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Utilization of farmer priority on local beef cattle development strategy in Central Java, Indonesia

RESTIYANA AGUSTINE[1], MUJTAHIDAH ANGGRIANI UMMUL MUZAYYANAH[2,♥], AHMAD ROMADHONI SURYA PUTRA[2], ENDANG BALIARTI[3]

[1]Doctoral Program, Faculty of Animal Science, Universitas Gadjah Mada. Jl. Fauna No. 3 Yogyakarta 55281, Yogyakarta, Indonesia
[2]Department of Livestock Socioeconomics, Faculty of Animal Science, University Gadjah Mada. Jl. Fauna No. 3 Yogyakarta 55281, Yogyakarta, Indonesia. Tel./fax.: +62-274-560867, ♥email: m_anggriani_um@ugm.ac.id
[3]Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada. Jl. Fauna No. 3 Yogyakarta 55281, Yogyakarta, Indonesia

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Abstract. *Agustine R, Muzayyanah MAU, Putra ARS, Baliarti E. 2023. Utilization of farmer priority on local beef cattle development strategy in Central Java, Indonesia. Biodiversitas 24: 508-515.* Indonesian local beef cattle, Peranakan Ongole (PO), is essential cattle breed predominantly raised by smallholder farmers in Central Java Province. Although it is generally perceived that raising PO cattle is not a regular source of income for the majority of farmers, however, there are few specific studies investigating the aspects and motives of farmers to keep their cattle. Therefore, this study is designed to explore the perspective of farmers leaders in Central Java, Indonesia, toward the priority aspects of raising PO cattle for their livelihoods. We selected Blora, Klaten, Grobogan, and Rembang as representatives of the study involving 29 farmers leaders with at least ten years of experience. Analytic Hierarchy Process was employed as a decision-making instrument to understand better various aspects used by PO cattle farmers. The results show that farmers consider investment function as their primary goal in raising PO cattle in all study areas. Then, farmers consider reproduction performance as the top priority aspect. In conclusion, the study revealed that smallholder farmers consider reproductive ability as a priority due to farmers make the investment function the main goal in raising PO cattle. Therefore, we recommended that farmers improve their knowledge regarding cows' reproduction through extension workers' assistance. Certainty on the PO cattle's selling price is needed so that raising PO cattle is feasible as an investment and stimulates the interest of farmers raising PO cattle.

Keywords: Farmers' leader assessment, indigenous cattle, the smallholder farmer

INTRODUCTION

One of Indonesia's local cattle breeds is Peranakan Ongole (PO) (Sutarno et al. 2015) which has been established based on the Decree of the Minister of Agriculture number 2907/Kpts/OT.140/6/2011 (Badan Standardisasi Nasional 2015). PO cattle are found almost throughout Indonesia (Hartati et al. 2015). In Java Island, the PO cattle population is estimated to be nearly 90% of the overall beef cattle population (Director General of Livestock Services Indonesia 2003). However, the PO cattle population has decreased, from 86,003 in 2010 to 64,292 in 2014 in Kebumen, one of the PO cattle development areas in Central Java, based on population dynamics research conducted by Rohyan et al. (2016).

Crossbreeding is one of the important factors for the decline in the local cattle population (Bottani et al. 2019). The increasing prevalence of crossbreeding involving PO cattle makes the existence of PO cattle increasingly threatened (Sutresniwati et al. 2006). The crossbreeding was carried out based on economic reasons (Agustine et al. 2019), high weight gain despite high production costs (Sutarno and Setyawan 2015), and steps to improve carcass grade and commercial value (Favero et al. 2019). Crossbreeding activity is feared to produce offspring that cannot adapt to environmental conditions in Indonesia and decrease reproductive ability (Sutarno and Setyawan 2015). Many local cattle are endangered because other cattle breed replace them with higher productivity (Schäler et al. 2019; Demir et al. 2021). If this continues, the role of local cattle in the economy, socio-culture, and their contribution to livelihoods will be lost and irreversible (Hoffmann et al. 2014; Nyamushamba et al. 2017; Mapiye et al. 2020).

