport vehicle.

The vessels seen on this photo have a full load of sand eel, which is a fatty fish species caught by trawling predominantly in the North Sea. The fish and ice is pumped ashore using vacuum pumping system

The operation cycle of this type of machine is simple. Potable water is filled into the conically rectangular tapered forms up to approximately 85 % capacity. The filled forms are submerged in a circulated brine solution, cooled by the primary HCHF circuit and frozen, or produced in a direct contact freezing ice machine.

The latter is an improved version of the block ice machine, combining the principles of contact- and air blast freezing.

The block harvest cycle is also relatively simple. The manufactured block forms are exposed to an external heat source, which will cause the formed ice blocks to release the forms. The blocks are removed from the forms and transported either by conveyor or trolley for storage or use.

The storage of ice blocks is very economical because the blocks stack with a very high degree of utilization and reduces the operational cost of the ice store at a minimum, when the space is kept filled.

The block ice machines normally have 2 to 3 production cycles per 24 hours. The production capacity of the machines of this type is from 0.5 MT up to 100 MT/24hours.

5.7.2 Plate ice machines

Plate ice machines are in working principle almost identical to the direct freezing, block ice machine, but have more components incorporated for the harvest mechanism. The machine essentially is a direct contact freezer, which has a much faster cycle time depending on the dimension of the plates manufactured, typically up to 12 cycles per 24 hours. The produced ice only needs to be crushed as is the case of the block ice depending on the intended utilization. The ice does not store as economically as block ice and will require more staff for handling.

The production capacity of the machines of this type is from 0.5 MT up to 100 MT/24hours.

5.7.3 Tube ice machines

Tube ice is a versatile type of ice, which can be used without preparation for both direct chilling or dosed into a CSW system. The production of tube ice is made in shell type, vertically positioned evaporator, fitted with vertically positioned ice production pipes. These pipes are slightly conical with the largest aperture at the bottom part of the evaporator vessel. The refrigerant is admitted at the bottom part of the evaporator and is exposed to the exterior part of the ice production pipes and leaves at the top most part of the evaporator after having removed heat from the ice production pipes.

Water for ice production is circulated from a water tank located below the evaporator shell by a circulation pump which admits the water into the internal area of the vertical ice production pipes. The water is entering the ice production pipes through nozzles to ensure it is flowing correctly into the ice production pipes touching the interior, cold surfaces to form ice. As time progresses, the build-up of ice on the interior surfaces of the ice production pipes increases, and the heat transfer from the ice production pipes become increasingly more difficult. The harvest cycle can either be determined by a refrigeration system signal from a pressure switch or a simple timer function, which will stop the water circulation pump and consequently the water feed. A quick hot gas defrost cycle is initiated, which will cause the ice to spontaneous melt on the interior surfaces of the ice production pipes and the gravity pull of the formed ice will cause it to exit the pipes.

On most tube ice machines the initiation of the defrost cycle also will automatically start a rotary cutter, which consists of a rotating blade, which will cut the long ice rods into shorter and more manageable pieces, which will exit the machine through a harvest plate and be transferred into an ice store by use of either tubs or a conveyor. The ice is normally delivered to the point of use by an auger feeding a conveyor belt, incorporating a weighting cell.

The approximate production capacity of machines of this type is from 10 up to 300 MT/24hours for industrial machines and some smaller capacity machines have been developed for the catering and hospitality industry.

5.7.4 Crush and nugget ice machines Crush or nugget ice is normally used for processing plant, final packing or for display purposes in for example supermarkets. The ice is crushed from block or plate ice in a shredder to the particle size determined by the rotor in the shredder machine. There are also manufactured dedicated ice machines manufacturing this type of ice which are typically small, compact machines, which manufacture plate ice continuously, which is passing through a shredder mechanism for delivery into a hopper. From the dedicated bin/hopper the ice is transferred to the point of utilization. Ice of this type has a tendency to form a crust, which reduces the melt down velocity and extends the service time for the ice. Machines of this type can be found fishing processing industry for in – line processing top up need while raw material is under transformation.

The approximate production capacity of machines of this type is from 100 kgs up to 1.000 kgs/24hour.

