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# The application of material handling in fish fillet production process of red snapper in PT X

A L Rucitra

Department of Agro-industrial Technology, Faculty of Agricultural Technology  
Universitas Brawijaya, Malang, Indonesia

E-mail: andanrucitra@ub.ac.id

**Abstract.** Fish is one type of food that contains protein, fat, vitamins and minerals that are good in fulfilling necessary for human nutrition. Indonesia is a country with fisheries and marine resources reaching 5.8 million km with a potential of 6.4 million tons of fish every year. PT X is one of the companies engaged in fish freezing in Indonesia which has exported many products to several countries. Production activities are the most dominant part carried out by PT X. A good production management system is system that regulates the smooth process of its production, besides that it is also determined by the proper handling of materials. In any companies, include PT. X, production activities are critical, thus a good production management is necessary to smoothing the production process and material handling. While, the material handling itself has a big portion in the operational cost. The purpose of this study was aimed to determine the application of material handling and the costs required in the process of handling red snapper fish in PT X. The results of the application of material handling that there are 8 directions of material transfer in the process of fish fillet production in PT X namely the transfer of material to Carbon monoxide's (CO) room, transfer to Air Blast Freezer (ABF), transfer to packing room, transfer to cold storage and transfer from ABF to containers. From these transfer, the total cost of these material transfer per day in PT X is IDR 291,592.94.

## 1. Introduction

Fish is one type of food that contains protein, fat, vitamins and minerals that are good in fulfilling human nutrition. Indonesia is a country with fisheries and marine resources reaching 5.8 million km with a potential of 6.4 million tons of fish every year [1]. From these data shows that the results of Indonesian fisheries production are very large. Therefore, it is necessary to use in the framework of developing food diversification. Fish is known as a food ingredient that is very fast spoilage and decomposes. Murniyati defines Preservation as every effort to maintain the quality of fish as long as possible so that it can still be utilized in good conditions and suitable for consumption [2].

Some types of fish favored by the community include tuna, grouper and snapper. Red snapper is one type of fish that can improve the foreign exchanges. Red snappers are very popular, not only in Indonesia but also in other countries. PT X is one of the companies engaged in fish freezing in



Indonesia with one of the favourite product is red snapper fillet. At PT X, production activity of company is the most dominant part. Production is not the application of tools to materials; it is the application of logic to work. Management needs to understand the logic behind each system of production and applies these principles consistently and thoroughly [3]. There is a strong concern to adjust the supply system in a company to achieve a higher service level internally and to the outside customers to bring to a higher operational level and even a possible differential when compared with the other competitors [4].

A good production management system is a system that regulates production activities that ensure the ease in production processes, this is needed to support the ease in production activities. In addition to setting up a good production management system, the ease in production process is also determined by the appropriate material handling. To implement a cost effective system company that is able to work at the present time without any obstacle for its successful implementation [5].

Material handling is an activity that is very important in PT X, because there are many activities that must be done in the transfer and placement of materials in the form of fresh fish at the levels of the production process that must be passed. Starting from the arrival process of raw materials, the process of fish fillet freezing to the fish fillet product that is ready for export. This causes material handling to take a large production cost. Therefore, material handling costs are difficult to be separated from the elements of other production costs. So it can be said that the industry needs to be paying attention to the material handling matters ranging from raw materials to finished products.

## 2. Materials and methods

This research was carried out at PT X, processing at the Computing Laboratory and System Analysis of the Department of Agricultural Industry Technology, Universitas Brawijaya. This research was conducted by observing all aspects of the company's production starting from the arrival of raw materials to producing finished products. In addition to solving problems and supporting statements related to the transfer and laying of materials, the interview process was conducted with the head of the company's production department. Identification of the problem in this study was carried out with the aim of providing clear direction to researchers regarding the steps that must be taken. The identification of the problems that will be solved through this research is "The Application of Material Handling in Fish Fillet Production Process of Red Snapper in PT X". Material handling analysis is used to determine the process and stages of material transfer in the production process at PT X and provide an overview of the costs incurred from material handling.

