

## **Production process and profitability of dried fish in chalan beel areas of Bangladesh**

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### **Abstract**

*Bangladesh has a great potentiality to earn huge foreign exchange by exporting dry fishes. As the largest beel of the country, Chalan beel produces huge amount of fish every year. A large number of fish is being used in sun drying in Chalan Beel region. The present study was designed to figure out the production process and estimation of profitability of dried fish production in Chalan beel areas. The study was conducted in January and October 2017. Field survey was carried out in Tarash and Singra upazilas adjacent to Chalan Beel to assess the fish drying status. A total of 32 dried fish producers were selected for the study through simple random sampling technique. It was observed that, the processing system of dried fish in the areas was traditional. Washing of raw fish was done by beel water and poor quality salts were used for salting in most cases. Majority drying were done by spreading raw fishes on bamboo rack without any protection measure from insects or dust. On an average an amount of 38.8 tonne of raw fishes were dried by a processor per year in Chalan beel areas. The average net return of a processor in dried fish production was Tk. 131911.77 per year and undiscounted BCR was 1.08. There are several factors (age, experience, labour cost, cost of mancha/rack)) which have significant effects on gross return of dried fish processors. Those factors should be given emphasized for earning more gross return. This study revealed that substantial improvement was needed at different stages of handling, processing, and transportation of the dried fish in Chalan Beel areas to get the high quality dried fish products. Training of the fish processors on above aspects including hygiene, sanitation, good water quality and raw materials was found very important to ensure high quality dried products for the consumers.*

**Keyword:** Dried fish, Production Process, Chalan Beel, Bangladesh

### **1. Introduction**

Bangladesh, with its rich inland waters and rivers systems, has significant capture fishery and aquaculture potential. The favorable geographic position of this country comes with a large number of aquatic species and provides plenty of resources to support fisheries potential. Fish and fisheries are indispensable part in the life and livelihoods of the people of Bangladesh and it is the part of our cultural heritage. Fish is a popular complement to rice in the national diet, giving rise to the adage Maache-Bhate Bangali (“a Bengali is made of fish and rice”) (Ghose, 2014). Fish contributes substantially in human diets as good sources of animal protein that also provide other important elements necessary for maintenance of healthy bodies (Ravichandran et

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al., 2012). As a good source of high quality protein, fish can make an outstanding contribution to the nutritional development in Bangladesh. As an extremely perishable commodity due to high water activity and neutral pH, several processes like drying, smoking, salting, curing are often carried out to preserve fishes for a longer period of time. Every year, huge amount of fresh fishes are cured for mass people consumption at the scarcity of fresh fishes in Bangladesh. Sun drying of fishes is a simple and the oldest known method of fish preservation where fishes are dried under the light of sun. Drying method is considered as the least expensive method of fish preservation (Balachandran, 2001). It is one of the most important methods of fish preservation in Bangladesh which is regarded as a traditional and primitive preservation method of fish. Dried fish is a very favorite food item among Bangladeshi people and has a good market demand besides fish and seafood products. Dried fish is low cost dietary protein source and used as a substitute of fish at the scarcity of fresh fish. The nutritional quality remains intact, sometimes retains higher quality standards compared to fish (as per unit weight). The product of dried fish is easily transportable, marketable and storable (Nowsad, 2007). Moreover, dried fish has a storage life of several years.

Chalan Beel is the largest and most important watershed in the North Central Bangladesh covering an area of about 375 km<sup>2</sup> during the monsoon season and 52-78 km<sup>2</sup> during the dry season. Chalan Beel is suitable for indigenous fishes and culture fishes. In the rainy season, the people living around this beel include both professional and non-professional fishers' harvest a huge amount of fishes. During the dry season, the water-covered area is reduced by significant amount and turns individual small water bodies called ponds as well as lakes and canals. These separated water bodies are vital for breeding and maintaining stocks of fish. The farmers met their fish protein during the dry season by producing fish in these small water bodies and during the wet season when the whole area inundated the farmers formed community and cultivate as well as harvest fish cumulatively. So, being the largest beel of the country, Chalan Beel produces huge amount of fish every year. A large number of fish is being used in sun drying in Chalan Beel region. The traditional method of preserving fishes through sun drying is an old practice in areas adjacent to the beel. But the production processes of dried fish of the area are not well developed. Moreover, in the past, the beel covered an area of about 1,085 km<sup>2</sup> but now is reduced to 375 km<sup>2</sup>. The fishermen living in and around the Beel have been severely impacted. Though fishermen used to catch fishes for the whole year in the past, they only go fishing in rainy season now. A survey of Chalan beel showed that the number of fishermen in the area decreased from 177,061 in 1982 to 75,000 in 2006 (BDP 2100, 2015). Large number of fish and aquatic organisms in this water body has diminished. So the production of both fresh and dried fish of this area is now under threat. Through personal encouragement dried fish enterprise is trying to generate spaces in the area but there is no export processing zone which is a crying need now. Bangladesh has a great potentiality to earn huge foreign exchange by exporting dry fishes. Last few years, Bangladesh exports dried fish to abroad and earns a huge amount of foreign currency and this rate is increasing day by day. In 2015-16 financial year the amount was 2229 metric ton which worth 30.12 crore taka (FRSS, 2017). But the contribution from Chalan beel areas is not much more. If it could be organize properly it can be take part in GDP earning for Bangladesh. Though few