5.7.5 Cube ice machines

These machines are normally used in the hospitality and catering business as their capacity is normally relatively small due to the configuration of the evaporator.

The photo shows a typical example of a cube ice machine. This one is used and

The photo above shows large scale ice machine manufactures by the Danish company BUUS A/S

The photo above shows the produced cube ice inside the storage bin.

Cube ice ready for use.

A larger production rate can be achieved by combining the plate ice machine with a mould for the desired size of cubes.

The machines are relatively compact and complex of structure and require regular, specialized service by a trained technician.

The machinery has incorporated electronic controllers and circuit boards and electric solenoid valves, which makes the machines vulnerable to fluctuations above of ± 10 % of the supply voltage.

The machines are widely popular due to their compact design and relative low acquisition pricing.

Machines of this type are not customary to find in the fishing industry.

The approximate production capacity of machines of this type is from 100 kgs up to 1.000 kgs/24hours in the catering industry, but can if utilized in combination with the above described plate ice machines, vastly increase the production capacity.

5.7.6 Scale or flake ice machines

The scale /flake ice machines use a rotating cylinder for forming ice. The water is applied to the cold cylindrical shaped evaporator either by spray or by partially submersion into a water tank. A mechanically adjustable blade or chippers will remove the crust of ice in flakes or scales of adjustable thickness and size.

This type of machine normally requires water conditioning with addition of small quantities of salt in order for the ice to break cleanly from the evaporator surfaces.

The scale ice machine has 2 mechanical seals for retaining the refrigerant in the system, as well as a reduction geared drive mechanism for the rotating evaporator, which are vulnerable components.

Machines of this type require daily checks and possibly adjustments to produce optimally, but are flexible in use in the sense their production starts within moments after starting the machine.

With additional machinery it is possible to press the formed scale/flake ice into block ice, which are semi/solid in consistency and has the advantage that a block can easily be broken into smaller chunks for application. The scale ice is used widely where one needs a fast drop of temperature either as direct chilling or in a CSW system due to the relative large surface area and the low mass. It is frequently used for packing of end customer final products for refrigerated road transport. The machines are customary to find in the fishing industry.

The scale ice is often pressed into blocks for ease of transport and space savings during storage. These blocks are easy to break into smaller parts, when ready to use

The approximate production capacity of machines of this type is from 500 kgs up to 60 MT/24hours.

5.7.7 Slush ice machines

These machines are generally used aboard industrial and semi-industrial sized fishing vessels, where the catch is typically gutted after harvest or in the case of the catch being smaller specimen, placed in a tub, where after the slush or slurry is pumped through a hose and dispersed directly on the catch.

Due to the sub-zero temperature of the slush-slurry the temperature drop in the catch is almost instant because the entire opened meat tissue of the catch is exposed to the liquid ice. The machine works with a heat exchanger, consisting of a double pipe spiral, where sea water is pumped in at the lower end and inner pipe and the liquid refrigerant administered at this location to the outer pipe for cooling the water below zero degrees Celsius. The flow rate of the water is controlled by a valve located in a handle at the end of the hose, which receives the slush-slurry ice from the evaporator under pressure.

The technology is approximately 15 years old and is principally used aboard fishing ships.

5.7.8 Ice from solar operated adsorption ice makers

The general low production rate of ice generated from these machines, typically approximately 50 kgs/24h, in conjunction with the relatively hazardous refrigerant liquid mixture used are the principal reasons for not pursuing this method.

The machines are relatively simple in design and would, even on an overcast day generate ice. This type of machine would work anywhere, provided access to sunlight, albeit expensive in acquisition costs. The Chinese refrigeration industry is making great advances on research using the vacuum tube technology, but there are not any commercial solutions available yet, which would satisfy the project demand for a stable, hygienic ice production from this type of machine at present.

5.7.9 Dry ice

The dry ice is normally only available, where there are large fermentation processes occurring and/ or where there are large amounts of CO_2 is available from another industrial process such as oxygen

production for welding gas etc. The CO_2 gas is compressed and condensed. During exposure to normal atmospheric conditions in the liquid form and under controlled fabrication facilities, the CO_2 transforms into the solid state instantly. The dry ice is solid at approximate - 60 ^{o}C, for which reason it can absorb heat from any source rapidly, returning into the gaseous state and is bled off to the surrounding environment. CO_2 liquid under pressure is seen as an alternative for road transport, where the trailers used must meet very stringent noise level requirements and where the storage / transport time is counted in hours. Cryogenic transport of perishable product is used principally in city zones, where there exist stringent regulations for sound emission from refrigerated trucks, etc.

