

## **FISHERIES TSUNAMI EMERGENCY PROGRAMME**

### **MALDIVES**

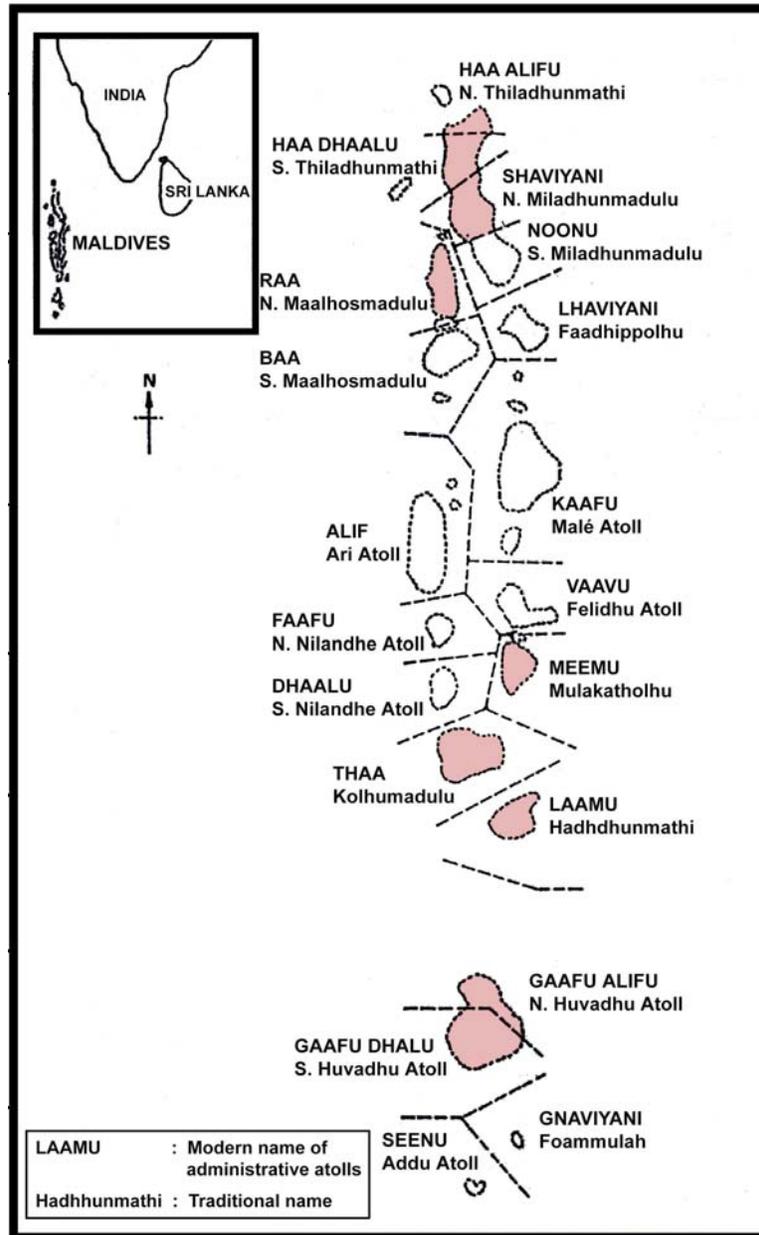
Assessment of rehabilitation and reconstruction needs in the  
Tsunami affected post-harvest fisheries sector- Maldives.

by  
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# ASSESSMENT OF REHABILITATION AND RECONSTRUCTION NEEDS IN THE TSUNAMI AFFECTED POST-HARVEST FISHERIES SECTOR – MALDIVES



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# **Assessment of Rehabilitation and Reconstruction Needs in the Tsunami affected Post-harvest Fisheries Sector - Maldives**

## **Summary**

Within the fisheries sector in Maldives, the pole and line tuna fishery and the small-scale fish processing sub sectors were the ones most affected by the tsunami. The traditional fish processors, mainly women, in the most affected atolls in the central region lost their productive assets and production stocks. Those most seriously affected will lose the high fishing season (January–April). The economic losses will be severe, especially for the artisanal, small-scale fishers and fish processors. Total fishery assets lost and/or destroyed as a result of the tsunami has been estimated at Rf. 321.32 million (US\$ 25 million) while the number of units lost or damaged in the processing sector due to tsunami has been estimated at 744.

Over 90% of the artisanal processors, nearly 800 out of a total 861, are located in nine atolls/ islands, especially in outer islands, where tsunami damage was highest. Most affected are Meemu (ME), Thaa (TH), Laamu (LA), Gaafu Dhaalu (GD), Gaafu Alifu (GA), Kaafu (KA), Lahaviyani (LH), Shaviyani (SH), Raa (RA) and Haa Alifu (HA) atolls where over 650 processors have lost their assets, stocks and savings. As such, provision of these processors with fish processing utensils and necessary credit to recommence fishing/ processing operations is one of the most urgent needs at present.

MOFAMR has assessed the basic equipment cost for a standard small-medium scale Maldivian fish/ dry fish processing unit to be around Rf. 80,000. The model introduced and field tested by FiDEX, handles 3-5MT of fresh fish/ day and has been found to be very useful in forging community participation and introduction of improved techniques to women's groups through extension training. Considering the wide, positive socio-economic impact such a community based approach would have in artisanal fish processing, the installation of 97 fish processing units, with priority focus on the affected atolls (67 units) is recommended at a total cost of US\$ 608,000/=.

Improving the availability of ice and development of fish landing centers are considered as two areas where urgent investment is needed if the quality of fish landed in the Maldives is to be further improved. Poor availability of ice when and where it is needed and the relatively high cost of ice has acted as disincentive for improved ice utilization in the post-harvest sector. The total ice requirement of the fishery sector at present is

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This overview report is prepared by S Subasinghe (Post-harvest Rehabilitation/Reconstruction Adviser), a member of the FAO Tsunami Damage and Needs Assessment Team. The report focuses specifically on the needs of the post-harvest sector, recommending short, medium and long term as well as rehabilitation/ reconstruction developmental needs of the sector. Where appropriate indicative cost estimates (which should be treated only as guidelines) are given to facilitate formulation of project proposals for donor funding.

estimated at around 96,000MT/ annum, pointing to the need for an additional daily ice production capacity of 275MT to fulfill the urgent ice requirements of the industry.

Need was also felt for a national policy promoting ice utilization and other healthy practices in the catch sector, ideally pursued by MOFAMR in consultation with and the consensus of all the stakeholders. In this respect it would also be important to build institutional capacity within MOFAMR to provide technical advice and extension support to industry.

Realizing the need for an improved supply of ice, there are already several donor pledges for investment in the sector. The report recommends that any new investment should be tied up to a careful needs assessment in the sector to identify the location, capacity, type of ice, various options and techniques of ice production and delivery etc to ensure the economic viability and sustainability of such investment, an area where FAO could be of assistance.

It was also felt that urgent investment is also needed in upgrading the fish landing sites, with priority on those with heavy landings. Almost all the atolls have fairly poor facilities for fish landing, most of the fish being landed directly on the beach or by feeder boats, gutted and prepared on the beach and/or adjoining areas. Even the fish which has undergone some chilling on-board suffers due to lack of ice and/or suitable facilities to keep the fish chilled after landing. Contamination of the fish from polluted beach areas and water is yet another drawback. To address the urgent needs in preserving the quality of fish landed, a) establishment of sheltered areas/ sheds with proper water supply/ drainage and waste disposal for fish processing and b) installing facilities at these sites for storing fish chilled in ice after landing, is recommended.

Another area which needs urgent attention is quality/ safety assurance of seafood, for both exports and the domestic market, a task undertaken jointly by MOFAMR and the Public Health Laboratory (PHL) at present. Fisheries Development and Extension Unit (FiDEX, MOFAMR) plays a key role in ensuring the overall quality of seafood landed and processed in the Maldives. However, considering the increasing volumes of fish landed, wide geographical distribution of landings and growing focus on product/ market diversification of exports, there is an urgent need to build FiDEX's capacity to handle the emerging needs of the industry. In this respect increasing its extension outfits with recruitment of additional staff and provision of advanced training to its staff in areas such as seafood quality assurance, HACCP verification and audit, seafood traceability and risk assessment etc, is recommended. It was also noted that there is an urgent need to improve the analytical capabilities at PHL through the acquisition of special equipment for the analysis of heavy metals/ antibiotics/ pesticides etc supported by appropriate training.