works were done on fish drying in different regions of Bangladesh but systematic research on fish drying of Chalan Beel region is rare. This study is a modest effort undertaken to examine the production practices that the processors in Chalan Beel areas follow to process dried fish. The specific objectives of the study are to figure out the processing system and estimate the profitability of dried fish production in Chalan Beel areas and to determine factors affecting gross return of dried fish production. The information may be helpful to both government and non-government organizations to take necessary steps for the improvement of dried fish production in the study area.

## 2. Methodology

The study was conducted in different dry fish yards at Tarash and Singra upazila in Chalan beel area of Sirajgang and Natore districts. The selection of the area for this study was made on the basis of concentration of fish drying and processing in Chalan beel areas of Bangladesh. These areas are famous for supplying dried fish all over the country mainly Rangpur, Sayedpur. Tarash upazila and Singra upazila are well known for fish drying in Chalan beel areas. A total of 32 dried fish processors were selected through simple random sampling technique from Tarash and Singra dry fish yards in Chalan beel areas. The raw data was collected during the field survey in January and September, 2017 through structured interview schedule. Data of secondary sources was collected from various research publications, government annual reports, official statistical abstracts and other authentic sources as per requirement of the study. The collected data for the study were processed and analyzed using different descriptive statistics such as mean, sum, ratio, percentages, etc. were derived and calculated to present the results. Graphical presentation of the data was done in Microsoft Excel. Some analyses were done by using Stata.

In this study, profit was calculated by deducting total costs from total returns. The profitability of dried fish production was derived in terms of gross return, gross margin, net return and benefit cost ratio (undiscounted). The formulas need for the calculation of profitability in discussed below:

### Gross return, gross margin and net return

Gross return is calculated by multiplying the total volume of output of an enterprise by the average price in the harvesting period (Dillon and Hardaker, 1993). The following equation was used to estimate GR:

$$GR = QdPd$$

Where,

GR = Gross return (Tk./season)

Qd = Average amount of dried fish produced (kg./season)

Pd = Price of dried fish (Tk./kg.);

Gross margin was calculated by the difference between gross return and total variable costs. That is,

$$GM = GR - TVC$$

Where,

GM= Gross margin (Tk./season)

GR = Gross return (kg./season.);

TVC = Total variable costs

Net return will be calculated by deducting all costs (variable and fixed) from the gross return.

$$NR = GR - GC$$

Where,

GR = Gross return (Tk./season);

GC = Gross cost (Tk./season) (TFC + TVC);

### Benefit cost ratio (BCR)

The BCR is a relative measure which is estimated as a ratio of gross returns and gross costs. The formula of calculating BCR (undiscounted) is shown below:

$$BCR = GR/GC$$

Where,

GR = Gross return (Tk./season);

GC = Gross cost (Tk./season);

To determine the influence of different factors on the gross return of dried fish production the following model was used in this study:

$$Y_i = \alpha_0 X_{1i}^{\alpha_1} X_{2i}^{\alpha_2} X_{3i}^{\alpha_3} X_{4i}^{\alpha_4} X_{5i}^{\alpha_5} X_{6i}^{\alpha_6} X_{7i}^{\alpha_7} X_{8i}^{\alpha_8} e^{u_i}$$

This non-linear form of Cobb-Douglas model was specified by taking natural logarithms on both sides of the equation as follows:

$$\ln Y_i = \ln \alpha_0 + \alpha_1 \ln X_{1i} + \alpha_2 \ln X_{2i} + \alpha_3 \ln X_{3i} + \alpha_4 \ln X_{4i} + \alpha_5 \ln X_{5i} + \alpha_6 \ln X_{6i} + \alpha_7 \ln X_{7i} + \alpha_8 \ln X_{8i} + u_i$$

Where,

$Y_i$  = Gross revenue of dried fish production (kg.)