This type of ice is very expensive and not considered a viable option in this context.

5.8 Comparison of ice making machines

The solar energy principle has not yet been perfected to comprise machines with a production capacity required to satisfy the demand situation. These machines are generally costly and operate with refrigerant mixtures, if leaking could cause severe risks to the human body. If the technical development had been more advanced this type of ice machine would have been an obvious choice.

The table in the following summarizes the text above to form an overview of the different ice machines and properties of the ice these produce and how ice types may be applied in the small scale fisheries sector.

Type of ice	Production capacity & sizes	Ice production cost	Acquisition costs
Block/plate ice	Absorption machines with a production of approximately 50 kgs/24h.	Low > 0.010 USD/kg	High
Block ice	Small 0.3 MT to industrial size plants up to 100 MT/24h. Compact design.	Low > 0.030 USD/kg	Low
Plate ice	Small to industrial size plants. Absorption machines	Low > 0.030 USD/kg	Low
Crush or nugget ice	From block ice or small machines up to 5 MT/24h	Low to medium >0.040 USD/kg	Medium
Tube ice	From small to industrial size plants up to 100 MT/24h	Low to medium > 0.040 USD/kg	Low to medium
Cube ice	From small to industrial size plant	Low to medium > 0.040 USD/kg	Low to medium
Scale /flake ice	Small to industrial size plants	Low to medium > 0.040 USD/kg	Medium
Slush ice	Small to medium size machines	Medium to high > 0.060 USD/kg	High
Dry ice	Medium to large industrial size machines	High≤ 1.00 USD	High

Table 16 Types of ice machines

As previously mentioned such block ice machines are already available in Timor-Leste and their availability to the NDFA, MAF is under negotiation at present.

For the sake of completeness of this report, the contacted contractors have been asked to include the pricing of ice production equipment in their quotations as part of the terms of reference listed as point 13.

6. RECOMMENDED SOLUTION FOR HYGIENIC ICE SUPPLY TO THE SMALL SCALE FISHERIES SECTOR

6.1 Recommended concept for hygienic ice supply to the TL fisheries sector

This feasibility study report will focus on the hygienic ice production and distribution, presented in 5different options:

6.1.1 Option 01 – Centralized hygienic ice production with existing machinery

Availability of the 04 block ice production machinery from MED and MTCI. The equipment is installed and supported by 04 depot support structures and additionally 4 double cold rooms and vehicles at district level to meet the demand for production and distribution of hygienic produced ice. The new infrastructure will contain adequate sanitary installations for staff at the ice factories and depots.

6.1.2 Option 02 - Centralized hygienic ice production with purchased machinery

Project purchase of ice production machinery, combined with complementary depot support structure and as described in point 6.1.1 above.

6.1.3 Option 03 – Small scale decentralized ice factories with local transport

Project purchase of small scale decentralized ice machines to be installed at the recommended depot support structures to produce the demand for hygienic produced ice. The infrastructures will contain adequate sanitary installations for staff at the combined ice factories and depots. The ice factories are to be provided with optional refrigerated trucks for local ice distribution to the fisher's centers at sub district level.

6.1.4 Option 04 – Small scale decentralized ice factories with local transport

As per point 6.1.3 above, but without the local transport option available.

6.1.5 Option 05 - Small scale decentralized ice factories without local transport

At Liquiça and Oecussi LdP there exist conditions permitting local ice production with storage of ice in domestic chest freezers. The water is to be treated with chlorine supplied by an electronic dosage pump working with the ice machines. The proximity to the fishers and the landing site negate the need for local transport , as the Lotas de Pesca are centrally located and there exist local transport in the area.

6.2 Description of recommended solution for supply of hygienic produced ice

The recommended option 01 consists of installing 2 central ice factories, one in Dili and the other in Baucau. The ice is then transported by road to either the ferry for maritime transport to Oecussi or Atauro depots or by road to the district depots.