Considering the importance of fisheries to the Maldivian economy and the socio-economic development of the fisheries communities, importance of developing both domestic and international trade in fisheries, including product/ market diversification cannot be over emphasized. In this connection the report highlights the importance of improved access to technical and trade information and recommends establishing a fish

marketing information unit within MOFAMR. The facility would have as its main focus facilitation of transfer of fisheries information to private/ public sector entities, governmental policy makers and planners as well as small-medium scale operators including fisheries community bodies and cooperatives. This would be achieved through the creation of suitable databases and a technical information unit to facilitate the dissemination of such information.

The growing demand for fish products, especially for value-added products, globally, rapid growth of private sector involvement in the export trade in the Maldives and expected increase in landings due to planned fleet expansion would necessitate the industry to adapt itself rapidly to cater for emerging needs. The government has, and should continue to play an even more active role in this respect by providing technical assistance and support services to industry to identify and develop products to suit various markets. The industry, thus could benefit by the services of an outfit which caters for seafood product development, one which provides for pilot-scale production operations, conduct storage trials, design and development of appropriate packaging and presentation methods for the products, conduct test marketing and consumer acceptability studies, cost analysis etc. Such an outfit would be most useful for small-medium scale operators who have limited financial resources to invest for such experimentation. It is recommended that FiDEX, which has assisted and guided the private entrepreneurs in this process, be further strengthened through capacity building to undertake the additional responsibilities.

Considering the large amount of fish waste generated by the industry, the importance of ongoing efforts towards waste utilization cannot be overemphasized. It is estimated that 3-10MT of waste is produced at the Central Fish Market daily, amounting to a total conservative estimate of 1500-2000MT of waste production/ annum at the market. In addition to this, a large quantity of waste is also generated at the Felivaru canning plant and in atolls with heavy fish landings. The amounts are considerable at peak fish landing seasons, especially so in those atolls where Maldivefish/ dry fish is produced on a large scale. Trials carried out so far by FAO on the use of such waste in the production of fish silage has shown positive results.

Another possible option is the use of fish waste in the production of animal feed. Considering the fact that Maldives is totally dependent on imported poultry, production of poultry feed, which incidentally is the highest cost component in poultry production, could help to establish a domestic poultry industry, creating an additional source of income to island communities. The report also recommends to examine the use of composting as an option for fish waste generated in the islands/ atolls. Availability of compost could support home gardening and vegetable production among island communities.

# **Assessment of Rehabilitation and Reconstruction Needs in the Tsunami affected Post-harvest Fisheries Sector - Maldives**

## **1. Introduction**

This report is based on the findings made during the consultant's visit to Maldives and discussions held with governmental and industry persons and FAO and ADB personnel and technical experts associated with post-tsunami fisheries reconstruction and rehabilitation programmes. Discussions especially focused on the post-harvest fisheries sector, and rehabilitation and reconstruction needs in the affected areas. The document discusses:

- general situation of the sector prior to tsunami
- tsunami damage in the post-harvest sector
- short-term needs assessment (6-12 months)
- medium-term rehabilitation and reconstruction needs
- broader developmental requirements

Statistical data available with the Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR), interim damage/ needs assessment reports prepared by MOFAMR and the Ministry of Planning and National Development (MPND) and various draft reports prepared by MOFAMR/ FAO Post-Tsunami Fisheries Reconstruction and Development Programme were used in the preparation of this report. Valuable information was also collected through discussions and meetings held with the officials and field staff of MOFAMR, Maldives Industrial Fisheries Company Limited (MIFCO), Public Health Laboratory of the Ministry of Health and the private fish export-processors and traders.

Fisheries sector in Maldives has experienced strong growth in recent years, contributing about 9.3% for the national GDP into the Gross Domestic Product (GDP). The sector is primarily rural based and is intimately integrated with rural livelihoods and income. It has evolved from a traditional subsistence-based pole and line tuna fishery to a number of commercial fisheries and small processing units. The fishing industry is the second major source of foreign exchange after tourism. Although about a third of the annual catch is consumed domestically, fish exports currently account for almost half of the country's exports. Fish exports in 2003 amounted to \$76 million (equivalent to \$250 per capita; [Table 1](#)). The sector is a major provider of employment in the Maldivian economy, particularly in outlying atolls. With 14,955 fishermen, the sector employs 11% of labor

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force. About 20% of the total population is dependent on fisheries as the major income earning activity.

**Table 1 : Maldives - Exports of Marine Products, 2003**

Item	Quantity (kg)	Value (Rf)	Share of Exports (V)	
			Government	Private
Frozen fish	47,609,013	347,507,138 (\$ 27.04 mil)	80%	20%
Fresh/ chilled fish	5,592,895	218,671,564 (\$ 17.02 mil)	16%	84%
Canned fish	7,093,582	156,182,556 (\$ 12.15 mil)	100%	0%
Maldivefish etc	6,519,709	130,775,949 (\$ 10.20 mil)	10%	90%
Sea cucumber	239,334	43,147,093 (\$ 03.36 mil)	0%	100%
Salted dried fish	2,672,908	27,830,469 (\$ 02.17 mil)	0%	100%
Live fish	392,441	22,337,881 (\$ 01.74 mil)	0%	100%
Steamed skipjack/ tuna	290,726	8,116,878 (\$ 00.63 mil)	100%	0%
Others*	-	24,208,037 (\$ 01.88 mil)		
<b>Total</b>	-	<b>978,777,565 (\$ 76.17 mil)</b>		

\*includes fish meal, dried shark fins, cowrie shells, fish minced products, fish oil etc.

Source: Fisheries statistics 2003

Most areas of seafood export processing and marketing is now open to the private sector. Exports of salted dried fish, live fish and sea cucumber are virtually totally in the hands of the private sector while canned tuna exports and steamed skipjack tuna (arabushi/katsuobushi) exports are handled by the government owned Maldives Industrial Fisheries Company Limited (MIFCO).

## **2. Post-Tsunami Post-Harvest Sector Situation Analysis**

### **2.1 Tsunami Damage in the Post-harvest Sector**

As per the MOFAMR, within the fisheries sector, the pole and line tuna harvesting sub-sector and the small-scale fish processing sub-sector are the ones most affected by the tsunami (Figure 1-3). In the post production sector, the traditional fish processors, mainly women, in the most affected atolls in the central region lost their productive assets and production stocks. Those most seriously affected will lose the high fishing season (January–April). The economic losses will be severe, specially for the artisanal, small-scale fishers and fish processors.







**Table 2: Damage Assessment**

No.	Type of Facility	Unit	Damage to Infrastructure <sup>1</sup>		Total Damage to Infrastructure	
			Full	Part	Rf Million	\$ Million <sup>2</sup>
1.	Fishing vessels	No.	120	50	147.50	11.48
2.	Fish processors <sup>3</sup>	No.	374	0	17.80	1.38
3.	Reef fishery <sup>4</sup>	No.	0	5	1.88	0.14
4.	Infrastructure <sup>5</sup>	No.	8	2	1.55	0.12
5.	Business loss <sup>6</sup>				152.57	11.87
	<b>Total</b>				<b>321.32</b>	<b>25.00</b>

<sup>1</sup> Damage estimate is based on the estimate of the Ministry of Fisheries, Agriculture, and Marine Resources (MOFAMR), which was received on 13 January 2005.

<sup>2</sup> US\$ 1.0 = Rf 12.85.

<sup>3</sup> 337 Cottage fish processors and 37 commercial processors lost equipment and materials.

<sup>4</sup> Reef fishery damages include lost equipment and materials of the harvesting fleet and lost ocean cages.

<sup>5</sup> Infrastructure includes fully damaged 8 boatsheds, Mariculture Research Station, and FAD centre

<sup>6</sup> Direct income losses from fishing and other businesses estimated here. MOFAMR estimate of Rf 405.04 million as total business losses.

Over 90% of the artisanal processors (nearly 800 out of a total 861) are located in nine atolls/ islands, namely, HA, HD, SH, RA, ME, TH, LA, GA and GD. Table 2 gives an estimate of total fishery assets lost and/or destroyed as a result of the tsunami valued at Rf. 321.32 million (US\$ 25.00). Number of assets lost or damaged in the processing sector due to tsunami has been estimated at 744 (Table 3).

**Table 3 : Assets Lost or Damaged in the Processing Sector due to the Tsunami**

Asset	Quantity
Lost equipment of fish processors	374
'Maldivefish' cottage processing units lost (equipment and units)	333
'Maldivefish' commercial processing units lost (equipment and units)	37
<b>Total</b>	<b>744</b>

An analysis of the flow of fish in various marketing channels shows that the atolls/ islands could be broadly categorized into those which have a high focus on Maldivefish processing/ fish drying and those which dispose their catch to government/ private purchasers mostly in the fresh form. As such any assessment of investment needs in the fisheries sector, whether it be artisanal fish processing sector or commercial fresh/ frozen fish handling operations has to carefully assess the medium-long term needs in the sector and pattern of trade development. The fish handling, processing and marketing scenario has thus two major components; handling, processing and marketing fresh/ frozen fish, handling, processing and marketing of dried/ smoked fish.