### 2.1. Data collection

The respondent is the person that directly involved with the daily flow of materials, selected intentionally. The respondents held positions as leaders. Data collection for the satisfaction survey was divided into two stages. The first step was an open-ended question survey. Respondents were asked about their perceptions regarding the suggestions for the relevant attributes in question about material handling.

### 2.2 Material handling cost

The equation used to calculate material handling costs is as follows [6]:

$$MHC = r \times f \times \frac{\text{cost}}{d} \quad (1)$$

Where:

MHC = Material handling cost  
 r = displacement distance (m)  
 f = displacement frequency  
 cost = operating cost/ hour

### 3. Results and Discussion

In PT X material handling activities can be interpreted as a material transfer activity (moving) which includes the transfer of raw materials from receiving, the production process until the product is ready for export. Material handling processes are important in planning the layout of production facilities, because they determine the relationship between production facilities with each other.

#### *3.1. Material handling in the production process of red snapper fish fillet*

In fresh red snapper products, the raw material comes from the purchases in Fish Auction Place, which is located in Tuban and Cilacap areas and also comes from the place of direct purchase from fishing or fish cultivation companies in Probolinggo. Furthermore, the fish that have met the standards desired by PT X will be sent to the company by using a pick-up car or trucks equipped with ice cubes. The raw material in the form of red snapper is immediately received in the receiving room. Before the unloading, the quality control for the quality itself, size and appearance is carried out. The stage I washing is also done. Then the sorting is done by sizing and grading. This sizing and grading serves to classify the red snapper according to the size, weight and quality. The equipment used is the container basket and a scale, then the unloading of fish is carried out and transferred into a plastic basket and then directed to the production room using a push cart.

Red snapper enters the stage II, which is the washing stage, as soon as it arrives in the production room. This washing stage is used to clean the fish from dirt that may still be attached to the skin or dirt that may be carried out when receiving using the cold water at a temperature of 5°C, then the sweeping and washing stage III in the washing tub are performed. The next step is the filleting process by separating the fish meat from the head and main bone (center) to the maximum extent so that not much meat is left in the bone with a fillet knife on the aluminum table, transferred to the next table by using a basket for trimming. The trimming process is carried out using a trimming knife with a thickness of 1-1.5 mm and also tweezers to remove the thorns from the fish meat. After the trimming process, the fish is packaged and arranged in a polyethylene plastic with each plastic containing 9 fish arranged in 3 levels. Each level is limited by the wet sponges. The function of the wet sponge is to absorb the excess fluid from the body of the fish so that the CO penetration in the fish body is more effective.