6.2.1 Transport logistics

The ice is delivered by combined road and sea transport in large insulated tubs to the Oecussi and Atauro destinations and by road transport to the remainders and inside Dili and Baucau districts.

This concept is the most practical and cost efficient manner in which the majority of the TL small scale fisheries sector rapidly and cost efficiently can have access to sufficient, hygienically produced ice. The produced ice is distributed to district level ice and catch depot facilities at:

- Atauro, by scheduled ferry service
- Oecussi, local production or optionally by scheduled ferry service
- Bobonaro, by refrigerated road transport
- Liquiça, local production or optionally by refrigerated road transport
- Lautem, by refrigerated road transport
- Viqueque, by refrigerated road transport
- Same, by refrigerated road transport
- Suai, by refrigerated road transport.

6.2.2 Central ice factories proposed lay-out

Each factory is proposed to have 2 identical machines installed and have dedicated large volume ice storages provided as part of the premises to allow for sudden peak loads from unexpected high catches or buffer supply for shut –down periods for maintenance and repair without causing any inconvenience to the client base. The equipment and costing is available under section 7 and 8 in the following.

6.2.3 De-centralized depots for ice and catch

In each coastal district at sub/district level, it is recommended using factual feasibility study criterion on location of the recommended facilities to benefit the largest number of fishers, rather than focusing on the LdP locations. At Oecussi and Liquiça the LdP can be utilized as described in under point 6.1.5. Selection criteria are:

- Location in proximity to fisher landing sites, achieved in positive and proactive dialogue with the fishers in the area,
- Verify the access road system is in a good condition and with established public transport system available,
- Verify the access to public utilities system, that these are working and that the future will have a supply situation covering 24/24h.

6.3 Pilot project for simulation of recommended concept

In order to collect data necessary to make budgets and cost calculations it was decided at a meeting with the director of NDFA on October 06, 201 to launch a pilot project to confirm the above concept and also to train the NDFA staff in preparation for the conduct of business in the large scale nationwide project.

This project was launched on week 45 and completed on week 46. MTCI and MED was kept briefed on the developments and lessons learned from the exercise. It was established that the NDFA staff could produce ice and to a certain point maintain interest in the project activities, but that the attitude towards the activity was initially negative amongst the trained operators. The cube ice machine installed produced ice for the use during the pilot project on hygienic ice production and distribution launched during November month 2010. The ice production was calculated at

approximately 7 kgs ice per hour and was initiated on November 9, 2010 at 16.00h LT and terminated on November 23, 2010 at 08.00 h LT. The machine was in operation for approximately 304 hours of which 30 were on diesel generator supply and approximately 10 % down time was recorded.

The general shortcoming of the machine was related to its dependency on electrical power for operation, in other aspect the machine functioned in automatic mode without any abnormalities observed.

The total production could not be ascertained as the requisitioned equipment did not arrive timely for use during the pilot project and only became available after the conclusion of the pilot project activities. The estimated production amounted to 4.000 kgs.

The electricity consumption was registered to approximately1.2 kW/h for the ice machine and an additional 0.4 kW/h for the water pressure booster pump. The storage container used for ice storage has a recorded supply of 2.5 kW/h and was operative for approximately 275 hours.

Price for NDFA locally produced cube ice is calculated in USD 0.068/kg without distribution costs.

The distribution costs were estimated in USD 0.098/kg, ∑ costs: USD 0.166/kg

Please refer annex 21 for further details in the monitoring and evaluation carried out after terminating the pilot project.

7. FINANCIAL ASPECTS OF HYGIENIC ICE PRODUCTION

7.1 Cost calculation assumptions

The cost calculations are based on a number of assumptions, known charges, taxes, costs and levies which affects the costs and operation of the project.

It must be expected that the prices for infrastructure, equipment and machinery listed for the project will alter from the time of submitting this report, until the project is approved.

For this purpose, and also covering the elements of terms of reference point 8, 10, 12 & 13 a document with accompanying sketches and listed equipment was prepared by the FAO - IC, and submitted to a number of local contractors. The document describes in details the envisaged options for the infrastructure needs and for equipment and machinery to make each district autonomous with respect to ice supply to the small scale fisheries sector.