Although PO cattle have a low selling price (Agustine et al. 2019), however, PO cattle are reported to have the good reproductive ability (AGRI 2018), and quickly adapt to the tropical environment thorough Indonesia (Sutarno and Setyawan 2016). PO cattle are also draught animals because they have a large body size and are strong and docile (Director General of Livestock Services Indonesia 2003). Environmental conditions, production, and market systems are undergoing rapid changes, so adaptive local cattle are highly recommended to optimize livelihoods (Mapiye et al. 2020).

Local livestock contributes to farmers' livelihoods (Nyamushamba et al. 2017). They play an essential role in economic and socio-cultural for the welfare of rural households, including sources of income, asset savings (Bettencourt et al. 2014), indicators of a person's wealth status (Setianto et al. 2014), and specific rituals (Moyo and Swanepoel 2010). Each livestock species has a different function for society, such as cattle which are considered a symbol of wealth judged by the amount owned (Bettencourt et al. 2015). The economic contribution of cattle rearing is

directly through the provision of food products, such as meat and milk (Smith et al. 2013), and indirectly through cash income derived from the sale of live cattle (Mapiye et al. 2020). Cattle rearing accounts for 29% of total household income (Chaminuka et al. 2014). In addition, some farmers in Indonesia use cattle as savings and assets (Agus and Widi 2018; Haq et al. 2019).

Based on previous studies, local livestock is beneficial for smallholder livelihoods. Therefore, studies need to be carried out to determine priorities using local livestock for farmers. Although it is generally considered that raising PO cattle is not a source of regular income for most farmers, there have been few specific studies that examine the aspects and motives of farmers raising their cows. Research on PO cattle that has been carried out before, including research on reproduction appearance (Prihantoko et al. 2020), estimation of population dynamics (Rohyan et al. 2016; Kusuma et al. 2017), genetics (Hartati et al. 2015; Fathoni et al. 2017; Sumadi et al. 2017; Sutiyono et al. 2018; Putra et al. 2022). Previous studies on PO cattle development focus on livestock as research material. Thus, the study on PO cattle development, which focuses on the farmers' perspective, is unique compared to previous studies. Therefore, this study is specifically designed to determine the priority aspects of raising PO cattle for farmers' livelihoods through the perspective of farmers' leaders in Central Java, Indonesia.

MATERIALS AND METHODS

Study area

The study was conducted in Jepon Subdistrict, Blora District; Prambanan Subdistrict, Klaten District; Wirosari Subdistrict, Grobogan District; and Kragan Subdistrict, Rembang District, Central Java Province, Indonesia (Figure 1) in March-April 2021. Central Java Province is the second-largest contributor of beef cattle after East Java Province in providing beef cattle in Indonesia (Ministry of Agriculture 2020).

Blora, Klaten, Grobogan, and Rembang Regencies were selected as the study area because these districts rely on local cattle for breeding. PO cattle are one of the local breeds widely raised in Central Java with a population of 51.3% (Kusuma et al. 2017). Each district has a beef cattle breeding center. Moreover, there is an animal market center, named Kliwon Market, in Wirosari Subdistrict, Grobogan District, the largest cattle sales center in Grobogan, Blora, and surrounding areas. As beef cattle breeding centers, these sites have livestock groups fostered by the local government.