## 2.2. General Situation in the Post-harvest Sector

Most of the fish landed in Maldives is marketed fresh or frozen, the latter for export to canneries abroad, mainly Thailand. Quality improvement of fresh fish has gained much focus in recent times. It is heartening to note that both government and private sector are increasingly focused on improving fish quality through the application of improved on-board/ on-shore handling practices. Such effort would also have a direct relevance not only to country's attempt in product/ market diversification and improved utilization of its resources for human consumption. It will also be important with regard to the reported discards of catch by some vessels during peak fishing seasons, especially in the Northern islands. Fish discards are variously estimated at between 2-7% of the total catch.

### 2.2.1 Ice availability

The total ice production in the country is far from adequate to cater for the industry's growing needs. The total installed capacity of ice plants is estimated at 306MT (Table 4). The MIFCO facilities at Kooddoo, Felivaru cannery and KOG loining plant (25MT flake ice) produce a total of around 80MT of block ice and 25MT of flake ice per day. A flake ice unit operated by a private company at TH (Funadoo) produces 30MT/ day while a barge operated flake ice plant (60MT) in Male' (Ensis) mainly caters for the export oriented tuna long-line vessels.

**Table 4 : Maldives - Total Ice Production and Cold Storage Capacity (2004)**

Company/ location	Installed Capacity (MT)	
	Ice Plant	Cold Storage
1. Maandhoo (Private-LA)	62 (F&B)	1000
2. KOG (MIFCO-KA)	25 (F)	1850
3. Felivaru (MIFCO-LH)	50 (B)	700
4. Kooddoo (MIFCO-GA)	30 (B)	1800
5. Funaddoo (Private-TH)	30 (F)	1000
6. Keekimini (Private-SH)	20	-
7. Ensis (barge operation Private-K)	60 (F)	-
8. Fares community (GDh)	10 (F)	-
9. MIFCO (Barge mounted)	-	1450
10. Big Fish Co. (Private-K)	19 (F)	20
11. GOM (community)	-	100
<b>Total</b>	<b>306</b>	<b>7920</b>

The total capacity, however, could shortly increase with the planned expansion of MIFCO plants at Kooddoo and KOG. Even with these new installations, the total ice production capacity in the country would be far from adequate to cater for the needs of the industry.

### ***2.2.2 Refrigerated Seawater (RSW), Chilled Seawater (CSW), Ice Slurry applications***

The FAO Technical Cooperation Programme (TCP/MDV/2903) "Improved handling of fresh fish", which commenced in 2003, has initiated some very useful work with the view to introduction of Chilled Sea Water (CSW) and Refrigerated Sea Water (RSW) techniques to fisherman. The project has so far fitted three boats, 2 boats of 3MT and 10MT capacity with CSW facilities and the third (total capacity of 30MT split into 6 separate holds) with a RSW system. The project has now embarked on the field testing of the techno-economic feasibility of the techniques introduced.

Studies so far have shown that the two systems have their own unique advantages and disadvantages. The fact that there is no price premium in the open market for RSW/ CSW stored fish has acted as a definite disincentive for broader introduction of the technique. On the other hand it has been reported that Maldivian Industrial Fisheries Company Limited (MIFCO) is more selective and gives preference to CSW/ RSW stored fish due to their quality. This has apparently influenced some vessel owners to install RSW systems in their vessels on their own. High cost (approximately 1 Rf/ kg in Male' and Rf 350/ MT elsewhere) and difficulties in sourcing ice as and when needed, has encouraged fishermen to take the RSW option as against CSW, and is reported to be gaining popularity among vessel owners.

However, in the light of more recent technical developments, it would be useful for the CSW option to be further explored. The technique of usage of slurry ice is gaining popularity in many countries. The slurry ice units now come in a wide range of capacities, while the cost of units too has come down significantly due to competition among manufacturers.

However, considering the geography of the Maldives and the nature of the fishing operations (national fleet has over 1400 pole and line vessels operating in a vast sea area), it would be advisable to conduct a careful assessment of techno-economic feasibility of production and delivery of ice from land-based facilities and also to appraise other available options.

Thus, considering the importance of further improving the quality of fish landed by the artisanal sector in Maldives for long-term sustenance and growth of the industry, it is important for the government to urgently decide on a national action plan in this direction, carefully assessing all options, including the emerging RSW/ CSW techniques.

### ***2.2.3 Waste Utilization***

Waste utilization is yet another area of focus in recent times. FAO Technical Cooperation Programme TCP/MDV/6711(A), "Utilization of Fish Waste for development of Products for Human Consumption" implemented in Maldives in 1998 with the experimental production of tuna burgers from frame meat, gelatin from skins, calcium powder from skipjack bones, tuna jerky from loin meat and salted dried tuna belly flaps.

Estimates have shown that a crude gelatin yield of 8% by weight of skin is possible with tuna waste giving a maximum yield of 3.2MT of crude dried gelatin per annum from skins discarded at the Male' market. Study also showed that 28-40kg of calcium powder/day is a possibility from filleting waste.

Another product the project recommended was tuna jerky, which has a good market in US, also possibly in the local tourist market and elsewhere. The project also recommended export-promotion of salted, dried belly flaps of skipjack, a byproduct of Maldivefish production; which is normally wasted or cooked and consumed. However, the high content of oil in the belly flaps make it prone for rapid development of rancidity, a factor which should be considered in marketing such a product.

The ongoing CFC/ FAO/ INFOFISH Project on "Promotion of tuna value addition and market diversification" too focuses on waste utilization, especially off-cuts and carcass meat from export-processing of tuna loins. The project has also identified tuna oil and tuna meal as potential by-products from cannery waste. It is worth exploring the possibility of using tuna meal to promote indigenous poultry production. Poultry is at present imported to Maldives. Meal cost is the major cost item in poultry production. With access to a continuous supply of quality tuna meal, Maldives may stand to gain by way of employment generation and foreign exchange savings by such an initiative.

#### ***2.2.4. Maldivefish and Dried Skipjack***

Production of dried smoked skipjack loins (Maldivefish) and dry fish is the main fish processing option available for the artisanal fisherman in locations where fresh fish purchases by the private sector is relatively low and where there is a surplus of fresh fish. From its very nature, processing of Maldivefish and dry fish, has been and will continue to be a cottage scale industry, though the scale of operation may vary considerably. Majority of processors handle 1-2MT of raw material per day while the large more commercial operators may handle up to 2-5MT daily. Thus, the industry is of much significance to a large number of fisher families in remote islands. The socio-economic importance of the industry, by way of employment and income generation has encouraged MOFAMR to support the industry. Exports of Maldivefish were valued at US\$ 8.3 million in 2004 (Table 5) while the value of dry fish exports stood at US\$ 2.17 million.

**Table 5 : Dried Skipjack Tuna Exports to Sri Lanka**

<b>Year</b>	<b>Quantity (MT)</b>	<b>Value (Rf Million)</b>
1995	3845	10.309
1996	3991	74.512
1997	3823	77.341
1998	4435	102.265
1999	5183	102.026
2000	5525	123.839
2001	5920	131.405
2002	5660	110.042
2003	6203	117.495
2004	5734	106.043

*Source: Ministry of Fisheries, Agriculture and Marine Resources*

It is interesting to note that the concept of solar drying has now got well accepted by many Madivefish/ dry fish processors. Same could be said about the improved techniques of smoking introduced by Fisheries Development and Extension Unit (FiDEX) of the Ministry of Fisheries. The processing operations have undergone much improvements in recent times due to various interventions by FiDEX. FiDEX has introduced the uses of solar dryers and smoke kilns to improve the quality of Maldivefish and dry fish produced by the artisanal processors in several islands. Seven solar dryer/ smoker units were installed in ME (3 units) and GD (4) atolls. Even though there is no definitive incentive for the processors to improve quality as there is no price premium for quality produce (nor a quality grading system by traders based in Thulushdoo Island), FiDEX has embarked on the quality improvement programme to ensure quality assurance of exports and prevent post-harvest losses. FiDEX programme encourages a community based approach under the programme and has focused on centralized facilities used by the fishing community in the locality for solar drying/ smoking their fish.

#### ***2.2.5. Seafood Safety/ Quality Assurance and Export Certification***

Ministry of Fisheries, Agriculture and Marine Resources, jointly with the Public Health Laboratory (PHL) of the Ministry of Health, is involved in seafood safety/ quality assurance. Public Health Laboratory (PHL) of the Ministry of Health is the national seafood certification body empowered with the function of issuing health certificates for seafood products. The laboratory is manned by an 18 member team of experienced and professionally trained (microbiology, laboratory technology, food quality monitoring, HACCP auditing, histamine analysis etc) technical staff, some of whom have advanced academic and post-graduate qualifications. The laboratory is in the process of getting ISO 17025 accreditation. The PHL is also in the process of shifting to a more spacious facility which would enable it to expand its services to industry in due course.