Seen in the light of gained experiences, the nature of the project is to have each facility treated as a turn-key plant project, where the contractor is paid on a milestone performance basis and where the technical training is part of the package deal, because each individual plant is comprised by a guarantee.

In order to provide a decision base assumptions for the investment and for the operation have been made in order to determine the de facto price to the fisher for the hygienically produced ice.

7.1.1 Investment costs assumptions ultimo 2010

Investment assumptions	
1	It is assumed the 04 existing ice factories from MTCI / MED can be made available alternatively purchased at unit cost CIF Dili TL @ ± 42.000 USD each
2	It is assumed the installation costs, tests and commissioning of the 04 ice factories are estimated in additionally 24.000,00 USD
3	It is assumed that the 4 ice storage containers from MTCI / MED can be made available and deployed at the central ice factories.
4	It is assumed the 06 refrigerated distribution vehicles can be transferred from MTCI / MED to the project for ice distribution purposes.
5	It is assumed that the 06 refrigerated distribution vehicles can be procured for ±40.000 USD each, if the vehicles from MTCI / MED are not available.
6	It is assumed the district level located ice/catch depot infrastructure can be procured, installed, tested and commissioned for 88.000,00 USD each.
7	It is assumed the Timor-Leste government will provide land for the depots at district level

TABLE 17 INVESTMENT COST ASSUMPTIONS FOR HYGIENIC ICE PRODUCTION

7.1.2 Operational costs assumptions ultimo 2010

Operational assumptions	
1	It is assumed the ice production will covered by 3 block ice machines with a 3892 kgs daily production capacity operative in 2 cycles per 24 hours ± 125 days per year.
2	It is assumed that the entire ice production will be consumed.
3	It is assumed the ice production is taking place 10 to 11 days per month.
4	It is assumed the ice demand will remain stable at 1,900,000 kg per year in average
5	It is assumed the energy consumption is for each block ice unit is 18.0 kW / hour.
6	It is assumed the auxiliary electric load for each ice factory is 3.5 kW / hour 30 days per month per year.
7	It is assumed the average electric load for each depot is 2.5 kW/hour 30 days per month per year.
8	It is assumed the average load for each depot with own ice production is 8.5 kW/hour 30 days per month per

	year.
9	It is assumed the electricity costs will remain unchanged at 0.24 USD/kWh or not rise above 5 % per year.
10	It is assumed the diesel oil price will remain stable at 0.92 USD/ l or not rise above 5 % per year.
11	It is assumed that the prices of other consumable items such as detergents, disinfectants etc., will remain unchanged or not rise above 5 % per year.
12	It is assumed that the light truck will consume 1 liter diesel oil per every 6.0 km.
13	It is assumed that the average vehicle maintenance cost is 18 % of the fuel consumption costs.
14	It is assumed that a new refrigerated truck costs 40.000 USD and has a technical lifespan of 6 years.
15	It is assumed the truck will leave with a full load of ice ± 1.500 kg per trip.
16	It is assumed each truck will make 4 delivery round trips per week each averaging 320 km.
17	It is assumed that the staff will be appointed by NDFA, MAF and have a suitable technical background for receiving training to operate and maintain the ice factories and auxiliary machinery and equipment.
18	It is assumed the NDFA ice production at some period will be outsourced or contracted out to a private sector company in order not to place NDFA into a situation of conflicting interests with respect to the legislation.
19	It is assumed the hygienic ice production is a non-profit operation, based at providing the small scale fisheries sector with ice in order to introduce the cold chain from harvest through to the consumer or processor.

TABLE 18 OPERATIONAL ASSUMPTIONS FOR HYGIENIC ICE PRODUCTION

In case the hygienic ice production will be privatized there are several ways of formulating the contract between the parties, in order to guarantee the level of service to the NDFA clients is maintained.

With reference to point 6.2 where the recommended set-up is described in detail, the calculations, which are shown in annex 15 for further reference shows that the hygienic ice is available to the fishers based on above assumptions and current information.