$X_{1i}$  = Age of processor (years);

$X_{2i}$  = Education level of processor (years of schooling);

$X_{3i}$  = Experience (years);

$X_{4i}$  = Family size (no.);

$X_{5i}$  = Farm size (decimal);

$X_{6i}$  = Labor cost (Tk.);

$X_{7i}$  = Land use cost (Tk.);

$X_{8i}$  = Cost of mancha/ rack (Tk.);

$\alpha_1$  to  $\alpha_8$  = Coefficients of the respected variables;

$\alpha_0$  = Intercept; and  $u_i$  = Error term.

## 3. Results and Discussion

### 3.1 Production Process of Dried Fish in Chalan Beel Areas

The methods employed for handling and processing of dried fish in Chalan beel areas is still traditional and processors use sun drying method to processing dried fish. Researcher found some steps in the processing system of dried fish in the study area, which are described below.

### **3.1.1 Collection of raw fish**

Dry fish processors in the study areas collect raw fishes from two sources- local fish markets or landing centers (90%) and from fishermen directly (10%). It was observed that large amount raw fishes were collected by the dry fish farmers in the peak harvesting season (July to September) due to availability of raw fish and low market price.

### **3.1.2 Dressing and splitting of raw fish**

Only for large fish like, boal, silver carp and taki, gutting and splitting were practiced. First the fishes were beheaded and then alimentary canal was removed from the body. Other small fish species were directly dried under the sun without any dressing.

### **3.1.3 Washing and Salting**

In most cases, dry fish farmers washed their raw fish with beel water as there were no good water supply sources in drying areas and few dry fish farmers used tube well water for this purpose. Many dry fish farmers did not wash their raw fish. Dried fish processors used salt for mixing with raw fishes before drying but they did not maintain any fixed ratio of salt and fish. They generally mixed 1 kg commercial salt for 18-20 kg of fishes. All the dried fish processors (100%) used non-brand commercial salt for salting.

### **3.1.4 Drying under the sun**

In the surveyed area, drying process varied according to the size and type of fishes. Small fishes were dried in the sun by spreading them on fish drying yard which was either the open field or bamboo made rack called 'khola' of 0.6-1.2 meter high from earth in most cases. Fish drying yards were situated near the fish market or highway for easy communication. It was observed that large fishes were hanged from a rope tied horizontally to the two poles placed vertically for drying instead of using any rack. Most of the dried fish processors used fishing nets over the rack to prevent fish from insect infestation.

### **3.1.5 Sorting**

Except for large fishes, other fishes remained in mixed condition and were sorted after drying. Almost all the dried fish processors sorted out the mixed dried fishes and separated the fish according to the species and size of the dried fish (Plate 6.2).

### **3.1.6 Packaging and Storing**

After sorting, the dried fishes were bagged into a plastic and hessian bag for easy handling. Sometimes bamboo baskets were also used for this purpose. Storage of dried fish was found to be performed in a tent generally made of thin plastic sheet and bamboo splits (Plate 6.3). This tent is usually made in the place of fish drying. Bagged dried fishes were kept into these tents for temporary storage until marketing or selling where there is a great chance of contamination with filth and dust.



Plate 3.1 Pictorial view of fish drying under the sun



Plate 3.2 Pictorial view of sorting of dried fishes according to species and size

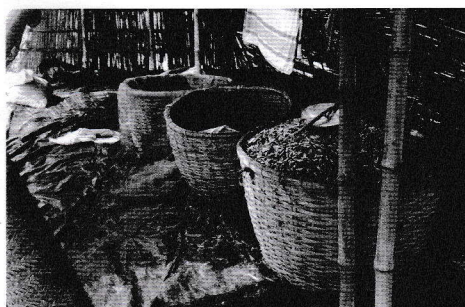


Plate 3.3 Pictorial view of storing of dried fish

**Collection of raw fish**  
(Local fish market, fishermen)

**Dressing, gutting and splitting of raw fish**  
i. done for large fishes only  
ii. small fishes dried without dressing