PHL has networked efficiently with the fisheries industry, export-processing sector in particular. The laboratory has six satellite focal points in various locations of the country, with significant fish export-processing activities. Five (05) EU approved export-

processing units are routinely monitored by PHL. These include a factory vessel belonging to Fish Pro Maldives Company and land based facilities belonging to Big Fish Processing Company, MIFCO loining plant at KGO, MIFCO tuna cannery at Felivaru and MIFCO fish processing center at Kooddoo. Annually over 2000 export certificates (over 2200 in 2004) are issued by PHL. Last year (2004), 245 detailed chemical/microbiological assessments of food samples were analyzed by the laboratory. In addition to fisheries developmental work, Fisheries Development and Extension Services (FiDEX) unit of the Ministry also closely associates itself with PHL in the inspection and auditing of export-processing facilities.

A recent report prepared by the UNIDO/ UNDP Project “Support to Metrology, Standardization Testing and Quality” (US/RAS/03/043/11-55) observes the need to accreditation of laboratories and certification of inspection bodies in Maldives, and also the urgent need for strengthening in-house ability for calibration of equipments. The UNIDO project has initiated action towards drafting legislation to facilitate introducing standardization.

Discussions with the technical staff at PHL were useful to identify their constraints by way of facilities and equipment. Planned movement to a more spacious building would enable PHL to physically separate the chemical and microbiological laboratories. As far as seafood testing capabilities are concerned, it would be important for the laboratory to enhance its heavy metal and drug/ antibiotic residue testing capabilities through procurement of a Gas Chromatograph (GC) for pesticide residue analysis, High Performance Liquid Chromatograph (HPLC) for detection of drug/ antibiotic residues and an Atomic Absorption Spectrometer with necessary accessories and other ancillary equipment needed for chemical/ microbiological analytical work. Purchase of these equipment would have to be coupled with appropriate staff training. Provision of these equipment would help the laboratory to address growing fish safety assurance requirements by importing countries. Considering the focus of Maldivian industry on tuna, special focus should be laid, among other things, on enhancing routine testing of samples for histamine and mercury.

There is also a need to further strengthen the fish safety/ quality assurance programmes to incorporate emerging requirements of major markets based on Hazard Analysis Critical Control Points (HACCP) principles incorporating elements of risk assessment and traceability as appropriate. It is important for the relevant governmental bodies and industry to take note of impending Country of Origin Labeling (COOL) by US and mandatory traceability and labeling requirements of the EU market.

### **3. Rehabilitation of Post-harvest Sector**

#### **Recommendations**

The medium-long term rehabilitation and reconstruction needs of the fisheries post-harvest sector should ideally focus not only on replacement of damaged assets but also on facilitation of bringing about necessary urgent improvements to ensure catch-up in the growth, continuity of ongoing development programmes and sustainable development of the sector as a whole. This is of paramount importance if the tsunami shattered industry is to establish itself and contribute towards national development and socio-economic upliftment of the artisanal sectors of production and processing.

An analysis of the flow of fish in various marketing channels shows that the atolls/islands could be broadly categorized into those which have a high focus on Maldivefish processing/ fish drying and those which dispose their catch to government/ private purchasers mostly in the fresh form. As such any assessment of investment needs in the fisheries sector, whether it be artisanal fish processing sector or commercial fresh/ frozen fish handling operations has to carefully assess the medium-long term needs in the sector and pattern of trade development.

In this connection, based on personal observations and through discussions with relevant governmental/ industry bodies the following priority areas could be recommended:

#### **Short-Term**

- 3.1. Replacement investment and new investment in the small-medium scale traditional fish processing sector: (US\$ 610,000);
- 3.2. Improving ice availability; addition of 275 MT ice production capacity through ice plants set up at suitable locations (US\$ 2.45million);
- 3.3. Improving shore-based facilities: development of fish landing centres (US\$ 268,000);

#### **Medium-Long Term**

- 3.4. Strengthening seafood testing capabilities at PHL (US\$ 426,000);
- 3.5. Setting up a fish marketing information unit at MOFAMR (US\$ 95,000);
- 3.6. Fishery product R & D Unit (Fish Technology Unit) (US\$ 177,000);
- 3.7. National fisheries industry board;
- 3.8. Improved fish waste utilization – feed production;
- 3.9. Improved fish waste utilization – community composting pits (US\$ 34,200).

## **Short-Term**

### **3.1 Replacement investment and new investment in the small-medium scale traditional fish processing sector**

The traditional Maldivefish/ dry fish processors in outer islands suffered irreparable damages due to tsunami. Most affected are Meemu (ME), Thaa (TH), Laamu (LA), Gaafu Dhaalu(GD), Gaafu Alifu (GA), Kaafu (KA), Lahaviyani (LH), Shaviyani (SH), Raa (RA) and Haa Alifu (HA) atolls (Figure 4) where over 650 processors have lost their assets, stocks and savings. As such it is important to provide these processors with fish processing utensils and necessary credit to recommence fishing/ processing operations.

Maldivefish processing is a labour intensive operation with gender focus. There is heavy involvement of women and children in the process, depending on the scale of operation, season, location and community structure in the atoll concerned. Cooking and drying/ smoking are areas where primarily women get involved while gutting/ cleaning the fish, packaging and marketing is done by men.

FiDEX technical support and extension programme has introduced community based approach of Maldivefish/ dry fish processing in GDh atoll. Members from the “Women’s Development Committee” of the TH atoll have already formed themselves into four women’s groups which have entered into a formal agreement with MOFAMR to work on a cooperative formation. FiDEX has introduced an improved medium-scale production outfit consisting of a solar dryer and a specially designed smoking kiln to the group, along with training in small-scale fish processing business management, including keeping the accounts (Figure 5, 6 and 7). The cooperative formed by the groups has performed well and has encouraged FiDEX use this model in its extension activities.

MOFAMR has assessed the basic equipment cost of small-medium scale Maldivefish/ dry fish processing units as Rf 15,000/ unit for small-scale operations handling up to 2MT fresh fish/ day and Rf 80,000/ unit for medium-scale operators handling 3-5MT fresh fish/ day (Table 3.1.1). The medium-scale units could also serve as community units which could be used by several small-scale operators collectively.

However, introduction of the improved processing model has to take note of the pattern of division of labour (and gender focus of various steps of processing) in various atolls. Introduction of appropriate models would undoubtedly encourage community participation and also facilitate introduction of improved techniques through extension and training. Considering the wide, positive socio-economic impact such a community based approach would have in artisanal fish processing, installation of 97 community fish processing units, with priority focus on the affected atolls (67 units) is recommended. The total cost of such installation is estimated at approximately US\$ 608,000 (Table 3.1.2).

Designs of improved medium-scale solar dryer/ smoking kiln are appended (Table 3.1.3).









**Table 3.1.1**

**Estimated Cost for a traditional Maldivefish processing operation**

*Medium-scale / intensive*

Details	Unit Cost/ Item (MRF)	Quantity/ Processing Unit (MRF)	Cost/ Processing Unit (MRF)
<b><i>Cutlery and &amp; Utensils for primary &amp; secondary processing</i></b>			
Filleting Knives (6" - 9" Blade)	55.00	8	440.00
Knife Sharpener	15.00	5	75.00
Wheel Barrows (Max. Load 0.5 Mt, 1 Wheel)	400.00	5	2,000.00
Buckets (40 L PVC)	60.00	10	600.00
Stove Stands (1.5' x 1.5'), Steel	250.00	4	1,000.00
Kerosene Solenoid Pump (electric)	1,875.00	1	1,875.00
Fuel Heads for stove (Large) 21 x13mm (Copper + Cast Iron)	330.00	4	1,320.00
Manual Lifting crane (for lifting mesh baskets)	1,500.00	1	1,500.00
Scale (max. wt. 100kg)	1,300.00	1	1,300.00
Wire Mesh Basket, (Diameter 32" Depth 19") Steel Mesh	300.00	10	3,000.00
Large pans, (Diameter 33" Depth 16"), Aluminum	2,200.00	5	11,000.00
			<b>24,110.00</b>
<b><i>Equipments/ means for Smoking and Drying</i></b>			
Smoking Chamber (Construct By Cement Brisk)	1,847.50	4	7,390.00
Smoking Racks / platforms (5' x 20') Steel, Wire Mesh	1,500.00	5	7,500.00
Drying racks (5' x 20') Steel Structure With Wire Mesh	2,000.00	10	20,000.00
			<b>34,890.00</b>
<b><i>Packaging and Storage</i></b>			
Packaging (Polythene Bags & Rolls)	3,500.00	1	3,500.00
Construction of Storage room	17,500.00	1	17,500.00
			<b>21,000.00</b>
<b>GRAND TOTAL</b>			<b>80,000.00</b>