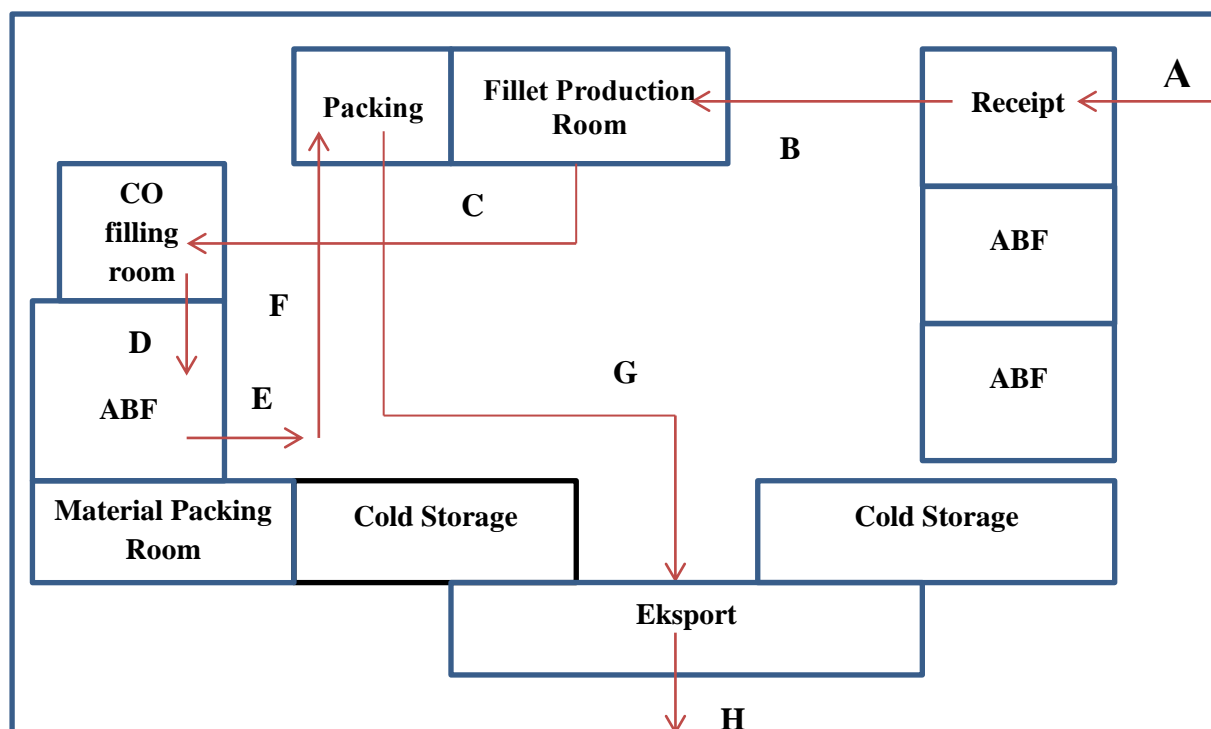
The red snapper fillets are then taken to the CO room by using a stroller. CO gas functions as an indicator to show the quality of meat. Plastic containing CO gas is stored in a chilling room with a temperature of 5-10°C. After the chilling process, fish fillets are removed from the plastic containing the CO, observed on top of the lamp to identify the presence of green stains or black spots on fish meat and packaged using polyethylene which is adjusted to the size of the fillet. The next treatment is vacuuming and retouching. Vacuuming is done to remove air in the packaging plastic so that it can prevent an aerobic microbial growth and retouching is done by using the fingers to smooth and shape the position of fish and skin meat in order to avoid an overlap. Next is the preparation of red snapper fillets on the pan that are done quickly so that the fillet temperature does not rise. The process of preparing red snapper fish fillets in a pan is aimed at arranging red snapper fish fillets in the pan so that the appearance of frozen red snapper fillets produced is interesting. The pan that has been filled with fillets are placed in a push rack and then inserted into the Air Blast Freezer (ABF). Arrangement of fillets on a shelf is carried out based on the capacity of ABF.

In the ABF space, the push rack is adjusted to the distance so that the cold air that is exhaled can be circulated properly. The labelling on the push rack shows the results of the production process, shifts, sharp air fluctuations, so that the temperature remains stable. ABF used has a temperature of -40°C for 4 hours. The fillets are then packed in boxes and labelled based on the type of fillet, product code and weight of each piece. As long as the product has not been sent, the product is stored in cold storage so that the quality does not go down since the temperature increases. The frozen products that have been packaged are stored in cold storage with a trolley through the ante-room (the space between rooms) which has the temperature of 10°C. As soon as the new stroller is full, the frozen products are put into the cold storage with a temperature of -26°C. Meanwhile, the delivery is carried out by using a

container equipped with a cooling device with a temperature of  $-20^{\circ}\text{C}$ . Red snapper fillet product produced by PT.X is ready to be exported to Asian countries, especially Japan, Korea and China

### 3.2. Plant lay out

Room arrangement in PT X for placement of production facilities and other facilities based on Product Lay Out. In the production of red snapper fillet., machines and equipment used are mostly still manual or controlled by humans. Some material handling factors that need to be considered in preparing equipment at PT X are there is sufficient space to place safely the types of mechanical equipment that can accommodate the largest load and enough for the movement of people who move parallel, availability of sufficient space for workers to walk, and store items to remain in good condition during work and plan a surveillance post. Facility placement is adjusted to the order of the production process (Figure 1).



