

Assessment of harvest and post-harvest losses in fisheries and aquaculture

V. Geethalakshmi

Principal Scientist, EIS Division, ICAR-CIFT, Cochin

Introduction

Indian fisheries and aquaculture is an important sector of food production, providing nutritional security to the food basket, contributing to the agricultural exports and engaging about fourteen million people in different activities. The total fish landing during 2018 was 34.9 lakh tons worth approximately Rs.57510 cores. India's marine product exports was 13.77 lakh tons earning 7.08 US billion dollars during 2017-18 which underlines the importance of the sector. Studies have pointed out that considerable harvest and post-harvest losses occur all along the fishery value chain through the various channels of distribution. Huge losses occur along the fish value chain, both in terms of quantity and quality due to discards at sea, improper handling, storage & icing, lack of cold chain facilities and delay in transportation. Reducing harvest and post-harvest fish loss will enable money saving for the primary producer, enable the sector to feed more and ease the pressure on water, land and climate. Ensuring proper cold storage facilities along the value chain, climate smart processing and packaging, value addition, technology interventions in transportation to avert spoilage can bring down post-harvest losses from 10 to 50% in the fisheries sector.

The inland fisheries covers the brackish and freshwater systems with aquaculture practiced and managed in ponds and fields connected to natural resources. The fish landing sites are numerous and remote in interior parts of the country sometimes inaccessible. Delay in transport, non-availability of ice for proper storage brings down the price of freshwater fishes in the markets which is an economic loss for the primary producer.

The resources once harvested has to be managed and utilized judiciously to derive the maximum benefit and sustain the livelihoods of lakhs of stakeholders involved along the fishery value chain. For an assessment of the extent of harvest and post-harvest losses in marine and inland fisheries at the National level, sound statistical estimates have to be computed. The changes in fisheries sector with reference to technology advancements have led to a changed definition of 'losses' which has been accepted by researchers worldwide. Therefore, assessment of harvest and post-harvest losses gains importance when formulating effective strategies for wholesome utilization of fish and fish products.

Fish losses

Loss per se is defined as the quantity of marine fish which is not fit for human consumption due to physical loss or spoilage of some other reason. Losses at the time of harvesting and onboard the fishing craft are called harvest losses and losses occurring after harvesting i.e. from the landing centre up to the consumer at different stages are called post-harvest losses. Literature classifies Post-harvest losses broadly into three categories –

- ✓ Physical loss
- ✓ Quality loss
- ✓ Market forced loss

Post harvest losses occur due to improper handling and lack of infrastructure at different points starting from the landing centre to the consumer. Apart from these, there are latent losses such as realization of low value due to glut, multi-day fishing etc.

Discarding takes place because, in the course of fishing, many species other than the target species are often caught. This by-catch is usually discarded at sea unless it is worth keeping. Discarding by-catch consisting of a small proportion of mature specimens from healthy stocks causes relatively little damage, but when it consists of juveniles of commercial species it will disturb the balance of the system. Catching large numbers of juveniles is likely to reduce the future number of mature fish. This will have a direct impact on the fishery taking the by-catch, or on other fisheries if the juveniles belong to their target species.

Apart from the loss of a massive amount of potentially valuable food, the incidental capture of dolphins in tuna purse seine nets, turtles in shrimp trawls and marine mammals, birds, turtles and fish in high-seas squid driftnets has led to widespread public concern. Unfortunately, by-catches are an inevitable consequence of an industry that depends upon the capture of species that live alongside other creatures in an opaque medium and as a result can seldom be directly observed and targeted.

By-catch arises primarily because of fishing gears and adopting practices which do not selectively target the desired size and species. The reason for discarding part of the catch is generally economic. In such cases the cost of bringing fish to market is greater than its market value and it gets dumped at sea. Similarly, where a fishing vessel has limited holding capacity, low-value species are discarded in favour of the high-value ones. Introduction of improved harvesting methods, starting from mechanization, indiscriminate increase in fleet size and number, multi-day fishing, use of unregulated mesh sizes have all led to imbalance in several forms and threatening of food security. In tropical countries, high temperatures lead to fish spoilage while still in the boat, at landing, during storage or processing, on the way to market and

while waiting to be sold. There is also considerable economic loss as value gets lost because of lower quality, including insect infestation and breakage.