**N.B** Medium-scale refers to processors who process an average of 3-5mt/day.

**Table 3.1. 2 : Fisheries data of atolls and the number of processing units recommended**

Atoll	Processors	Fishers	Landings	Purchased Fresh	Purchased fresh/landings (5)	No. affected	Processing units recommended*
Male'	0	350	11283	274	2.40%	0	0
HA	100	810	12607	5545	43.90%	334	7
HD	73	624	3140	162	5.20%	46	7
SH	83	98	7809	285	3.65%	61	7
NO	15	446	2111	24	1.13%	177	3
RA	100	1469	7956	2029	25.50%	691	7
BA	28	1286	3972	353	8.88%	761	5
LH	40	490	7480	2826	37.78%	247	5
KA	12	874	8535	751	8.79%	825	3
AA	0	688	7738	8	0.00%	0	1
AD	0	488	8158	0	0.00%	477	1
VA	6	131	626	0	0.00%	114	
ME	137	570	4222	643	15.22%	545	9
FA	3	432	830	0	0.00%	213	1
DH	13	617	1508	38	2.51%	487	3
TH	68	960	5633	546	9.69%	970	7
LA	64	824	11324	6602	58.30%	466	7
GA	124	1180	21630	17855	82.54%	731	9
GD	80	966	12582	12196	96.93%	148	7
GN	0	194	474	992	209.00%	0	1
SE	32	608	12632	9371	74.18%	238	5
<b>Total</b>	<b>978</b>	<b>14105</b>	<b>152250</b>	<b>60500</b>	-	<b>7531</b>	<b>97</b>

\* Number of processing units recommended to be installed in each atoll/ island

<05 processors	=	1 unit
5-10 processors	=	2 units
10-20 processors	=	3 units
20-50 processors	=	5 units
50-100 processors	=	7 units
100-150 processors	=	9 units

**Indicative cost estimate for installing 97 processing units**

Estimated unit cost of an improved Maldivefish processing unit	=	Rf	80,000
Total cost of 97 processing units @ Rf 75,000 x 97	=	Rf	7,760,000
	=	US\$	<b>608,627</b>

( US\$ 1 = Rf 12.75 )

### 3.2 Investment in infrastructure in the post-harvest sector – addition of 275MT ice production capacity

The major investment needs in fisheries infrastructure in the post harvest sector are a) improving the ice availability and b) development of fish landing centers. The objective of both investments is to enable maintenance of the cold chain in the harvesting and processing segments. Even though there has been a significant progress in the quality of tuna landed in Maldives in recent years the situation is yet far from satisfactory, with poor ice usage in most sectors. Two main reasons often cited in this respect are a) poor availability of ice when and where it is needed, and b) relatively high cost of ice. Fishermen’s poor response for usage of ice for chilling fish on-board was an issue initially which has since abated and the demand for ice increased as benefits of its usage became clear.

The present installed capacity of around 285MT of ice plants is far from adequate to cater for the industry’s needs (Table 3.2.1). Most of the ice produced by the plants presently in operation are either owned by MIFCO or private enterprises, mainly export-processors who use bulk of the product in their own operations, selling the surplus as and when available. Even at a 70% production capacity and 260 day annual operation the total amount of ice produced in the country would amount to approximately 50,000MT/annum. However, the actual availability of ice to fishermen is far less and can be safely estimated at around 20-25,000MT. Difficulties in transportation/ disposition of ice, seasonality of ice requirements (based on fishing season), and wide geographical distribution of major fishing grounds complicates the picture.

**Table 3.2.1 : Maldives - Total Ice Production and Cold Storage Capacity (2004)**  
(Table 4 repeated here for easy reference)

Company/ location	Installed Capacity (MT)	
	Ice Plant	Cold Storage
1. Maandhoo (Private-LA)	62 (F&B)	1000
2. KOG (MIFCO-KA)	25 (F)	1850
3. Felivaru (MIFCO-LH)	50 (B)	700
4. Kooddoo (MIFCO-GA)	30 (B)	1800
5. Funaddoo (Private-TH)	30 (F)	1000
6. Keekimini (Private-SH)	20	-
7. Ensis (barge operation Private-K)	60 (F)	-
8. Fares community (GDh)	10 (F)	-
9. MIFCO (Barge mounted)	-	1450
10. Big Fish Co. (Private-K)	19 (F)	20
11. GOM (community)	-	100
<b>Total</b>	<b>306</b>	<b>7920</b>

Targeting a very conservative overall ice: fish utilization ration of 0.60, the total ice requirement of the fishery sector at present (total landings around 160,000MT) can be

safely estimated at around 96,000MT (160,000MT x 60% ice utilization). Thus the deficit in ice supply at present is around 50,000MT/ annum. Assuming a 260-day annual operation at 70% capacity, this would need an additional daily ice production capacity of 275MT to fulfill the urgent ice requirements of the industry.

On the other hand, the planned introduction of 50 Nos. (20-25MT capacity) 85', RSW-FRP multi-day boats (3-5 day operations) could herald a new era in the country's fishing industry. Discussions with MIFCO and other boat operators revealed that the landings from the RSW boats were much better in quality and experienced no rejections. The development could release the pressure on the ice industry and also on ice distribution logistics. However, the increased landings from these multi-day operations and the expected expansion of fishing activities in Maldives in general, would further increase the demand for ice in the future.

Taking note of the present ground situation with respect to demand and usage of ice and the ongoing and planned developments in the sector, the following could be recommended:

**Table 3.2.2 : Additional Ice Plant Capacity Recommended**

<b>Atoll</b>	<b>Landings</b>	<b>Purchased fresh</b>	<b>Landings/ fresh purchased</b>	<b>Additional Recommended</b>
SE & GN	13106	13106	79%	25
GD	12582	12196	97%	50
GA	21630	17855	83%	50
TH & LA	16957	7148	42%	50
LH & NO	9591	2850	30%	25
BA & RA	11928	2382	20%	50
<b>Sub total</b>	<b>85794</b>	<b>42431</b>	<b>49%</b>	<b>250</b>
<b>Maldives Total</b>	<b>152250</b>	<b>60500</b>	<b>40%</b>	
<b>Maldives Total (%)</b>	<b>56%</b>	<b>70%</b>		

**Indicative cost estimate:**

25 MT flake ice plant, unit cost	=	US\$ 210,000
Accessories (02 years) installation and testing	=	US\$ 35,000
<b>Total cost/ unit</b>	=	<b>US\$ 245,000</b>
<b>Total cost for 10 Nos. 25MT units</b>	=	<b>US\$ 2.45million</b>

***An appraisal of ice plant, cold storage and freezing capacities:*** As an aid in policy making and planning, a detailed assessment of national requirements of fisheries post-harvest infrastructure (ice plants/ cold storages/ freezing plants) is recommended.

Such an exercise should ideally be carried out by a team of experts (refrigeration/ fishing and fish processing/ marketing/ economist) supported by field staff, as appropriate. The study should examine not only the engineering and economic aspects (Table 3.2.3) but also potential developments in fishing technology, fish handling/ transport options, trade flow/ forecasts etc with due consideration to national development plan and national aspirations in developing the socio-economic status of the fishing communities. The study should also clearly define specific roles of the private/public sector, MIFCO and other stakeholders and mechanisms of interaction.

**Table 3.2.3 : Ice Plants, Cold/ Ice Storage Rooms – Indicative Costs\***

Capacity (MT)	Ice Plant			Cold Rooms
	Flake Ice	Slurry Ice	Block Ice	
5 MT	60-80,000	100-116,000	50,000	12,000 (ice storage)
10 MT	90-120,000	-	90,000	18-27,000 (cold storage)
15 MT	150-185,000	-	-	-
20 MT	180-200,000	-	120-145,000	32-47,000 (cold storage)
25 MT	-	200-250,000	-	-
50 MT	260-280,000	-	220,000	28,000 (ice storage)

\* cost covers all expenses including installation and test running and depends on the country of origin.

***A national extension campaign encouraging ice utilization in the catch sector:*** It is recommended that a national extension campaign encouraging ice utilization and other healthy practices in the catch sector has to be pursued by the government/ Ministry of Fisheries, in consultation with and the consensus of all the stakeholders.