**Figure 1.** Stream production process of snapper fillet production.

### 3.3. Material handling equipment

The material handling equipment that is usually used in a factory can be divided into 2 types. First, Fixed Path Equipment, which is the material handling equipment used for certain production processes and cannot be used for other purposes. Second, Varied Path Equipment, which is material handling equipment that is not specific to transport or move certain materials or goods [7]. In PT X, the types of material handling equipment used in the production process are mostly Varied Path Equipment types, namely material handling equipment that is not specific to transporting or moving certain materials or goods. This type of material handling equipment is not only used specifically for one particular process but is also used for other processes. With this type of material handling equipment there is no need to be specific in using this type of equipment which will later confuse workers such as a stroller.

To expedite the production process, PT X uses several machines and equipment in its work activities. The freezing machines used in PT X in the production process is ABF. This freezing machine is a room where cold air is circulated around the product which is exhaled with the help of a blower/fan. Basically, the freezing process used is the fast freezing to produce soft ice crystals so that

it can suppress the amount of drip loss when the product is thawed. ABF owned by PT X has a temperature that can reach  $-30^{\circ}\text{C}$  with a capacity of 15 tons.

The equipment used in the process and freezing of the product includes: the compressor for flowing the refrigerant by sucking the liquid refrigerant from the condenser and pressing (compressing) the liquid refrigerant to the evaporator that is loaded with frozen products, plastic baskets, digital scales, push carts

### 3.4. Material handling cost

In material handling, the cost has a large influence on production cost. In order to reduce the production costs, material handling costs must be minimized. Material handling costs are influenced by the amount and type of material removed and the distance of material transfer. The purpose of material handling analysis is to achieve material transfer in an orderly fashion without disrupting the production process and low cost process.

Direct Labor is a workforce that is directly involved in the production process. The costs incurred by the company to pay for this workforce are linked to the cost of goods produced and are proportional (comparable) to the level of activity that carried out. Due to the production process that is done manually at PT. X, there is no fuel cost. Wages earned by workers amounted to IDR 33,500 per day. As for the production process, PT. X experienced 8 transfer processes which can be seen in the Figure 1. Material removal includes:

- a. Transfer of Materials (fish) from Trucks. The first transfer in the production process is the transfer of fish from the truck at the Receiving site. This transfer is carried out by 4 workers with a displacement distance of approximately 2m, with materials weighing 4 tons. The movements are done 2 times with the 180 minutes amount of time in every transfer using a plastic tub.
- b. Transfer of fish to the production room. The next transfer is the transfer of fish to the production room. This transfer is carried out with the help of a push cart, with the time needed is 5 minutes for one transfer, so it needs to be done 10 times to be able to meet the production needs per day. The weight of the fish that is moved is 300 kg with 2 workers as fishers
- c. Transfer of fish to CO room. The third transfer carried out is the transfer of fish to the CO room, this transfer is carried out at a distance of about 10 meters, the workers needed in this process is 1 worker, with the amount of material transferred as much as 100 kg, because it had undergone a production process carried out within 5 minutes by using a stroller.
- d. Transfer of fish from the CO room. The fourth transfer is the removal of fish from the CO room. This transfer is carried out 10 times with 1 person working with a load of 100 kg with the help of a push cart for 6 minutes with a transfer distance of 10 m.
- e. Transfer of fish to ABF. The fifth transfer is the transfer of fish from CO room to ABF, this transfer is carried out with a displacement distance of 8 meters, with a total workforce of 2 people with a fish load of 25 kg. The transfer of fish to ABF is carried out 40 times with a time of 5 minutes for every transfer using a stroller.
- f. Transfer of fish from ABF to the packing room. The sixth transfer is the transfer of fish from ABF to the packing room for the packaging process to be carried out. The transfer using the stroller is carried out for 5 minutes with 10 times transfer a day, material in the form of 100 kg of fish with a distance of 10 m and a workforce of 2 person.
- g. Transfer of products to the cold storage. The seventh transfer is the transfer of fillet products to cold storage with a displacement distance of 2m, 4 workers in charge of this process. Products in the form of fish fillets produced are as much as 360 kg with a displacement of 3 times per day within 2 minutes to make this move.
- h. Transfer of products to containers. The last transfer is to move the product in the form of fillets to containers, this process is carried out for approximately 5 minutes, with a displacement of 40 times, the weight of the finished product is 360 kg. Since this process requires a fast time to be

