Innovated Conceptual Design of Loading Unloading Tool for Livestock at the Port

Achmad Mustakim, Firmanto Hadi

Department of Marine Transportation Engineering, Institut Teknologi Sepuluh Nopember (ITS)

E-mail: mustakim@seatrans.its.ac.id

Abstract. The condition of loading and unloading process of livestock in a number of Indonesian ports doesn’t meet the principle of animal welfare, which makes cattle lose weight and injury when unloaded. Livestock loading and unloading is done by throwing cattle into the sea one by one, tying cattle hung with a sling strap and push the cattle to the berth directly. This process is against PP. 82 year 2000 on Article 47 and 55 about animal welfare. Innovation of loading and unloading tools design offered are loading and unloading design with garbarata. In the design of loading and unloading tools with garbarata, apply the concept of semi-horizontal hydraulic ladder that connects the ship and truck directly. This livestock unloading equipment design innovation is a combination of fire extinguisher truck design and bridge equipped with weightlifting equipment. In 10 years of planning garbarata, requires a total cost of IDR 321,142,921; gets benefits IDR 923,352,333; and BCR (Benefit-Cost Ratio) Value worth 2.88. BCR value >1 means the tool is feasible applied. The designs of this loading and unloading tools are estimated up to 1 hour faster than existing way. It can also minimize risks such as injury and also weight reduction livestock agencies significantly.

1. Introduction

1.1. Background

Beef is one source of animal protein with an average consumption level of 5.1 kg / capita / year [1]. The demand for meat in Indonesia is mostly (± 65%) still fulfilled from domestic production and the rest is obtained from import. However, the condition of loading and loading process of livestock in a number of Indonesian ports does not meet the principle of animal welfare, which causes cattle to lose weight and also injury when unloaded. Transportation or transportation used by inter-island cattle entrepreneurs or cities in general can lead to stress, so that it can affect decreased appetite and in the end can lose weight cattle. It is therefore necessary to have careful handling of inter-island, city, and local transportation, so that not only the road factors affect it but the condition of the vehicles used, the density of livestock, the nation or the type of cow, the climate / weather at the time of transportation, and the availability of food on the long journey [2].

The way to unloaded is done by throwing cattle into the sea one by one then TKBM (Tenaga Kerja Bongkar Muat/ loading and unloading labors) ready to herd cows from the sea to the edge of the beach to be taken to the quarantine. Or by tying a cow hung with a rope to be transferred to the truck. This process is contrary to PP. 82 year 2000 that is on Article 47 and Article 55 about animal welfare [3]. The absence of SOPs (Standard Operating Procedures) also worsened the treatment of livestock that
caused cattle to lose weight up to 20-30% or even die during the trip until it often reap protests from other countries.

A study by Aletha Yuliana contained in the journal Indonesia Medicus Veterinus 2016, reveals that the means of transportation and the way of loading and unloading cattle from NTT to the Animal Market Beringkit Bali cause cattle stress and injury. Transportation modes used are ships, large trucks, medium trucks and pick-ups. In the Animal Market Beringkit Bali consists of male and female calves both young and adult. Of the 6,881 incoming cows, there were about 400 incidents of cattle due to trauma related to transportation. Lame cattle have low prices, because cows cannot be sold out of the region or island and are not productive if they are to be used as breeders, breeding or fattening. Breeders will experience losses ranging from one million rupiah to three million rupiah per tail due to the incident [4].

Along with technological advances, Indonesia should immediately clean up to improve the quality of domestic livestock. In addition to nurseries and livestock care facilities, livestock loading and unloading facilities should be built to facilitate the loading and unloading activities of animal welfare, user friendly and integrated. Therefore, a loading and unloading tool is required by applying the concept of semi-horizontal hydraulic ladder connecting the ship and truck directly. This livestock unloading tool design innovation is a combination of fire extinguisher truck design and bridge equipped with weightlifting equipment. With this tool, it is expected to reduce the risk of cow accidents and increase the speed of loading and unloading that is safe for animals.