7.2 Calculations for option 01- centralized hygienic ice production

OPTION 01 – CENTRAL ICE PRODUCTION WITH DEPOT SERVICE & NO LOCAL DISTRIBUTION			
DESCRIPTION OF PRODUCTION COSTS	QUANTITY	UNIT COST	SUM
Average annual electricity consumption 04 machines for 125 days and 08 ice depot storages for 200 days	331,200	0.24	79,488.00
Average annual water costs, cum	2,500	0.60	1,500.00
Average annual plant maintenance costs	12	500.00	6,000.00
Average annual operator salaries	12	3,600.00	43,200.00
Average annual fuel costs for ice distribution	40,000	0.15	6,000.00
Average annual fuel cost generator operation	100	20.00	2,000.00
Average annual vehicle maintenance	36,000	0.18	6,480.00
Average annual driver costs	06	3,600.00	21,600.00
Average annual communication expenses	10	100.00	1,000.00
Average annual administration and auditing costs	01	5,000.00	5,000.00
Annual ice production and storage costs			172,268.00
Annual average ice production in kgs 125 days @3892 kgs from 04 machines	1,946,000		
Average cost of hygienic produced ice delivered to any district depot			**USD 0.089**

TABLE 19 OPTION 01 BREAK DOWN OF COSTS

7.3 Calculations option 02- decentralized hygienic ice production with local distribution

OPTION 02 – CENTRAL ICE PRODUCTION WITH DEPOT SERVICE & LOCAL DISTRIBUTION			
DESCRIPTION OF PRODUCTION COSTS	QUANTITY	UNIT COST	SUM
Average annual electricity consumption 04 machines 125 days and 08 ice depot storages 200 days	331,200	0.24	79,488.00
Average annual water costs, cum	2,500	0.60	1,500.00
Average annual plant maintenance costs	12	500.00	6,000.00
Average annual operator salaries	12	3,600.00	43,200.00

Average annual fuel costs for ice distribution	60,000	0.15	9,000.00
Average annual fuel cost generator operation	100	20.00	2,000.00
Average annual vehicle maintenance	54,000	0.18	9,720.00
Average annual driver costs	06	3,600.00	21,600.00
Average annual communication expenses	10	100.00	1,000.00
Average annual administration and auditing costs	01	5,000.00	5,000.00
Annual ice production and storage costs			178,508.00
Annual average ice production in kgs 125 days @3892 kgs from 04 machines	1,946,000		
Average cost of hygienic produced ice delivered to any district depot and landing site			**USD 0.092**

TABLE 20 OPTION 02 BREAK DOWN OF COSTS

7.4 Option 03 – Local hygienic ice production at depot with no local distribution

OPTION 03 – LOCAL ICE PRODUCTION WITH DEPOT SERVICE & NO LOCAL DISTRIBUTION			
DESCRIPTION OF PRODUCTION COSTS	QUANTITY	UNIT COST	SUM
Average annual electricity consumption 02 SCOTCHMAN MV 600 machines and 01 ice depot storage rooms and general utility 200 days	35,000	0.20	7,000.00
Average annual water costs, cum	200	0.60	120.00
Average annual plant maintenance costs	02	500.00	1,000.00
Average annual operator salaries	02	3,600.00	7,200.00
Average annual water conditioning costs for ice distribution	200	1.00	200.00
Average annual fuel cost generator operation	100	5.00	500.00
Average annual vehicle maintenance	0	0.18	0.00
Average annual driver costs	0	3,600.00	0.00
Average annual communication expenses	01	100.00	100.00
Average annual administration and auditing costs	01	2,000.00	2,000.00
Annual ice production and storage costs			18,120.00
Annual average ice production in kgs 200 days @ 400kgs from 02 machines	80,000		
Average cost of local hygienic produced ice at any district depot			**USD 0.227**