able to maintain the condition of the product, there are 8 workers needed for this transfer. The complete calculation of costs can be seen in Table 1.

**Table 1.** Data on material transfer in production activities.

Direction	Each Material Transfer (kg)	Moving Distance (meter)	Total time in each transfer (minutes)	Number of transfers per day	Number of Workers	Number of materials transferred (ton)	Amount of time to move (minutes)	Labor Costs *) (IDR)
	(1)	(2)	(3)	(4)	(5)	(1 x 4)	(3 x 4)	
1. A	4000	2	180	2	4	8	360	100,500
2. B	300	10	5	10	2	3	50	6,951.2
3. C	100	10	5	10	1	1	50	3,475.6
4. D	100	10	6	10	1	1	60	4,187.5
5. E	25	8	5	40	2	1	200	27,888.76
6. F	100	10	5	10	2	1	50	6,951.2
7. G	360	2	2	3	4	1.08	6	16,750
8. H	360	5	5	40	8	14.4	200	33,500
TOTAL								200,204.26

\*) Labor Costs (IDR) = Transfer time (minutes) x (1 hour)/(60 minutes) x Number of workers (man) x IDR 4187,5 / man.hour\*\*)

\*\*) Obtained from : Wages per day = IDR 33,500

1 day = 8 production hour

From the calculation, it is obtained that for the material transfer activities are as follows: for the transfer of materials in the form of fish from the truck costs IDR 67,121.53 per day (80 tons of fresh fish), for the transfer of fish to the production space requires a fee of IDR 6,743.403 (3 tons of fresh fish), for the transfer of fish to the CO room requires a fee of IDR 3,393.403 (a fillet product of 1 ton), and for the removal of fish from CO room requires a fee of IDR 3,393.403 (1 ton fillet). Next is the transfer of fish to the ABF with a transfer fee of IDR 8,429.25 (1 ton of fillet products), for transferring the fish from ABF to the packing room for IDR 6,743.403 (with a product of 1 ton), and the transfer of products to the cold storage with the fee of IDR 67,217.015 and the transfer of products to containers with the fee of IDR 53,600 so the total material handling costs in the process of producing the red snapper fillets as much as IDR 216,641.41 per day is obtained.

The material handling at PT X is already suitable because the transfer of materials has been carried out smoothly. This is supported by the arrangement of facilities in accordance with the production process flow of the red snapper fillets. In the material transfer path (Fig. 3) there is a crossing line of the material transfer which suggests a bottleneck in the material transfer process. However this does not occur in fact. Because the activities of product transfer from ABF to the packing room are only done 10 times a day and this does not interfere with the movement of fish from the production room to the CO filling room.

#### 4. Conclusion

Transfer the materials at PT X is divided into 8 direction of transfer, namely the transfer of materials (fish) from the truck, transfer of fish to the production room, transfer of materials to CO room, transfer of material from CO room, transfer of fish to ABF, transfer of fish from ABF to packing room, transfer product to cold storage and product transfer to container. Of these transfers, the total material handling costs per day are IDR. 291,592.94.

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