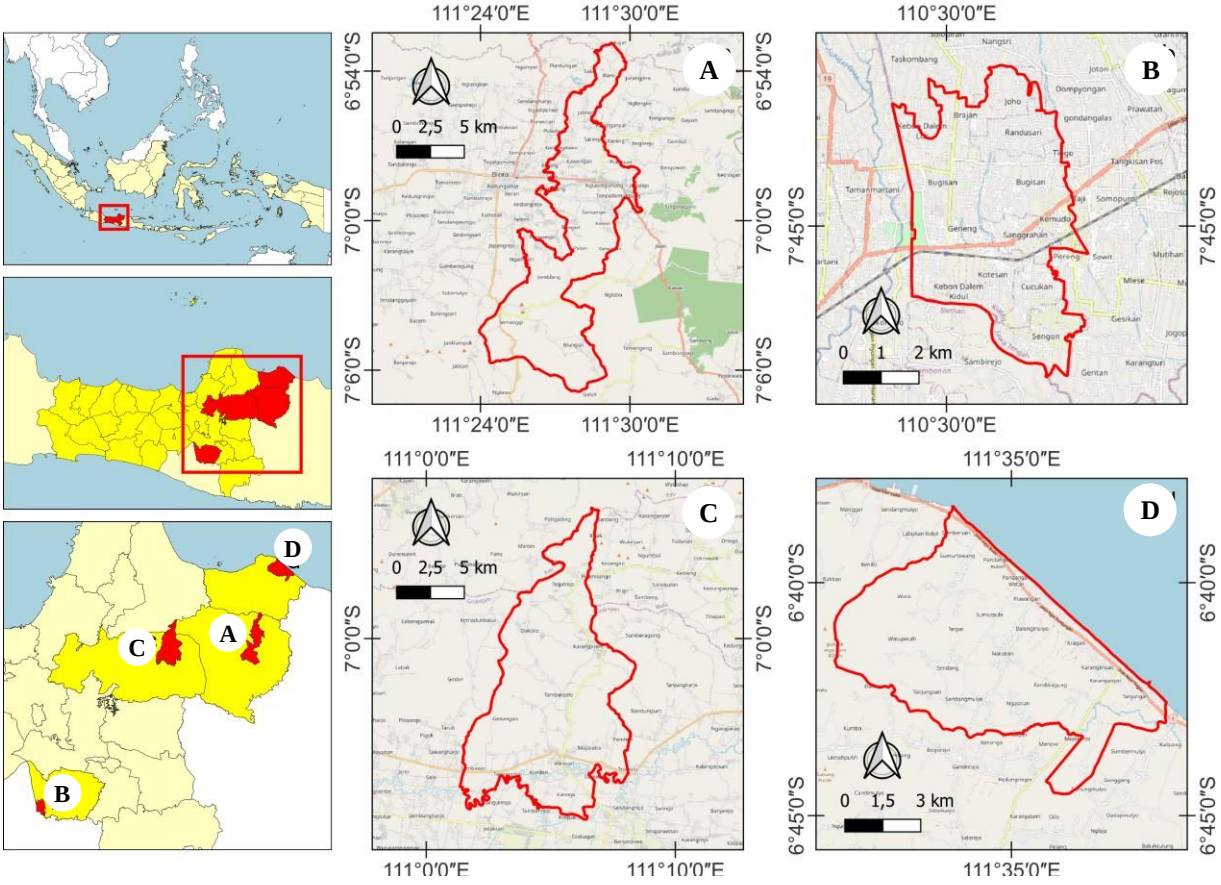

Figure 1. A. Location of Jepon Subdistrict, Blora; B. Prambanan Subdistrict, Klaten; C. Wirosari Subdistrict, Grobogan; D. Kragan Subdistrict, Rembang of Central Java Province, Indonesia

Sampling technique and sample size

Study locations were selected purposively based on the existence of active beef cattle farmer groups in developing PO cattle breeding. Respondents were determined through a purposive sampling method with strict qualifications: having experience in PO cattle breeding for at least ten years and holding a position as a leader in a farmers' group. The involvement of farmers' leaders as respondents aims to acquire valid answers during the survey because their answers represent farmers. The farmers' leaders participating in this study were selected with assistance from the extension worker at that site. A total of twenty-nine farmers' leaders were chosen in this study: six from Rembang, six from Blora, eight from Klaten, and nine from Grobogan.

Data source and methods of data collection

Primary and secondary sources of data were used in this study. Primary data was collected from the selected respondents using the AHP scheme questionnaire. Secondary data was obtained from the study literature. Data collection for this study was carried out in two different stages.