TABLE 21 OPTION 03 BREAK DOWN OF COSTS

7.5 Option 04 – Local hygienic ice production at depot with local distribution

OPTION 04 – LOCAL ICE PRODUCTION WITH DEPOT SERVICE & LOCAL DISTRIBUTION			
DESCRIPTION OF PRODUCTION COSTS	QUANTITY	UNIT COST	SUM
Average annual electricity consumption 02 SCOTCHMAN MV 600 machines and 01 ice depot storage rooms and general utility 200 days	35,000	0.20	7,000.00
Average annual water costs, cum	200	0.60	120.00
Average annual plant maintenance costs	02	500.00	1,000.00
Average annual operator salaries	02	3,600.00	7,200.00
Average annual water conditioning costs for ice distribution	200	1,00	200.00
Average annual fuel cost generator operation	100	5.00	500.00
Average annual fuel consumption @ 6 km/l diesel oil, 10000 km	1,670	0.92	1,537.00
Average annual vehicle maintenance	1,537.00	0.18	276.00
Average annual driver costs	1	3,600.00	3,600.00
Average annual communication expenses	01	100.00	100.00
Average annual administration and auditing costs	01	2,000.00	2,000.00
Annual ice production and storage costs			23.533.00
Annual average ice production in kgs 200 days @ 400kgs from 02 machines	80,000		
Average cost of locally produced hygienic ice delivered to district landing sites			**USD 0.294**

TABLE22 OPTION 04 BREAK DOWN OF COSTS

7.6 Option 05 – Local hygienic ice production at depot with no local distribution

OPTION 05 – LOCAL ICE PRODUCTION WITHOUT DEPOT SERVICE & NO LOCAL DISTRIBUTION			
DESCRIPTION OF PRODUCTION COSTS	QUANTITY	UNIT COST	SUM
Average annual electricity consumption 02 SCOTCHMAN MV 600 machines and 06x 360 l chest freezers and general utility 200 days	25,000	0.20	5,000.00
Average annual water costs, cum	200	0.60	120.00
Average annual plant maintenance costs	02	500.00	1,000.00
Average annual operator salaries	02	3,600.00	7,200.00
Average annual water conditioning costs for ice distribution	200	1.00	200.00
Average annual fuel cost generator operation	100	5.00	500.00
Average annual vehicle maintenance	0	0.18	0.00
Average annual driver costs	0	3,600.00	0.00
Average annual communication expenses	01	100.00	100.00
Average annual administration and auditing costs	01	2,000.00	2,000.00
Annual ice production and storage costs			11.120.00
Annual average ice production in kgs 200 days @ 400kgs from 02 machines	80,000		
Average cost of local hygienic produced ice at any district depot			**USD 0.139**

TABLE23 OPTION 05 BREAK -DOWN OF COSTS

7.7 Comparison of production and distribution costs for hygienic produced ice

The table overleaf will show the prices for hygienic produced ice in for reasons of price comparison and the decision making process.

The acquisition, investment and depreciation figures are not incorporated at this stage of the project.

COMPARABLE ICE PRICES	
Recommended options	USD/kg
Option 01, centrally produced and distributed to depots only	**0.089**
Option 02, centrally produced and distributed to fisheries landing sites	**0.092**
Option 03, locally produced and available at depots only	**0.227**
Option 04, locally produced and distributed to fisheries landing sites	**0.294**
Option 05, locally produced and stored at Lotas de Pesca	**0.139**
Pilot project hygienic produced ice, distributed to Dili, Vemasse & Atabae	**0.166**

TABLE 24 PRICE COMPARISON FOR HYGIENIC ICE BETWEEN OPTIONS 01 AND 04

As can be seen from the above table the centralized operation is most beneficial for the fisher in terms of pricing as well as security of availability of hygienic produced ice.

8. PROPOSED GUIDELINES FOR NDFA MANAGEMENT OF ICE FACTORIES

The pilot project on hygienic ice production has demonstrated that the NDFA is capable of producing hygienic ice and distributing this on a small scale. The key managerial positions and specific operator skills have to be trained on and delegated before a large scale nationwide project can become a successful reality. Most importantly, the will exists. The below organigram is recommended to be organized in case the NDFA choose to launch the nationwide hygienic ice production and distribution project.

