The influence of Artificial Insemination (AI) cost to profitability of beef cattle farming in Banjarnegara District, Central Java Province, Indonesia

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Abstract. Banjarnegara district has numbers of poverty problem and beef cattle farming have been contributing to reduce these numbers of poverty. Increasing number of cattle for each farmer will improve profit and welfare of the farmer. High reproductive rate of cow is very essential to gain an economic advantage. However, the increase in the cost of reproduction may influence the lack farm profit. This study aimed to (1) identify the contribution of artificial insemination (AI) cost to the total cost of beef cattle farming (2) analyze the factors influencing profitability of beef cattle farming (age of farmers, education of farmers, experience of farmer, number of cows, AI cost, and feed cost) and (3) analyze the factors affecting the artificial insemination cost (age of farmers, education of farmers, experience of farmer, number of cows). The study was conducted using a survey of 45 respondents whom were selected by a stratified random sampling based on agro ecological zone (low and high land). Data were analyzed using multiple regression test. The results depicted that cost of artificial insemination is not a determinant factor to change the profitability of beef cattle farming (P>0.05). Experience of farmers and number of cows determined the AI cost of beef cattle farming in Banjarnegara District (P<0.05). Increasing the ability of farmers in identifying the signs of estrus is necessary to minimize the cost of artificial insemination.

1. Introduction
Banjarnegara district has put the livestock sector as one of the development priorities to increase people's income during the period of last 3 years (2014-2016). Beef cattle population in 2016 reached 31,194 heads spread over 20 districts. Based on data of Regional Statistic Office of Banjarnegara, population of beef cattle in Banjarnegara district showed a negative trend with the decreasing rate of 2.56 percent per year. However, the beef cattle population has played an important role in the economic development through generating employment and increase of community revenue. Nationally, the development of beef cattle is expected to be able to encourage the economic resilience of society and to participate in the supply of
national food. To meet the national need of food, intervention from national government is needed by implementing technology for production, processing and marketing. Sarma and Raha [1] suggested alternative strategies for developing beef cattle agribusiness by adapting technology for high production, enhancing partnerships agribusiness in rearing, processing and marketing. Increasing beef productivity must be done through transferring innovative technology, increase support services and sustainable market linkage.

One of the limitations of beef cattle population in Banjarnegera Regency is the lack number of calves. In addition, farmers who directing their farm to produce valves are only 27.3 percent of the population of beef cattle farmers in Banjarnegera District. Increase in cattle population has been done through artificial insemination which is a modified technology and is expected to have a significant role in improving the success of pregnancy. Holm et al [2] stated that artificial insemination (AI) is a tool for improving production efficiency of beef cattle. However, there is a problem in implementing AI such as high cost of labor, need for skilled insemination technicians, and infrastructure requirements.

The use artificial insemination has the potential to influence the economic efficiency of cow-calf enterprises. Lamb and Mercadante [3] mentioned that artificial insemination has facilitated the widespread utilization of artificial insemination (AI) and can greatly impact the economic viability of cow-calf systems by enhancing weaning weights. However, the increase in the cost of reproduction may influence the lack of logistic support and revenue of farmers. This study aimed to (1) identify the contribution of artificial insemination (AI) cost to the total cost of beef cattle farming (2) analyze the factors influencing profitability of beef cattle farming (age of farmers, education of farmers, experience of farmer, number of cows, AI cost, and feed cost) and (3) analyze the factors affecting the artificial insemination cost (age of farmers, education of farmers, experience of farmer, number of cows).

2. Materials and methods
The study used survey method by conducting interviews using questionnaires and observations of beef cattle farmers in Banjarnegera district. Forty-five breeding type cattle farmers were selected as respondents using multistage sampling method. First, the area that the research sample selected by stratified random sampling based on agro ecological zone (high, medium and low land). Sub district area was chosen 20 percent of each stratum randomly. Second, respondents (farmers) have been selected randomly 20 percent in selected sub districts.