In the first stage, based on the study literature, three criteria and six alternatives were determined (Troxel and Barham 2012; Bettencourt et al. 2014; Setianto et al. 2014; Badan Standardisasi Nasional 2015; Bettencourt et al. 2015; Nyamushamba et al. 2017; Agus and Widi 2018; Haq et al. 2019). The three criteria include cash income, investment function, and socio-cultural function, while the six alternatives include cattle breed, selling price, adaptability, reproductive ability, body size, and physical appearance. Then, a questionnaire was created based on the AHP scheme. Each question consists of a paired comparison between two criteria. Three criteria resulted in three questions, and six alternatives resulted in 45 questions concerning the criteria. We interviewed 29 selected farmers' leaders in the second stage using the "AHP scheme" questionnaire. The interview process explored farmer leaders' assessment of criteria and alternatives pairwise comparison.

Data analysis

AHP is a measurement theory using paired comparisons and relies on expert judgment using priority scales. This analysis is included in the multi-criteria decision analysis (MCDA) tool (Kim et al. 2022; Sánchez-Lozano et al. 2022; Zhang et al. 2022). Respondents have chosen based on strict qualifications regarding the position, education, and experience. There is no general provision regarding the number of participants to be taken. Studies using AHP involve stakeholder participation based on opinion leadership; therefore, a smaller number of respondents than a statistical approach is possible (Okello et al. 2014). This analysis was performed using Expert Choice 11. If the value of the consistency ratio is below 0.1, it indicates that the assessments carried out by respondents are consistent.

The definition of variables used as criteria and factors in this study is presented in Table 1. Next, a comparative assessment was carried out. The judgment has been carried out subjectively by farmers and then converted into a numerical value using a scale of 1 to 9, as shown in Table 2 (Veisi et al. 2016).

Table 1. Definition of variable

Variable of AHP Scheme	Definition
Cash income	Income earned from the sale of livestock.
Investment function	Livestock functions as savings, insurance, loan guarantees, capital accumulation, and buffer stock in case of crop failure.
Socio-cultural function	The function of livestock that provides status and identity for farmers.
Cattle breed	The breed of cattle kept by the farmer.
Selling price	Amount of money charged by the farmer to the buyer on the livestock handed over.
Adaptability	The ability to survive from disease and climate.
Reproductive ability	The ability of livestock to reproduce.
Body size	It is related to the quantitative nature of livestock, such as body weight, body height, body length, and others.
Physical appearance	Associated with the appearance of important traits, such as skin and coat color, horn size and shape, body shape, and other exteriors in livestock.

Table 2. The fundamental scale based on (Saaty 2008)

Intensity	Definition	Information
1	Equally important	The two things that are compared are equally important.
3	A little more important	One thing that is compared is slightly more important than other components.
5	More important	One thing that is compared is more important than other components.
7	Very more important	One thing that is compared is very important than other components.
9	Absolutely more important	One thing that is compared is absolutely more important than other components.
2, 4, 6, 8	Compromise among the above values	For example, a number between 3 and 5, which is 4, is an option with qualifications between slightly more important and more critical.
Reciprocal	Opposite	If the pair is reversed, then the intensity is the opposite.

RESULTS AND DISCUSSION

Development of a decision hierarchy model

The first stage of AHP is to create a hierarchical network to show problems, with the top section showing the overall goal, the middle section showing the criteria, and the bottom section showing the alternatives/factors. The AHP scheme in this study is illustrated in Figure 2.

Pairwise comparison of criteria and alternatives

Table 3 shows the results of a pairwise comparison of the criteria for each district and the overall district based on calculating the weights vector using expert Choice software. Pairwise comparison is carried out based on alternatives concerning each criterion. A pairwise comparison based on factors/ alternatives is shown in Table 4.

We also performed a sensitivity graph. Sensitivity graph is used to determine how sensitive the alternative changes to the criteria's importance and to check the suitability of the weights assigned by the expert (Veisi et al. 2016; Moradi et al. 2020). In addition, this graph can be used to check the sensitivity of the criterion weights and to validate the results obtained (Höfer et al. 2016).