**Washing**  
(Beel water mainly, rarely used tubewell water)

**Salting**  
(Mixed with 1 kg. salt for 18-20 kg. fish)

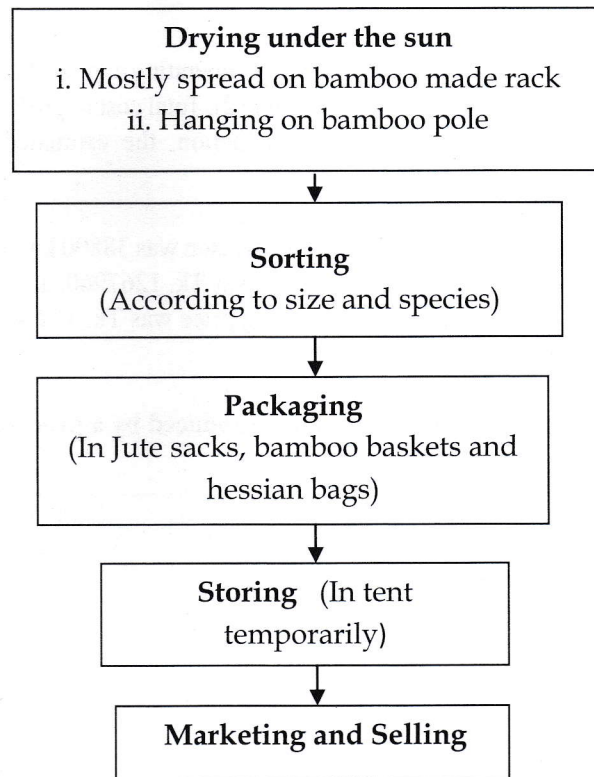


Fig. 1 Flowchart of overall fish drying activities in the study areas

### 3.2 Profitability of dried fish production in Chalan Beel areas

For profitability analysis, it is necessary to compute both variable and fixed cost. To calculate the costs, returns and profitability of dried fish in the study area, calculations were done in terms of per year or season basis.

#### Variable costs, Fixed costs and Total costs/gross costs

Variable costs are incurred because of the costs of using the variable inputs. These costs vary with the level of production. For dried fish production, variable costs includes purchase cost of raw fish and all kinds of processing and marketing cost like labor cost, transportation, loading and unloading, salt, basket, net, equipment, Aratdar's commission etc. Generally dried fish processors use leased land for dried fish production which is adjacent to the beel areas. The lease value of land varies from area to area depending upon the location and convenience. So, it is also a variable cost. The estimated variable cost incurred for dried fish production was Tk. 1512884.2 (Table 2). Fixed costs are those costs which do not change in magnitude as the amount of output changes and are incurred even when production is not undertaken. In case of dried fish production,

fixed costs include cost of mancha or rack and interest on operating capital. The estimated fixed cost incurred for dried fish production was Tk. 71474.33 (Table 2). Total cost or gross cost is the summation of variable cost and fixed cost. For dried fish production, the estimated total cost was Tk. 1584402.62 (Table 2).

Table 1 shows the average amount of raw fish dried in a season was 38800 kg. or 38.8 tonne, average purchase price of raw fish was Tk. 32.67, purchase cost was Tk. 1267960, amount of dried fish after drying was 11255.6 kg. or 11.255 tonne, average selling price was Tk. 152.48 and total return was Tk. 1716314.

**Table 1 Estimation of average amount of dried fish produced by a processor and total return in a season/year**

| Particulars                                              | Total amount/value          |
|----------------------------------------------------------|-----------------------------|
| i. Average amount of raw fish dried in a season          | 38800 kg. or 38.8 tonne     |
| ii. Average Purchase price (Tk./kg.)                     | 32.67                       |
| iii. Raw fish purchase costs (Tk.) (i*ii)                | 1267960                     |
| iv. Amount after drying (by considering conversion rate) | 11255.6 kg. or 11.255 tonne |
| v. Average Selling price (Tk./kg.)                       | 152.48                      |
| vi. Total Return (Tk.) (i*ii)                            | 1716314                     |

Source: Authors estimation, 2017.