1.2. Problem formulation
Based on the background that has been described previously, then the problems studied are:
1. How is the process of loading and unloading cattle in the Indonesian port today?
2. What factors affecting the loading and unloading activities of cattle do not meet the animal welfare principles in Indonesian ports?
3. How to design an innovative conceptual design of integrated loading and unloading tools between ships and trucks to minimize animal unwelfare treatment at Indonesian ports?

1.3. Objective
Based on the description of the above problem formulation, the purpose of this study are:
1. Knowing the existing condition of loading and unloading cattle process at the port of Indonesia
2. Being able to identify the factors that affect the loading and unloading activities of cattle does not meet the animal welfare principles in Indonesian ports
3. Designing a conceptual design of integrated loading and unloading tools between ships and trucks at Indonesian ports to minimize the number of incidents of cows that are not treated to meet the principle of animal welfare.

2. Literature Review

2.1. Animal Welfare Principal for Livestock
There are 5 (five) principles of freedom in the rules of animal welfare that need to be considered as already adopted and contained in Government Regulation No. 95 of 2012 are [5]:
1. Free from thirst and starvation
2. Free from the discomfort
3. Free from pain
4. Freely expresses normal behavior
5. Free from fear and depression

2.2. Port Planning
In a study conducted by Arrazi Rustam (2016), reveal that to reduce the existence of treatment that does not meet the principle of animal welfare as stated in Government Regulation No. 95 of 2012, the
port planning is adjusted with the concept of animal welfare. The development of the port is done with the construction of floating dock HDPE. HDPE pier is a pier that can be a floating cube or pipe (cylinder) which is the latest innovation to replace the three pontoons above because it is more durable and not damage the environment / Green Technology [6]. The floating dock HDPE has advantages over the concrete dock in general, such as:

1. Environmental friendly because it is made of HMW HDPE (High Molecular Weight- High Density Polyethylene) materials so it can be recycled and resistant to chemicals
2. Safer because it can adjust eith the tides of sea water
3. Easy to use
4. Quite cheap with range square meter reaches 1.5-2.5 million
5. Anti-corrosion
6. Complete accessories that are very supportive to change the function of the floating cube/poontoon
7. Minimize the risk of loss of livestock due to loading and unloading that is not animal welfare resulting in maintenance cost
8. Minimize the cost of livestock depreciation

2.3. Ship Route Planning
In a study conducted by Silvia Dewi Kumalasari (2016) that to reduce the existence of treatment that does not meet the principle of animal welfare, the ship's planning is done [7]. The operating pattern for optimum selected mode of cattle vessel is obtained by the optimization result of port to port and multiport operation pattern, with details as follows:

1. For the port to port operation pattern is obtained route 2 that is Larantuka-Jakarta with the number of fleet needed in a year that is as much as 1 fleet and route 4 namely Waingpau-Jakarta with the number of fleet required in a year that is 4 fleet
2. For the multiport operation pattern, the route 16 is Tenau Kupang-Ende-Jakarta with the number of fleet required for one year of 43 fleets and 26 routes is Maumere-Labuan Bajo-Jakarta with the number of fleet required for one year is 4 fleets.
3. The total fleet required in ayear of 52 fleets of cattle ships

In terms of the fastest time, by ignoring the administrative time, that is for the port of origin Tenau Kupang using general cargo ship with total delivery time of 6.8 days, whereas with the port of origin Waingapu obtained the fastest delivery time with results using the same mode that is for 5.5 days. While in terms of meat production, the least experienced shrinkage with the port of origin of Tenau Kupang is using the mode of cattle ship with the weight of cows produced per tail of 378 kg, and 106 meat production produced by 137 kg per cow, while with the port of origin Waingapu yielded cow weight per tail of 381 kg and meat production of 138 kg.