The independent variables used in this study were age of farmers, education of farmers, experience of farmer, number of cows, AI cost, and feed cost. Profitability of beef cattle farming and amount of artificial insemination cost are dependent variables. The obtained data was presented descriptively and analyzed using multiple regression test [4].

3. Results and discussion
3.1. Contribution of artificial insemination (AI) cost to the total cost of beef cattle farming
Farmers in Banjarnegera District have an average 2 heads of cow and having experience to use artificial insemination for an average 3 years. Artificial Insemination program in livestock development has many advantages, both in increasing the rate of livestock population and improving the income of farmers. Development of beef cattle in breeding type is particularly intended to increase the profits of farmers [5]. The results showed that almost all farmers run the business as a sideline to the main work as rice farmers and employees. Briefly, net profit was computed as gross return minus total cost. Total cost included variable and fixed costs that are dependent and independent of the size of the operation, respectively. Operational cost of breeding type beef cattle farming in Banjarnegera district includes the cost of feed, labor, artificial insemination, vitamins / medicines, and depreciation livestock and cage/equipment.
Breeding type which is identified with artificial insemination (AI) is expected to produce a calf without having to invest capital for bull. AI technologies include ease of farmers to obtain information, ease of facilities/services, and the ability to use it. However, the rate of adoption and implementation of the technology is remaining low especially on people with small-scale farms [6].

Table 1. Cost structure of breeding type of cattle farming

| Cost component                        | Amount (IDR) | Percentage (%) |
|---------------------------------------|--------------|----------------|
| Fixed Cost                            |              |                |
| Cows depreciation                     | 947,225.00   | 22.8           |
| Equipment and cowshed depreciation    | 403,733.00   | 9.7            |
| Land tax                             | 6,500.00     | 0.2            |
| Variable cost                         |              |                |
| Forage                                | 2,501,263.00 | 60.2           |
| Artificial Insemination (AI)          | 115,833.00   | 2.8            |
| Vitamin and Medicine                  | 66,727.00    | 1.6            |
| Transportation                        | 112,195.00   | 2.7            |
| Total cost                            | 4,153,476.00 | 100            |
| Revenue                               |              |                |
| Sales of cattle                       | 6,898,508.00 | 43.6           |
| Sales of feces                        | 250,000.00   | 1.6            |
| Increase in the economic value of cattle| 8,675,000.00 | 54.8           |
| Total revenue                         | 15,828,508.00| 100            |
| Net profit                            | 11,670,032.00|                |

The average cost of the breeding type of cattle farming was IDR 4,153,476.00 per year. Revenue obtained during a year of production has average of IDR 15,828,508.00 and generate profit of IDR 11,670,032.00 per year. These results are in accordance with the study of [7] that the management of beef cattle although in standard mode, the AI method is more profitable than the natural service. Descriptively, artificial insemination (AI) cost provides small contribution (2.8 percent) of the total cattle production cost. The farmers spent IDR 4,153,476.00 a year for cow calf operation and cost of AI was only 2.8 percent of total cost. It is much lower compared to cost of forage which contributed 60.2 percent of total cost.

3.2. Factors influencing profitability of beef cattle farming

The financial outputs studied included net profit, total revenue, and total cost. Net profit was computed as gross return minus total cost [8]. The farmers generated profit of IDR 11,670,032.00 per year. Age of farmers (X1), education of farmers (X2), experience of farmer (X3), number of cows (X4), AI cost (X5), and feed cost (X6) were tested to identify influence to the profitability. Based on multiple linear regression, profitability of beef cattle farm is explained by an equation of $Y = -3,818,099.15 - 30,596.92X_1 + 1,356,932.02X_2 + 77,026.37X_3 + 8,155,406.63X_4 - 31.19X_5 + 7.40X_6$.