**Table 2 Estimation of average amount of total cost in dried fish production by a processor in a season or year**

| Cost items                             | Unit       | Quantity | Price per unit (Tk.) | Total value (Tk.) | Percentage |
|----------------------------------------|------------|----------|----------------------|-------------------|------------|
| Variable costs                         |            |          |                      |                   |            |
| a. Purchase cost of raw fish           | kg.        | 38800    | -                    | 1267960           | 80.02      |
| b. Processing and marketing cost       |            |          |                      |                   |            |
| Transportation                         |            |          |                      | 26331.3           | 1.66       |
| Raw fish                               | Tonne      | 38.8     | 200                  | 7760              |            |
| Dried fish                             | Tonne      | 6.753    | 2750                 | 18571.3           |            |
| Loading and unloading                  | Tonne      | 38.8     | 225                  | 8730              | 0.55       |
| Salt                                   | kg.        | 1940     | 18                   | 34920             | 2.20       |
| Repair cost of mancha/rack             | -          | -        | -                    | 8875              | 0.56       |
| land use cost                          | -          | -        | -                    | 10425             | 0.65       |
| Labor cost                             |            |          |                      | 120000            | 7.57       |
| i. Hired labour                        |            |          |                      | 82500             |            |
| Men                                    | man/day    | 1        | 250                  | 37500             |            |
| Women                                  | man/day    | 3        | 100                  | 45000             |            |
| ii. Family labour                      | man/day    | 1        | 250                  | 37500             |            |
| Bamboo basket                          | piece      | 8        | 650                  | 5200              | 0.32       |
| Net                                    | piece      | 7        | 560                  | 3920              | 0.24       |
| Bamboo made equipment                  | piece      | 12       | 25                   | 300               | 0.01       |
| Storeroom                              | -          | -        | -                    | 3225              | 0.20       |
| Wastage                                | -          | -        | -                    | 8500              | 0.53       |
| Aratdar's commission                   | kg         | 6753.36  |                      | 14497.9           | 0.91       |
| c. Total processing and marketing cost | 244924     |          |                      |                   | 15.45      |
| i. Total variable cost (Tk.) (a+c)     | 1512884.2  |          |                      |                   | 95.49      |
| Fixed costs                            |            |          |                      |                   |            |
| Cost of mancha/rack                    | 40000      |          |                      |                   | 2.52       |
| Interest on operating capital          | 31474.33   |          |                      |                   | 1.99       |
| ii. Total fixed cost (Tk.)             | 71474.33   |          |                      |                   | 4.51       |
| iii. Total cost (Tk.) (i+ii)           | 1584402.62 |          |                      |                   | 100        |

Source: Authors estimation, 2017.

**Results of financial returns of dried fish production**

Table 3 shows gross return, gross margin, net return and benefit cost ratio (BCR) of dried fish production in a season. Gross returns were calculated by multiplying the average amount of dried fish produced per year with their respective market prices. Gross return or total return from dried fish production per year was Tk. 1716314.4. Gross margin is the difference between the gross

return and total variable costs. Gross margin from dried fish production was Tk. 203430.2/year and Tk. 5.24/kg. (Table 3). Net return was obtained by subtracting gross costs from gross return, or deducting fixed cost from gross margin. Net return from dried fish production was Tk. 131911.77/year and Tk. 3.39/kg. (Table 3). The benefit cost ratio (BCR) was calculated as a ratio of gross returns and gross costs. Benefit cost ratios of dried fish production were 1.08 which implies that Tk. 1.08 would be earned by investing every Tk. 1.00 in dried fish production

**Table 3 Estimation of costs and returns in dried fish production by a processor in a season or year**

| Particulars                                             | Total value    |          |
|---------------------------------------------------------|----------------|----------|
| i. Total return (Tk./year)                              | 1716314.4      |          |
| ii. Total variable cost (Tk./year)                      | 1512884.2      |          |
| iii. Total cost (Tk./year)                              | 1584402.62     |          |
| iv. Gross margin (Tk.) (i- ii)                          | 203430.2/year  | 5.24/kg. |
| v. Net return (Tk.) (TR-TC) (i-iii)                     | 131911.77/year | 3.39/kg. |
| vii. Benefit cost ratio (BCR) (i÷iii)<br>(Undiscounted) | 1.08           |          |

Source: Authors estimation, 2017.

### 3.3 Factors affecting gross return of dried fish production

To determine the key factors that affect gross return of dried fish production, several tests were done and it was seen that Cobb-Douglas model fits best for the particular data set and there was no multicollinearity, omitted variables and heteroskedasticity problems in the model. Table 4 shows the results of the tests.