3. Research Methods
In doing this research begins with the observation and analysis of existing conditions then continues on the primary and secondary surveys. For more details can be seen in figure 1.
4. Result and Analysis

4.1. Existing conditions analysis
From the results of the primary survey that has been done to the Port of Tanjung Perak Surabaya, then obtained data on the dimensions of ships, containers, trucks and cattle. In the method of transporting / loading and unloading activities using containers at the Port of Rakas Kalimas, Surabaya with KM PASENDANA 8 which can carry up to 500 cows. This ship is dimensionless with length (Lpp) 65m, width 10m, height 7m and full 5m ship. While the container with a length of 380cm, 156cm wide and 205cm high. Box truck with length 555cm, width 240cm and height 165cm. Average size of cow is 200cm long, 60cm wide and 110cm high.
Figure 2. Visualisation of ship, truck, and container.

Figure 2 shows that loading and unloading of cattle in the port. Red line represent visualisation of ship, blue line represent visualisation of truck and green line represent visualisation of container for cows. Cattle is carried out through the transport of containers with a capacity of 7 cows to trucks with a capacity of 21 cows per truck. Delivery of cattle to the Port of Rakas Kalimas, Surabaya comes from several regions, among others Kupang, Bima, Waingapu, and Atapupu through PT. EMKL Kamadjaja Logistic. Loading and unloading activities which were then transported by trucks transported 21 cows per truck. Therefore, 1 cattle truck can be filled by 3 containers of each container containing 6-7 cows. The speed of loading and unloading per container is 4 minutes which consumes 0.05 liter per box.

Figure 3. Visualisation container for cows.

Figure 4. Unloaded cattle in the truck.

There are many kind of cow that loading and unloading in Kalimas port. The cows are Bali cow, Ongole cow, Madura cow and Kupang cow. The size of the cows are different each kind of cow. The size of the cows can be seen on table 1 below:
Table 1. Size of Cows.

| Size (cm)      | Bali | Ongole | Madura | Kupang |
|----------------|------|--------|--------|--------|
| Height         | 115  | 122    | 110    | 105    |
| Length         | 120  | 132    | 126    | 187    |
| Breast perimeter | 36   | 39     | 37     | 60     |
| Age (year)     | 4-8  | 4-8    | 4-8    | 4-8    |

4.2. User Requirement Analysis

After conducting the primary survey, Voice of Customer obtained from potential users is as follows:

1. Fast loading and unloading
2. Unharmed cattle during loading and unloading process
3. Inexpensive B / M tools in operation
4. Easy in tool storage
5. Easy operation of the tool
6. Low manufacturing cost
7. In accordance with the regulation

Furthermore, after obtaining the needs of prospective users as written design conceptualized design of loading and unloading tools Livestock as much as possible to accommodate the needs of potential users.

4.3. Design of Loading and Unloading Tools

Innovation of the planned loading tool is a loading and unloading system wherein a building will be constructed like a bridge equipped with a weight-weighting tool and also a stockman beside a bridge to drive in or out of livestock to and from the vessel. The function of digital weight scales placed in the bridge / garbarata is to weigh the weight of the cow. With this scale we can know the weight of cows when loaded at the port of origin until the destination port whether experiencing significant weight loss or not so that if the weight loss, the solution to overcome this can be quickly done by the animal quarantine hall of Port of Tanjung Perak. In addition to livestock transportation, livestock loading and unloading facilities at the port are also indispensable for improving livestock distribution processes both to Surabaya and throughout Indonesia. This supporting infrastructure is only a garbarata, but its application in real life strongly supports the process of loading and unloading livestock to conform with government autonomy to support the self-sufficiency of livestock. The design of this bridge or garbarata can be seen in figure 5.
Figure 5. Conceptual design of loading and unloading tools.