The equation explained that education, number of cows and feed cost were significantly influenced profit of cattle farmers ($P<0.05$). Education of farmers and increasing number of cows would significantly increase profit; otherwise increasing feed cost would decrease the profit of farmers. [9] stated education and performance of cattle have a positive impact on profitability. Feed cost spent by cattle farmers in Banjarnegara District contributed to 60.2 percent of total cost. This data consistent with statement of [10] that feed, capital and labor costs comprise nearly 91 percent of the total average input costs per cow and
be negatively related to overall efficiency. The results also depicted that cost of artificial insemination is not a determinant factor to change the profitability of beef cattle farming (P>0.05). However, increasing cost of AI would tend to decrease income of cattle farmers. Farmers spend more money to make their cows getting pregnant. Artificial insemination was done at least twice to make their cows is pregnant and costs associated with getting a cow pregnant was IDR 50,000.00 per artificial insemination. In addition, the calves resulted from the artificial insemination has no more value so selling price is remaining low. [11] stated artificial insemination increased returns and decreased cost when the activity of artificial insemination able to produce heavier calf at weaning. High reproductive performance of cows is needed to make artificial insemination is profitable to the cattle farmers.

Table 2. Multiple regression analysis of influencing factors to beef cattle farm profitability

| Variables          | Coefficient of Regression | Significance |
|--------------------|---------------------------|--------------|
| Age of farmers     | -30,596.92                | 0.722        |
| Education of farmers| 1.357E6 **               | 0.004        |
| Experience of farmers| 77,026.37               | 0.589        |
| Number of cows     | 8.155E6 **               | 0.000        |
| AI cost            | -31.19                    | 0.046        |
| Feed cost          | 7.40*                     | 0.157        |
| Constant           | -3.818E6                  | 0.499        |
| R²                 | 0.88                      |              |

** P<0.01 ; * P<0.05

3.3. Factors affecting the amount of artificial insemination cost

Reproductive aspect becomes important in the business of beef cattle especially for breeding type. That is because the calf production is a main result for economic calculations. Efficient reproductive activity will have positive impact on economic efficiency of farm. [12] explained that reproductive performance has a significant effect on the profitability. One common measures of reproductive performance is services per conception. In Banjarnegara District, cattle getting poor of artificial insemination service which indicated by service per conception was 2.3. Higher service per conception has driven higher cost of artificial insemination paid by farmers to produce calves. [13] stated that AI service done by technician and farmers has influenced reproductive performance of cows. Experience of farmers and number of cows determined the artificial insemination (AI) cost of beef cattle farming in Banjarnegara District (P<0.05).

Table 3. Multiple regression analysis of influencing factors to AI cost

| Variables          | Coefficient of Regression | Significance |
|--------------------|---------------------------|--------------|
| Age of farmers     | 367.61                    | 0.722        |
| Education of farmers| -3,643.53               | 0.326        |
| Experience of farmers| -2,866.94***            | 0.009        |
| Number of cows     | 11.959*                   | 0.041        |
| Constant           | 110,022.93                | 0.012        |
| R²                 | 0.45                      |              |

** P<0.01 ; * P<0.05

Increasing the ability of farmers in identifying the signs of estrus is necessary to minimize the cost of artificial insemination. Optimizing the experience of farmers can be the main capital in conducting
reproduction cost efficiency. The experience could help farmers to identify the signs of estrus accurately so that the mating process can take no more than once of artificial insemination. Furthermore, the number of cows owned by farmers affects the amount of costs artificial insemination. The more the number of cows owned, the cost required more and more. [14] conclude that good conception rate is supported especially by number of cows, good quality cement, experience of farmers in maintaining their cattle farming, and experienced inseminator.

4. Conclusions
Study on influence of artificial insemination (AI) cost to profitability of beef cattle farming in Banjarnegara District, Indonesia can be concluded that:
1. Cost of artificial insemination (AI) is contributed only 2.8 percent of the total cost of production.
2. Cost of artificial insemination is not determinant factor in changing the profitability of beef cattle farming.
3. Experience of farmers and the number of cows be the deciding factor of artificial insemination (AI) cost in beef cattle farming in Banjarnegara District.

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