**Table 4 Results of omitted variables test, heteroskedasticity test and multicollinearity test**

| Sl. No. | Test                                                              | Hypothesis                                      | F/chi <sup>2</sup> values with probability                   | Decision                              |
|---------|-------------------------------------------------------------------|-------------------------------------------------|--------------------------------------------------------------|---------------------------------------|
| 1       | Omitted variables by using Ramsey RESET test                      | H <sub>0</sub> : model has no omitted variables | F(3,20) = 1.68 and Prob > F = 0.2026                         | Failed to reject null hypothesis      |
| 2       | Heteroskedasticity test by using Breusch-Pagan/Cook-Weisberg test | H <sub>0</sub> : Constant Variance              | chi <sup>2</sup> (1) = 0.03 Prob > chi <sup>2</sup> = 0.8733 | Failed to reject null hypothesis      |
| 3       | Multicollinearity test                                            | H <sub>0</sub> : VIF constant                   | No value > 10                                                | There is no multicollinearity problem |

Source: Author's estimation, 2017 (Adapted from Appendix).

**Table 5 Estimated values of coefficients and related statistics of Cobb-Douglas production function model**

| Variables                                                                                      | Notation       | Value of Coefficient | Standard error | P value |
|------------------------------------------------------------------------------------------------|----------------|----------------------|----------------|---------|
| Constant                                                                                       |                | 2.9037               | 1.9963         | 0.159   |
| Age (year)                                                                                     | X <sub>1</sub> | 0.7080*              | 0.3701         | 0.068   |
| Education level (year)                                                                         | X <sub>2</sub> | -0.0026              | 0.1029         | 0.980   |
| Experience (year)                                                                              | X <sub>3</sub> | 0.3024**             | 0.1508         | 0.057   |
| Family size (No.)                                                                              | X <sub>4</sub> | -0.1312              | 0.2251         | 0.566   |
| Farm size (decimal)                                                                            | X <sub>5</sub> | 0.0313               | 0.0834         | 0.711   |
| Labour cost (Tk.)                                                                              | X <sub>6</sub> | 0.0834               | 0.0709         | 0.250   |
| Land use cost (Tk.)                                                                            | X <sub>7</sub> | 0.4595**             | 0.1916         | 0.025   |
| Cost of mancha/rack (Tk.)                                                                      | X <sub>8</sub> | 0.2931***            | 0.0943         | 0.005   |
| F (8,23) = 17.55<br>R-squared = 0.85<br>Adjusted R-squared = 0.8103<br>Returns to scale = 1.74 |                |                      |                |         |

Source: Author's estimation, 2017. \*\*\* Significant at 1 percent level; \*\* Significant at 5 percent level and \* Significant at 10 percent level

The result of Cobb-Douglas revenue type function model (double log model) is presented in Table 5. The estimated values of the relevant coefficient revealed that, among the included eight variables, age of processors, experience, labor cost and mancha/rack cost showed positive and significant effect on return of dried fish production.

It is evident from Table 5 that the value of the coefficients of determination (R<sup>2</sup>) of the model was 0.85 which mean that the explanatory variables included in the model explained 85 percent of the total variation of gross return of dried fish production.

The measure of overall fit of the estimated regression, F-values was 17.55 which was significant at 1% probability level implying that all the included explanatory variables included in the model significantly explained the variation in gross returns of dried fish production.

#### 4. Conclusions and Policy Recommendations

The findings of the study revealed that, fish drying in two drying areas of Chalan beel is traditional. Sun drying is carried out in an unhygienic condition. Different problems observed during study period which were selection of poor quality raw fishes for drying damaged fishes in most cases; washing of raw fishes with dirty water especially with beel water instead of tube well or other water of good quality; use of low quality commercial salt during salting, also proper ratio of salt and fish was not maintained. No dressing of used fishes in many cases; drying

directly on earth surface which affect the quality of dried product strongly. Moisture, dust and other harmful substances from the environment can easily be mixed to the fish and make the fish susceptible to the microorganism or insect attack. In most cases, storage of dried fish in unhygienic condition was observed which usually took place in the tent having no platform. Furthermore, it was also found that raw and dried products were kept in the same tent which badly affects the quality of dried final product. In this situation, therefore, it is necessary to practice scientific drying methods in all the drying process and, more research and extension opportunities along with the knowledge of dried fish processing to increase the awareness among dry fish farmers on proper handling procedures and quality standards to ensure reduction in losses and improving the quality of products. A satisfactory dried product is highly desirable at all consumer levels. In these instances, low cost solar dryer can be constructed by using locally available materials that will ensure high quality dried products which will be safe for consumption and will fetch higher economic benefits for the dried fish processors and consumers.

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