***Institutional capacity building and training for MOFAMR:*** It is recommended that institutional capacity be built within MOFAMR to provide technical advice and extension support to harvesting and processing sectors in the use of various refrigeration and chilling systems and technicalities involved. This capacity is presently lacking within the system.

### **3.3 Development of fish landing centres**

In addition to poor usage of ice on-board, the poor handling of fish during and after landing the catch too contribute significantly towards overall post-harvest losses in the fishery sector. Almost all the atolls have fairly poor facilities for fish landing (few have quays), most of the fish being landed (directly on the beach or by feeder boats), gutted and prepared on the beach and/or adjoining areas. Even the fish which has undergone

some chilling on-board suffers due to lack of ice and/or facilities to keep the fish chilled after landing. Contamination of the fish from polluted beach areas and water is yet another drawback.

**Table 3.3.1 : Proposed Locations for Fish Sheds and Chilled Fish Stores**

<b>Atoll</b>	<b>Landings</b>	<b>Fresh Purchases</b>	
Male'	11283	274	
<b>HA</b>	<b>12607</b>	<b>5545</b>	Chilled Store
HD	3140	162	
<b>SH</b>	<b>7809</b>	<b>285</b>	Chilled Store
NO	2111	24	
RA	7956	2029	
BA	3972	353	
LH	7480	2826	
KA	8535	751	
AA	7738	8	
AD	8158	0	
VA	626	0	
ME	4222	643	
FA	830	0	
DH	1508	38	
TH	5633	546	
LA	11324	6602	
<b>GA</b>	<b>21630</b>	<b>17855</b>	Chilled Store
<b>GD</b>	<b>12582</b>	<b>12196</b>	Chilled Store
GN	474	992	
SE	12632	9371	
<b>CTotal</b>	<b>152250</b>	<b>60500</b>	

To address the urgent needs in preserving the quality of fish landed two priority areas of focus can be identified; a) establishment of special sheltered areas/ fish sheds with an adequate fresh water storage for supply to fishing vessels/ suitable areas with proper drainage and provision for waste disposal, fish landing and preparation/ cleaning, and b) installing facilities for temporary storage or holding of chilled fish after landing, prior to processing (Figure 8). The chief beneficiaries will be small to medium scale fishers and fish processors.

**Indicative cost estimate:**

- |   |                       |
|---|-----------------------|
| 1. Twenty (20) fish sheds equipped with water supply and waste disposal @ at US\$ 9,000 | = US\$ 180,000        |
| 2. Four (04) chilled fish storage units (20' reefer containers) @US\$ 22,000 (cif)      | = US\$ 88,000         |
| <b>Total Cost</b>   | <b>= US\$ 268,000</b> |



## **Medium-Long Term**

### **3.4. Enhancing seafood quality/safety monitoring capabilities at MOFAMR and Public Health Laboratory (PHL)**

While MOFAMR has the overall responsibility of fisheries development in the Maldives, Public Health Laboratory (PHL) of the Ministry of Health functions as the national seafood certification body empowered with the function of issuing health certificates for seafood products. MOFAMR and PHL jointly take charge of quality assurance of seafood exports. Fisheries Development and Extension Unit (FiDEX, MOFAMR) plays a key catalytic role in this respect through its efforts in ensuring the overall quality of seafood landed and processed in the Maldives. However, considering the increasing volumes of fish landed and the wide geographical distribution of landings, rapid growth in the export-processing sector and its product range with a parallel diversification of export markets, there is an urgent need to build FiDEX's capacity to handle the emerging needs of the industry. In this respect increasing its extension machinery with recruitment of additional staff and provision of advanced training to its staff in areas such as seafood quality assurance, HACCP verification and audit, seafood traceability and risk assessment etc, as per the provisions in the Fisheries Bill to be enacted in 2005, can be recommended.

Meanwhile, taking note of the growing safety requirements in major markets, it would be important for the Public Health Laboratory (PHL) to enhance its heavy metal and drug/antibiotic residue testing capabilities through procurement of a Gas Chromatograph (GC) for pesticide residue analysis, High Performance Liquid Chromatograph (HPLC) for detection of drug/antibiotic residues and an Atomic Absorption Spectrometer with necessary accessories and other ancillary equipment needed for chemical/microbiological analytical work. Purchase of these equipment would have to be coupled with appropriate staff training. Provision of these equipment would help the laboratory to address growing fish safety assurance requirements by importing countries. Considering the focus of Maldivian industry on tuna, special focus should be laid, among other things, enhancing routine testing of samples for histamine and mercury.

During discussions with MOFAMR officials, it was noted that there is an urgent need to set up a proper customs inspection/ transit storage area for chilled/ frozen seafood exports from Male' airport. The system presently used often tends to affect the cold-chain and consequently affect quality of chilled/ frozen exports. Hence it is recommended setting up a 40MT walk-in freezer/ chilled store at the Male' airport to cater for the needs of such exports (estimated at US\$ 42,000/=).

A list of major equipment requirements of PHL and training needs of MOFAMR and PHL, and a rough cost estimate, including the cost of setting up a transit inspection/ storage facility for seafood exports at Male' International Airport, is given in Table 3.4.1. The total budgeted cost for this activity is US\$ 426,000/=.

**Table 3.4.1 : Equipments needed for Public Health Laboratory (PHL)**

	Item/ Specification	Unit Price (US\$)	Qty
1	Essential parts and accessories for GC, PC based GC workstation, headspace and liquid injection system detectors) etc.	80,000	
2	Gas generators for GC (Hydrogen gas generator, Zero Air generator, Nitrogen gas generator).	21,000	01 each
3	High Performance Liquid Chromatograph MS MS with UV Absorption and fluorescence detectors & accessories.	50, 000	01
4	Autoclave, capacity 100 litres, Front loading electrically heated. Must have printout or chart record of time/ temperature cycle. Temperature range 100-140°C.	12,000	01
5	Scanning Infra-red Spectrophotometer and accessories. Double beam instrument frequency range 40000 to 600 cm <sup>-1</sup> . Must have capability to capture and store spectra on computer; software to include curve fitting, integration and background subtraction.	25000	01
6	Reverse osmosis based water purification system. Capable of delivering ASTM type 1 reagent water.	12000	01
7	Incubator 4 cuft Mechanical convection type. Temperature range 5°C above ambient to 50°C. Required accuracy ±05 °C with uniformity of ±0.3 °C.	4000 each unit	03
8	Homogeniser Stomacher or equivalent type, capacity at least 1 litre.	8000	01
9	Homogeniser, powerGen 35 0.03-100ml volume.	900	01

	Item/ Description	Qty
1	Autoclave, capacity: at least 80 litres.	01
2	Colony Counter, automatic touch the plate operation.	02
3	Reverse Osmosis based water purification system, capable of delivering ASTM type 1 reagent water.	01
4	Six digit Microbalance, capacity 0-100g at least six digit readability.	01
5	Multi-unit extraction system.	01
6	Evaporator, rack type, 20 x 12 mm tubes, heating from 5°C above ambient to 50°C.	01
7	Solid phase extraction system, parallel manifold to hold at least 12 cartridges up to 20x4cm.	01
8	Standard Masses, set of E2 class masses covering the range 500g to 1 mg in '5-2-2-1' series pattern.	01
9	Thermometer Calibration Bath, to hold at least ten liquid in glass thermometers, cover range: -40°C to 200°C.	01
10	Calibration Standards for Ultra Violet-Visible Spectrophotometer.	01
11	Microwave Digestion System for sample preparation.	01

**Total Equipment Cost = US\$ 354,000**

### Short Term Training Requirements

	Name of the Training	Nos.	Level	Duration
1	Seafood Inspection (03 FiDEX, MOFAMR)	3	Certificate	1 month
2	HACCP Audit (3 staffs from FiDEX, MOFAMR)	3	Certificate	1 month
3	HPLC Application (PHL)	2	Certificate	1 month
4	Gas Chromatography Application (PHL)	2	Certificate	1 month
5	Instrumental Techniques (UV) (PHL)	1	Certificate	1 month
6	Food Microbiology (PHL)	1	Certificate	1 month
7	Instrument Calibration (PHL)	2	Certificate	1 month
8	AAS Application (PHL)	2	Certificate	1 month

**16 training programmes of 1-month duration at US\$ 2,500 each = US\$ 40,000**

Cost of walk-in freezer/ chilled-store at the Male' airport	= US\$ 42,000
Equipment costs	= US\$ 354,000
Training costs	= US\$ 40,000
<b>Total Cost</b>	<b>= US\$ 436,000</b>

### 3.5. Establishing a fish marketing information unit at MOFAMR

Considering the great importance of fisheries to the national economy and the socio-economic development of Maldives, importance of developing both domestic and international trade in fisheries, including product/ market diversification cannot be over emphasized.