Several studies have been conducted in the recent past for the assessment of extent of harvest and post-harvest losses in fisheries. As early as 1981 FAO recommended action to reduce post harvest losses in marine fisheries- estimated at that time to be 10 percent of the global total, and up to 40 percent in some developing countries. Studies were conducted at CIFT, Cochin on 'Assessment of harvest and post-harvest losses in fisheries' through a NATP funded project. The percentage loss due to harvest through traditional, motorized, mechanized and large trawlers has been put at 4.13, 3.61, 14.48 and 21.41 respectively within the craft/gear (Anon., 2005). The study has also assessed post-harvest losses in fisheries in different channels viz., market, pre-processing and processing and reported the percentage loss through each of these channels. Losses can be physical, economical and nutritional and can be minimized by adopting suitable post-harvest technology (Johnson and Ndimela, 2011).

Ahmed (2008) has assessed post-harvest losses of fish in Sudan with special emphasis on cultural and socioeconomic aspects including traditional food conservation; economic factors for food conservation and cost-benefit; assessment of the effect of globalization and liberalization of food markets and the fish trade in artisanal fisheries. Ward, A. (1996) developed methods to quantitatively assess post harvest fish losses and to understand and identify the causes in qualitative sense. Adams, (1995) advocates Individual Fishing Quota (IFQ) system where fishermen can be selective about factors as fishing depth, bottom substrate, or time of day, month or year. These factors are directly related to incidental halibut by catch mortality. Clucas, et. al. (1989) reported 20% post harvest losses of annual fish production of about 13.5 lakh tonnes by 16 ECOWAS countries of West Africa. Similar figures were observed in the artisanal fisheries sector that contributes about 90% of the total catch.

Estimation of losses in fisheries

A recent study completed at CIFT, Cochin attempted to estimate harvest and post-harvest losses in marine fisheries. Ernakulam and Alleppey districts were covered for the study. The estimation was carried out at the two stages harvest and post-harvest stages using stratified random sampling design. The channels of fish production namely mechanised, motorised and traditional formed the various strata at the harvest stage, In the post harvest stage, losses occurring at landing centre, processing, marketing and transportation sectors were observed. The study was conducted for a full fishing season to observe loss pattern during monsoon, pre-monsoon and post-monsoon seasons. Around 1 to 3% sampling was done in the harvest stage whereas for the post-harvest study, the sampling done was from 10 to 30% for the various channels.

In the processing channel, the pre-processing centres and fish processing centres in Ernakulam and Alleppey district were covered by using of a sample. The losses occurring in marketing

sector was studied in the wholesale markets, retail markets, roadside markets were covered for the study. The dryfish production and marketing channel was also studied by means of a sample for recording losses occurring in the dryfish sector. The estimates were computed using methodology derived by IASRI for loss estimation (Anon., 2005).

Harvest losses in marine fisheries was estimated from Ernakulam district by stratifying fishing crafts into mechanized, motorized and traditional. Primary data on fish catch and losses was collected for 12 months from fishing crafts operating in six selected fish landing centres at Ernakulam. Loss estimates were computed analyzing the season wise data and pooled data. The sector wise harvest loss estimates are as under :

Harvest losses

Sector	Pre-monsoon (%)	Post-monsoon (%)	Monsoon (%)	Overall (%)
Traditional	1.93 (0.43)	0.98 (0.37)	0.83 (0.28)	1.14 (0.28)
Motorised	3.45 (0.54)	2.76 (0.13)	4.38 (0.53)	3.65 (0.17)
Mechanised (upto 7 days fishing duration)	12.74 (1.23)	11.09 (0.11)	9.11 (0.05)	14.15 (2.10)
Mechanised (more than 7 days)	13.78 (1.24)	14.98 (1.35)	13.35 (1.32)	18.73 (2.22)

Multiday fishing by the mechanized trawlers reported maximum loss due to capture of juveniles and their discards. Around 1500 to 2750 kg of fish gets discarded at sea by trawlers during fishing trips for more than 7 days duration. The no. of hauls during fishing and loss was positively correlated (0.69) at 5% level of significance. The estimate of loss due to mechanized fishing was computed by utilizing information on no. of hauls which was more precise than the traditional estimator. The losses due to motorized fishing crafts was very less in comparison with trawlers. The traditional fisheries sector reported minimal or no loss during the period.

Post-harvest losses

The post-harvest losses in marine fisheries (at the landing centre level) was estimated as below :

Sector	Loss % (SE)
Traditional	0.09 (0.0004)
Motorised	1.19 (0.07)
Mechanised	4.79 (1.09)

The loss estimates when compared with the estimates brought out by earlier studies indicate that the post-harvest losses have come down due to efficient handling of catch. The post-harvest losses in processing and marketing sector was also computed from Ernakulam-Alleppey during the period under report. For reporting loss in processing sector, 50 pre-processing units and 25 processing units were observed and data on raw material processed and loss were recorded fortnightly. Shortage of ice and spoilage were cited as the reasons for loss in pre-processing. At the processing stage, losses occurred due to discolouration, broken tentacles, black spot and at time loss during glazing. Few units reported rejections at export destination due to heavy metal detection.