Blora District. The analysis shown in Table 3 shows that the investment function has the highest weight of 0.621. The consistency ratio calculation in the pairwise comparison in Blora shows a value of 0.04, where this value is below the tolerable level of 0.1. Table 4 shows that based on assessments from farmers in Blora, reproductive ability (0.360) is the most critical aspect farmers consider when raising PO cattle. The consistency ratio in this pairwise comparison is 0.07. Figure 3 shows that the reproductive ability of cattle is prioritized, especially when the farmer considers the investment function as the primary goal in raising local cattle. However, when farmers perceive raising local cattle as a source of cash income, farmers are more concerned with physical appearance than other alternatives.

Grobogan District. Table 3 shows that the investment function is the most critical criterion in the Grobogan with a weight of 0.606. The consistency ratio of paired comparison in the Grobogan district is 0.001. Table 4 shows that the factors of reproductive ability (0.299) are ranked first. The consistency ratio value in this pairwise comparison is 0.05. Figure 4 shows that farmers in Grobogan consider the reproductive ability of cattle to be the most important thing when they raise livestock for investment purposes. Likewise, with other maintenance purposes, such as a source of cash income and socio-cultural functions.

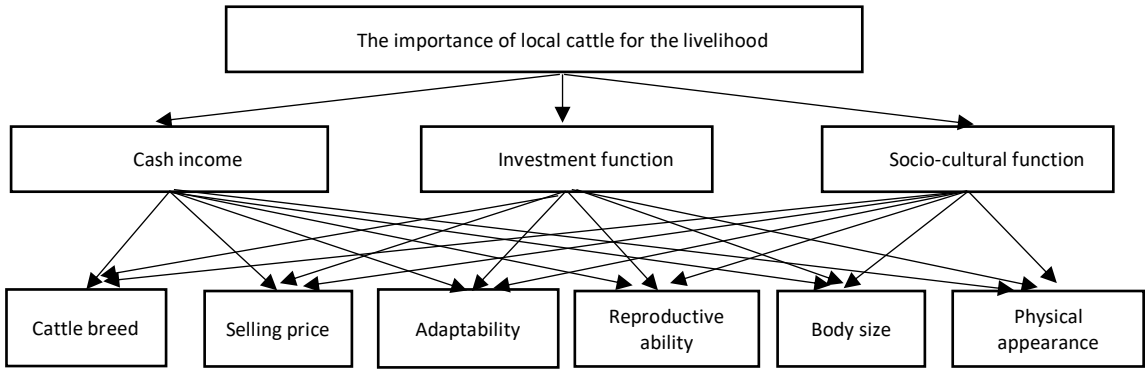

Figure 2. Hierarchical model on the importance of local cattle for the livelihoods

Table 3. Weights vector and criteria rankings

Criteria	Blora	Grobogan	Klaten	Rembang	Overall district
Cash Income	0.290 (2)	0.233 (2)	0.266 (3)	0.232 (2)	0.259 (2)
Investment Function	0.621 (1)	0.606 (1)	0.421 (1)	0.585 (1)	0.561 (1)
Socio-Cultural Function	0.089 (3)	0.161 (3)	0.313 (2)	0.183 (3)	0.180 (3)

Note: *The number in the sign () indicates the rank on each criterion

Table 4. Weights vector and alternatives rankings

Alternative	Blora	Grobogan	Klaten	Rembang	Overall district
Cattle breed	0.108 (4)	0.116 (5)	0.094 (6)	0.199 (2)	0.118 (5)
Selling price	0.084 (6)	0.134 (3)	0.129 (4)	0.076 (6)	0.108 (6)
Adaptability	0.090 (5)	0.102 (6)	0.159 (3)	0.151 (3)	0.126 (3)
Reproductive ability	0.360 (1)	0.299 (1)	0.345 (1)	0.335 (1)	0.345 (1)
Body size	0.162 (3)	0.134 (4)	0.101 (5)	0.104 (5)	0.124 (4)
Physical appearance	0.196 (2)	0.215 (2)	0.172 (2)	0.134 (4)	0.178 (2)

Note: *The number in the sign () indicates the rank of each alternative

Klaten District. As shown by Table 3, the investment function criteria become the first rank in Klaten with a weight of 0.421. The consistency ratio in this group is 0.008, which is also below the lowest fair value. Table 4 shows that the factors of reproductive ability (0.345) are ranked first. The consistency ratio value in this pairwise comparison is 0.03. Figure 5 shows that farmers in Klaten prioritize aspects of cattle's reproductive ability when rearing is a source of cash income. Likewise, with the maintenance objectives for the investment and socio-cultural functions.