Innovation of loading and unloading tool design that is offered is 2 (two) that is loading and unloading design with garbarata and loading and unloading design with container. In the design of loading tool unloading garbarata apply the concept of semi-horizontal hydraulic ladder that connects the ship and truck directly.

4.4. Benefit and Cost Ratio (BCR)

BCR is such of analysis which compare the benefit cost with investment and operation cost. The economic age of this tool is planned for 10 years. The calculation of benefit and cost with 10 years planning. The operations cost increase 10% per year. The calculation of the benefit and the investment costs are described below:

| Table 2. Investment Cost. | Table 3. Operations Cost. |
|---------------------------|---------------------------|
| Investment                | Operations Cost           |
| Item                      | Cost (IDR)                |
| Design                    | 5,000,000                 |
| Raw Material              | 17,760,568                |
| Manufacture               | 67,900,000                |
| Mobilize                  | 1,000,000                 |
| Total                     | 91,660,568                |
| Item                      | Cost (IDR)               |
| Labor                     | 27,200,000                |
| Gas                       | 310,000                   |
| Maintenance               | 5,000,000                 |
| Total                     | 32,510,000                |

From the cost calculation above the Present Value of cost is IDR 321,142,921.

The design of this loading and unloading tool will make the loading and unloading of the cow progressing smoothly and also efficiently because the time required for loading and unloading is faster. If the loading and unloading time is usually spent up to 2 - 3 hours, then the development of the port and also the procurement of special loading and unloading equipment will make the loading and unloading time faster up to 1 hour and also minimize risks such as injury and also weight reduction livestock agencies significantly. Then it can be calculated the benefit of this tool with assumption: Decreasing price of the cow because of the injury is 20% from cow price which is IDR 10.000.000 per cow. From the interview 1% cow has serious injury. The price of the cow increase 10% per year. With those assumption the benefit is IDR 923,352,333.

So the Benefit cost ratio (BCR) of this tool is 2.88. The BCR value is more than 1 so it can be concluded that this tool is feasible to apply.
5. Conclusion

There were some conclusion that we can get throughout the result and analysis that has done before, such as:

a. The innovation of this loading and unloading tool is a garbarata which in its application strongly supports the process of loading and unloading livestock to conform with government regulations to support self-sufficiency of livestock in Indonesia. Innovation of the planned loading tool is a loading and unloading system wherein a building will be constructed like a bridge equipped with a weight-weighting tool and also a stockman beside a bridge to drive in or out of livestock to and from the vessel. The function of digital weight scales placed in the bridge / garbarata is to weigh the weight of the cow. With this scale we can know the weight of cows when loaded at the port of origin until the destination port whether experiencing significant weight loss or not so that if the weight loss, the solution to overcome this can be quickly done by the animal quarantine hall of Port of Tanjung Perak.

b. Loading and unloading of cattle carried out through the transport of containers with a capacity of 7 cows to trucks with a capacity of 21 cows per truck. Delivery of cows to the Port of Rakas Kalimas, Surabaya comes from several regions, among others Kupang, Bima, Waingapu, and Atapupu through PT. EMKL Kamadjaja Logistic. Loading and unloading activities which were then transported by trucks transported 21 cows per truck. Therefore, 1 cattle truck can be filled by 3 containers of each container containing 6-7 cows. The speed of loading and unloading per container is 4 minutes which consumes 0.05 liter per box.

c. The factors considered in making the design of loading and unloading equipment are as follows:
   1. Fast loading and unloading
   2. Livestock that is not unjured during loading and unloading process
   3. Inexpensive B/M tools in operation
   4. Easy in tool storage
   5. Easy operation of the tool
   6. Low manufacturing cost
   7. In accordance with the regulation

d. The design innovation in 10 years of garbarata planning requires a total cost of IDR 321,142,921. While the benefits obtained in the 10 years of planning of IDR 923,352,333. The value of BCR (Benefit Cost Ratio) worth 2.88 which means the tool is feasible applied.

Acknowledgments

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