Losses in the marketing sector was due to damage during transportation, spoilage when delay in transport and weather. Two wholesale markets for fresh fish and one wholesale market for dry fish were covered fortnightly for recording losses due to marketing. Similarly 4 retail markets were surveyed fortnightly of reporting loss in retailing fish. The estimates for post-harvest losses due in processing and marketing are given below :

Post-harvest losses in marine fisheries

Sector	Loss % (SE)
Pre-processing	0.38 (0.04)
Processing	1.19 (0.07)
Dry fish production	36.97 (12.88)
Wholesale market (fresh)	3.79 (1.09)
Wholesale market (Dry)	7.56 (2.12)
Retail market (fresh)	3.13 (0.02)
Retail market (Dry)	8.23 (0.13)
Roadside market (fresh)	2.54 (0.11)
Roadside market (dry)	5.43 (1.19)

The reasons for losses were also recorded along with the loss details.

Harvest losses were mainly due to i) Fish fall from netii)Bruising due to handlingiii) Fish spends too long in the net and gets spoilediv) Lack of ice / Chilling causing spoilage

The reasons for post-harvest losses -

At landing centre the post harvest losses occurred while (i) loading for transport, (ii) kept in the beach without sufficient ice. During the processing of fish when there is a low capacity in the plant fish procured for processing gets spoiled leading to losses. Also adverse weather conditions while drying and insect infestation lead to post-harvest losses

The reasons for post-harvest losses during transport, storage and marketing are listed as under :

Transport

- i) Mechanical damage
- ii) Delay in transport

Storage

- i) Poor storage
- ii) Insect infestation

Market level

- i) Insect infestation
- ii) Packaging
- iii) Mode of transport
- iv) Handling

A look at the loss estimates reveal that the fish loss in the mechanised fishing sector is more compared to the other sectors. Multi-day fishing leads to larger volume of discards at sea which has inflated the estimates. Use of stipulated mesh sizes to avoid juvenile fishing, use of by-catch reduction devices, utilisation of low value fishes for innovative product development and waste utilisation for production of fish based feed and manure will help reduction in harvest and post-harvest losses in fisheries. Training and awareness programmes on the responsible fishing methods developed by CIFT among the merchandised fishermen will check discards at sea. Under NAIP value chain project at CIFT, Cochin a number of innovative technologies for value addition from low value fishes were developed and demonstrated as viable business models for adoption by coastal fisherwomen. Popularization of these technologies along the coastal belt will enhance the income and livelihood of the fisherfolk.

References

1. Adams,-D.J.(1995). Bycatch and the IFQ system in Alaska: A fisherman's perspective *Proceedings Of The Solving Bycatch Workshop, September 25-27, 1995, Seattle, Washington. Wray, T. Ed. Fairbanks, Ak Usa Alaska Sea Grant College Program 1996 pp. 211-218*
2. Ahmed, A.A. (2008) Post-harvest losses of fish in developing countries, *Nutr. Health*, 19(4), : 273-87.
3. Anon. (2005) Assessment of harvest and post-harvest losses – Marine fisheries. National Agricultural Technology Project, CIFT, Cochin 122 p.
4. Clucas, I.J., Poulter, R.G. and Caygill, J.C.(1989). Post-harvest losses of fish in West Africa. *Proceedings of FAO expert consultation on fish technology in Africa fao-1989-no-400 pp273-279*
5. FAO (1981) prevention of losses in cured fish. Fisheries Technical paper No.219, Rome : Food and Agricultural Organisation of the United Nations, FAO, 2003.
6. Kumolu-Johnson, C.A. and Ndimela, P.C. (2011) A Review on post-harvest losses in artisanal fisheries of some African countries, *J. of Fish. And Aq. Sciences*, 1-14.
7. Ward A. R., Jeffries, T. J.(2000). A manual for assessing post harvest fisheries losses, *Natural Resources Institute*.
8. Ward, A, (1996) .Quantification of post harvest fish losses. Overview document. *Programme-Rep-Post-Harvest-Fish-Res-Programme London-UK Overseas-Development-Administration-ODA 1997 no. 1, 21pp*
9. Ward, A. (1996) Quantitative data on post harvest fish losses using informal data collection techniques. *Asia-Pacific Fishery Commission : Summary report of and papers presented at the tenth session of the Working Party on Fish Technology and Marketing Colombo, Sri-Lanka, 4-7-June, 1996 James,D.G.(ed.) 1997 no. 563, pp. 345-356*