Rembang District. Table 3 shows that the results of the pairwise comparison of the criteria in Rembang show that the investment function becomes the first ranking criteria with a weight of 0.585. The consistency ratio value in this pairwise comparison is 0.04. Table 4 shows that the factor of reproductive ability (0.335) was ranked first. The consistency ratio value in this pairwise comparison is 0.07. The most highlighted in Figure 6 is when farmers in Rembang consider that the socio-cultural function is the primary goal of raising cattle. The cattle breed they raised becomes their primary concern. However, when they consider cash income as the primary goal, the reproductive ability of cattle becomes the most crucial aspect.

Overall district. The pairwise comparison results on the overall criteria hierarchy show that the investment function (0.561) ranks first according to farmers' preferences. Overall, farmers raise PO cattle for investment purposes, such as savings, insurance, loan guarantees, capital accumulation, and buffers in the event of crop failure. The consistency ratio in this paired ratio is 0.01. Most of the results of pairwise comparisons in Table 4 show that the reproductive ability factor (0.34) ranks first according to the farmer's preference. It means that farmers pay more attention to reproductive factors than other factors. The consistency ratio value in this pairwise comparison is 0.02.

Figure 7 shows that cattle reproductive ability is a priority for all local cattle raising purposes as a source of cash income, an investment function, investment, and socio-cultural function. For farmers in Blora, Grobogan, Klaten, and Rembang Regencies, the investment function is the primary goal of raising local cattle, and reproductive ability is the most concern for them in achieving this goal.

The results from all regencies showed that reproductive ability is a top priority for farmers in maintaining livestock, in this case, PO local cattle. The reproduction ability is the most important thing to realize the function of livestock as an accumulation of assets (Anderson 2003). Reproductive performance is one of the main aspects considered in economics (Lopez et al. 2019).

Physical appearance is the second priority of farmers' consideration in raising livestock. Especially if the farmer considers the socio-cultural function as the main criterion; for instance, the karapan and sonok festival in Madura can only be participated by selected Madura cattle with good conditions and performance. The karapan uses a pair of Madura bulls that race on the field. Meanwhile, sonok is a performance that assesses the height, color, body shape, body condition, health, and harmony in walking in pairs in Madura cows (Widi et al. 2014).