The proposed facility would have as its main focus facilitation of transfer of fisheries information to private/ public sector entities and to governmental policy makers and planners. Thus it should build up extensive databases on areas such as:

- Fish production/ trade data; national/ international price-market information;
- national/ international trade regulations/ enactments/ standards;
- vessel/ gear/ equipment manufacturers and suppliers;
- national/ international buyers/ sellers of fish and fishery products.

The Unit could not only serve as an information unit, but could also play an active role in market promotion. Databases created could be brought under a common web-site which could also serve as a platform for buyer-seller matching and dissemination of marketing information to end-users. The web-site could carry not only national statistics but also

profiles of export-processors/ small business entities/ cooperatives to facilitate networking and explore business opportunities both domestically and internationally.

Well established radio/ satellite-linked communication facilities with the atolls could serve to enhance the access to such information to small business entities, cooperatives, small-scale processors and to build entrepreneurship in the sector.

It would be also useful to have within the outfit, a centralized, dedicated, trade information unit (TIU or a library), open to public/ industry, to enable the users of the facility to have direct access to relevant technical/ trade/ marketing information. It is important for the proposed unit to network with established regional/ international technical/ trade information sources and databases (GLOBEFISG, FIS, INFOFISH, WTO/ ITC, FISHFILES, FISHPORT etc) some of which provide such information free while some others for a fee. Such a facility would also help policy makers/ planners to have ready access to data/ information on the global markets and their trends.

Within MOFAMAR, FiDEX already undertakes some of the above functions and could easily be upgraded to function as the proposed body, supported with additional staff, technical and logistical support and funding. A basic cost estimate for setting up such a unit, excluding staff costs, is given in Table 3.5.1.

**Cost estimate = US\$ 95,000/= per Table 3.5.1.**

**Table 3.5.1 : Basic Cost Estimate for setting up a Trade Promotion Unit**

		<u>Year 1</u>	<u>Year 2</u>
<b>a) Setting-up Databases</b>			
- high end computers (02)	US\$	5,000	2,000
- high speed modem linkage and electronic data transmission aids		6,000	2,000
Technical support (2mm x 1mm)		16,000	8,000
<b>b) Information unit</b>			
- publications (journals, periodicals, magazines)		8,000	3,000
- audio-visual material		5,000	2,000
- audio-visual equipment		6,000	3,000
<b>c) Trade fair participation (02 staffs x 2 visits)</b>		9,000	9,000
<b>d) Internal travel for trade promotion and information dissemination in atolls/ islands (@ US\$ \$1000/ per month)</b>		12,000	12,000
<b>e) Staff (02) training (database management/ web-design)</b>		8,000	4,000
Sub-total		75,000	45,000
<b>Total (for two years)</b>	<b>US\$</b>	<b>120,000</b>	

### 3.6 Fishery product R&D unit (fish technology unit)

Seafood export-processing sector has developed rapidly since the liberalization of the export trade, exhibiting a rapid expansion of the range of products and markets. So far, most of the initiatives in this respect have been taken by FiDEX, which has assisted and guided the private entrepreneurs in the process. Thus the best strategy would be to upgrade FiDEX to handle the extra responsibilities in this connection.

However, the growing demand for fish products, especially for value-added products, in the global market, rapid growth of private sector involvement in the export trade and expected increase in landings due to planned fleet expansion would necessitate the industry to adapt itself rapidly to cater for market needs. The government could play an important role in this respect by providing technical assistance and support services to identify and develop products to suit various markets. The industry thus could benefit by the services of an outfit which caters for seafood product development, one which provides for pilot-scale production operations, conduct of storage trials, design and development of appropriate packaging and presentation methods for the products, conduct of test marketing and consumer acceptability studies, cost analysis etc.

The total budget for this activity is estimated at US\$ 177,000/= (Table 3.6.1).

**Table 3.6.1 : Indicative Cost Estimate of Basic Equipment for a Pilot Unit and related Training**

#### I. Equipment

1. Mechanical de-boner	US\$ 18,000	
2. Meat strainer	US\$ 25,000	
3. Band saw	US\$ 10,000	
4. Silent cutter	US\$ 15,000	
5. Blender	US\$ 5,000	
6. Sausage stuffer	US\$ 7,000	
7. Vacuum packing machine	US\$ 20,000	
8. Ice machine – 1MT (flake)	US\$ 12,000	
9. Walk-in freezer	US\$ 12,000	
10. Other equipment and utensils	US\$ 20,000	
Sub-Total (Equipment)		= US\$ 144,000

#### II. Training

09 month training in fish processing technology	= US\$	15,000
09 months training in food packaging and sensory evaluation	= US\$	18,000
<b>Total</b>	<b>= US\$</b>	<b>177,000</b>

### **3.7 National Fisheries Industry Board**

The fisheries sector in Maldives is going through rapid transition, from an artisanal fishery to one with a more commercial outlook. The process has involved several governmental Ministries (Fisheries, Trade and Commerce, Health etc) and departments, quasi-government bodies, both artisanal and commercial sectors of the industry. They have had a direct role in the process of fisheries development and have significantly associated with the developmental processes.

However, with the diversification of products and markets and industry getting broad based with the entry of new players, it has become necessary to have a mechanism to get the views of a wide spectrum of the stakeholders in the policy formulation and decision making process. Such a mechanism would be specially helpful for policy makers and planners in developing national fisheries policy, in line with the broad national policy with due consideration to aspirations and expectations of the industry and other stakeholders. In the absence of a representative industry association for the fisheries sector, an apex body of the nature could also help to fill the void. Such a body could also help and assist the inter-ministerial “Fisheries Advisory Board” in its policy formulation functions.

Considering the closely knit nature of the Maldivian fisheries sector, a body of the proposed nature should ideally have the participation of all the stakeholders across the board, including fishermen’s groups, cooperatives, small-medium scale processors along with established industry players. Effective mechanisms of representation, representative participation of the stakeholders including policy makers and planners, modalities of communication with policy making bodies such as “Fisheries Advisory Board” have to be carefully worked out if the body is to achieve its goals.

### **3.8 Utilization of fish waste for animal feed**

Considering the large amount of fish waste generated by the industry, the importance of ongoing efforts towards waste utilization cannot be overemphasized. It is estimated that 3-10MT of waste is produced at the Central Fish Market daily, amounting to a total conservative estimate of 1500-2000MT of waste production/ annum at the market (Figure 8). In addition to this large quantity of waste, waste is also generated at the Felivaru canning plant and at atolls with heavy fish landings. The amounts are considerable at peak fish landing seasons, especially so in those atolls with Maldivefish/ dry fish production.

Waste from the MIFCO cannery at Felivaru is used in the production of fish meal for export. It is interesting to note that some of the black meat is now canned by MIFCO for the domestic market. With the planned focus on aquaculture development in the National Fisheries Development Plan, it is timely to examine the feasibility of using fish meal produced locally as aquaculture/ poultry feed. Even though meal from total fish waste can be used only for the grow-out phase in aquaculture due to the relatively low protein

content of the meal, such meal would fit well for formulations for poultry and other animal feeds.

### 3.9 Fish waste utilization - Composting of waste

It is also recommended to broad-base the ongoing fish silage activities to examine feasibility of fish composting. Considering the large amount of organic waste available in the country (plant material, domestic/ catering waste, saw dust etc) composting could become yet another feasible option, with minimal environmental impact and imported inputs. However, the process should be carefully designed to ensure that there is no contamination of the water table. This could be done by using specially designed cement pits for the purpose. The composting process may also be an alternative method for atolls, especially those with high waste production, to dispose their waste in an environment friendly manner and also to get organic manure for their gardening activities.

Basic cost estimate:

Construction of a 4' x 5' x 16', compartmentalized (in 3 compartments), cement composting pits with vents and a wooden lid would cost Rf 19,000. It is recommended that 2 such units are constructed in 10 selected atolls in the trial phase. The total cost of such construction would be Rf 380,000 or US\$ 29,800/=.