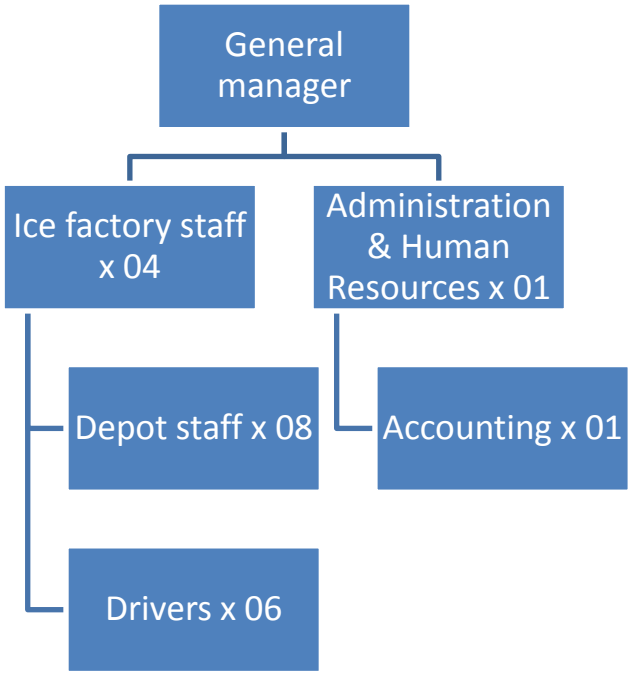


Diagram 01 Proposed management organigram for NDFA ice production project

The staffing requirement may need to be augmented to comprise night and day time guards, if the depots are not located close to other infrastructure already covered by such a service function.

9. RECOMMENDED SUPPLIERS & CONTRACTORS

9.1 Contractor 1

BIMAVI Unipessoal Lda.
Bebonuk, Dili TL
Tel.: +670 331 7171
Information and quotation can be found as annex 16.

9.2 Contractor 2

RMSL
Information and quotation can be found as annex 17.

9.3 Contractor 3

BEST WAY CONSTRUCTION, Lda
Colmera/Aldeia Rainain
Dili, TL. Tel.: +670 723 3549
Information and quotation can be found as annex 18.

9.4 Contractor 4

M. A. SANTANDER CONSTRUCTION INC.
Fatuhada, Comoro Road, Dili, TL
Tel.:+670 723 7443
Information and quotation can be found as annex 19.

10. OTHER TASKS CARRIED OUT

10.1 Assessment of AECID supported Baucau located processing plant

Please refer to annex 20 for further details.

10.2 Assessment of DNFA quality control laboratory facility at Teno.

Please refer to annex 14 for further details.

10.3 Assessment of Com fisheries port, Com

Please refer to annex 05 for further details.

10.4 Assistance with setting up a small scale ice production facility at NDFA, DILI

10.5 Elaboration of a operation and maintenance manual for a training workshop for NDFA inspection services and technical staff on ice production and operation and maintenance of ice machines

Please refer to annex 21 for further details.

10.6 Test and installation of NDFA emergency generator

10.7 Designed and assisted with performing a pilot project on hygienic ice production

Please refer to annex 22 for further details.

10.8 Designed a manual with 4 modules for the small-scale fisheries stake holders on basic hygiene, catch handling, ice and application and the cold chain principle.

Please refer to annex 23 for further details.

10.9 Designed and assisted with a DFO training for trainer's seminar for small-scale fisheries stakeholders.

Please refer to annex 24 for further details.

11. CONCLUSIONS

After completing the tasks as understood by the FAO –IC in the submitted TOR following conclusions are reached:

- It is the conclusion of the FAO –IC that it is possible to train NDFA staff to produce and distribute hygienic produced ice to the small scale fisheries sector in Timor Leste. It is debatable whether this activity should be done under public or private sector auspices.

- It is the conclusion of the FAO –IC that it is both feasible and viable to produce hygienic ice both at central as well as on a local level, however observing the basic requirement for establishing this activity with due respect to the public utility systems for electricity and water supply and staff training issues.

- It can be concluded by the FAO -IC that the majority of the Lotas de Pesca are not located at the most favorable locations, with respect to utilities supply, logistics and accessibility as well as concentration of fishers. However, there are alternative suggestions made for the utilization of the infrastructure meaning the investment per se is not lost for the sector.

- It is the conclusion of the FAO –IC that the ice supply strategy should be revised, located and introduced in such a manner it will benefit the largest possible number of fishers at the district and sub-district level.