**Table 3.9.1 : Indicative Cost Estimate (including one year's operational costs)**

Construction cost of 20 units (19,000 x 20)	=	Rf	380,000
Operational costs (collection of waste and mixing)/ annum	=	Rf	30,000
Miscellaneous	=	Rf	25,000
<b>Total</b>	=	<b>Rf</b>	<b>435,000</b>
	=		<b>US\$ 34,200</b>
<b>( US\$ = Rf 12.75 )</b>			

**Fig 1. Tsunami destruction to small scale fish processing facilities in Laamu Atoll**



**Destroyed solar dryer**



**Affected drying and cooking utensils**



**Kerosene pump and other destroyed utensils**



**Fig 2. Tsunami damaged small scale processing outfits in Raa Atoll**



**Destroyed fish smoking units**



**Fish vacuum packing unit**



**Kerosene pumps used for cooking**

**Fig 3. Tsunami damaged processing outfits in the Thaa Atoll**



**Damaged cooking baskets under water**



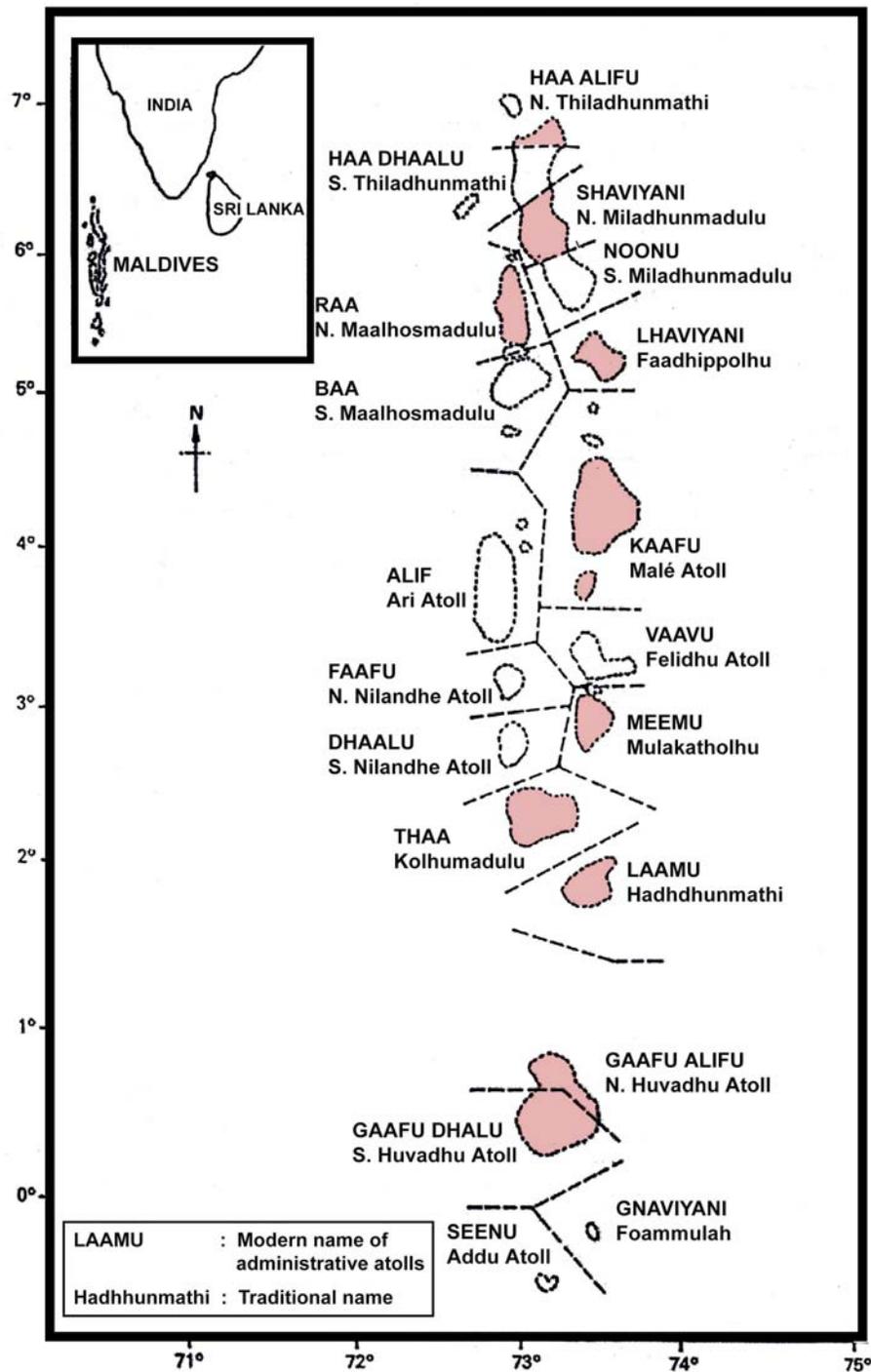
**Damaged cookers**



**Damaged generator**



**Maldive fish processing**



**Fig 4.**  
**MALDIVES – Atolls with heavy tsunami damage to their small-medium scale fish processing facilities**

**Fig 5. Improved fish smoking/drying units introduced by FiDEX, MOFAMR**



**Fish smoking racks**



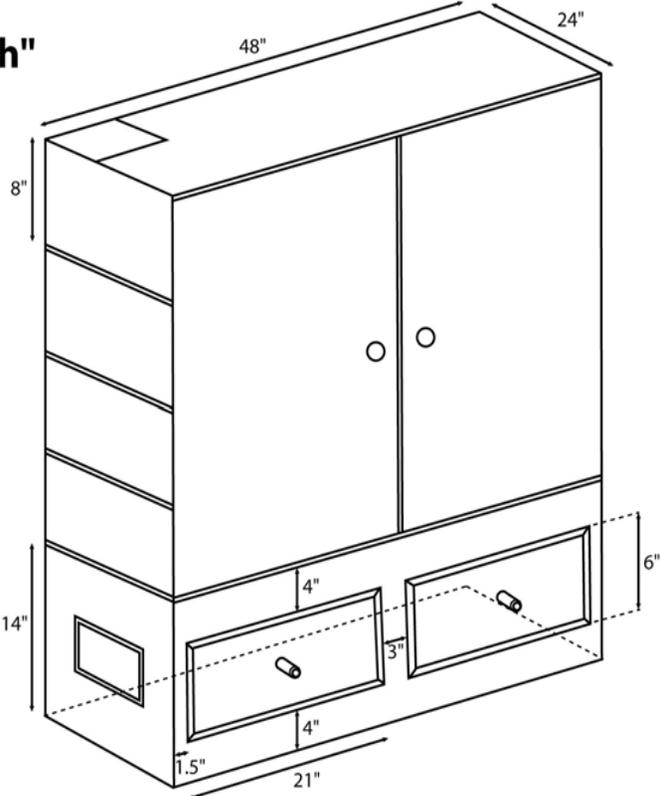
**Solar dryers**

**Fig 6. Training programmes undertaken by FiDEX, MOFAMR**

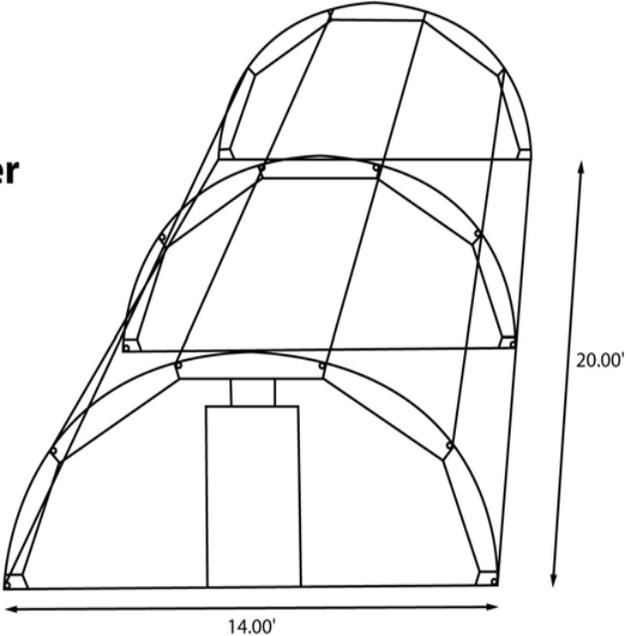


**Fig 7. Improved fish smoker/dryer introduced by FiDEX, MOFAMR**

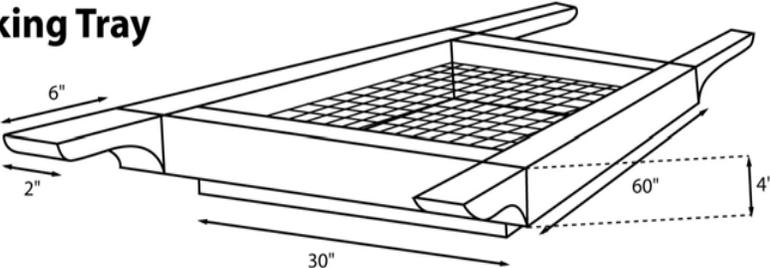
**"Maldivefish"  
Smoker**



**Solar Dryer**



**Smoking Tray**



**Figure 8**



Preparation of skin-off fillets at the Male' Central Fish Market



Fish waste/ offal at the Male' Central Fish Market. About 3-10MT of offal is produced daily at Fish waste/ offal at the Male' Central Fish Market.  
About 3-10MT of offal is produced daily at the Market