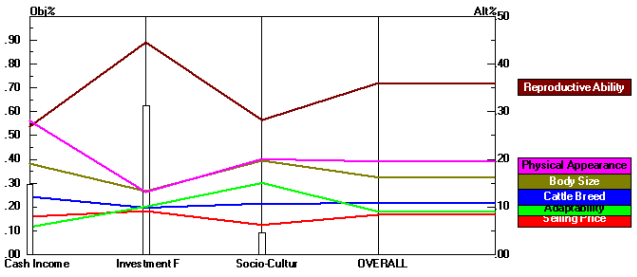

Figure 3. Sensitivity graph based on participant assessment in Blora

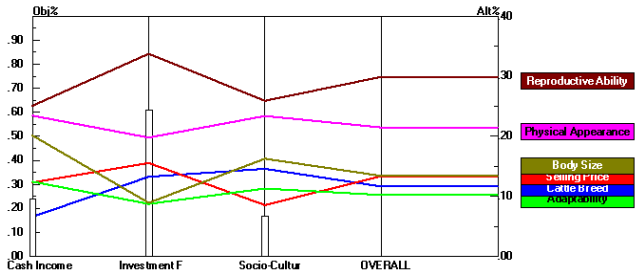

Figure 4. Sensitivity graph based on participant assessment in Grobogan

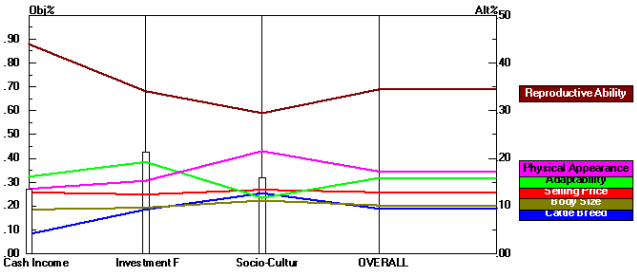

Figure 5. Sensitivity graph based on participant assessment in Klaten

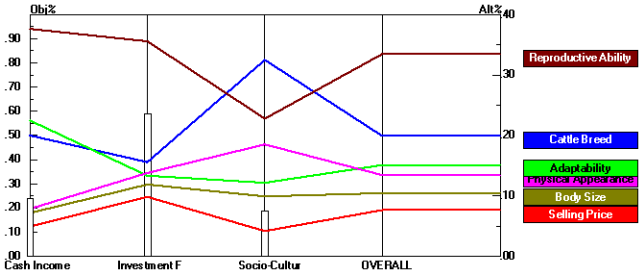

Figure 6. Sensitivity graph based on participant assessment in Rembang

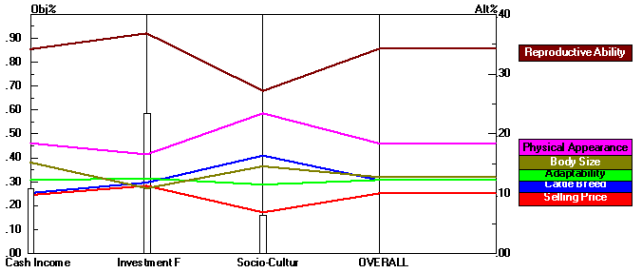

Figure 7. Sensitivity graph based on participant assessment in overall districts

Adaptability is the third priority for farmers in raising livestock. Especially, if the farmer assesses those cattle as a source of cash income for his life. Adaptability is the most important asset possessed by local cattle. This is because smallholder farmers, as local cattle keepers, live in marginal environments prone to drought, disease, and parasites (Hoffmann et al. 2014; Nouala et al. 2019; Mapiye et al. 2020). Local livestock is known to have a longer productivity life than exotic livestock because they have good adaptability, good fertility, and longer longevity, can walk long distances and can survive longer even with limited water availability (Nouala et al. 2019). Local livestock contributes to the livelihoods, food security, and nutrition of local communities with their ability to convert food that cannot be consumed by humans into food of high biological value (Nyamushamba et al. 2017; Hall 2019; Mapiye et al. 2020). As farmers' livelihood systems become more complex, diverse, and risk-prone, they will increasingly need flexible, resilient, and diverse various genetic resources to perform the necessary functions (Hoffmann et al. 2014).

Body size is the fourth priority for farmers in raising livestock. Especially if the farmer asses that livestock plays a role both as cash income and a socio-cultural function. This is in line with previous research by Traoré et al. (2017) in Mali, West Africa. The study stated that farmers who raise N'Dama local cattle are more concerned with the ability to withstand disease and their ability as working livestock compared to body size. Farmers' preference for body size is usually driven by higher market prices in larger livestock, while N'Dama cattle are known to be smaller in size (Traoré et al. 2017). PO cattle are known to have a body weight of up to 600 kg, while PO cows have a body weight of up to 450 kg. PO cattle are also very suitable for working livestock because they have a strong and large bodies, docile, and are tolerant of heat. However, PO cattle have fewer carcasses than other local cattle in Indonesia (Sutarno and Setyawan 2015). The ability of PO cattle as working cattle to provide cash income directly or indirectly to the farmer's household, thus contributing significantly to families to access food and services. The contribution of livestock to income is directly obtained from the transportation of goods and people and the rental of livestock for processing agricultural land (Hoffmann et al. 2014).

Cattle breed becomes the fifth priority for the farmer in raising livestock, especially, if the farmer considers cattle as a socio-cultural function. Different breeds and livestock species contribute to livelihoods by providing food, fiber, fertilizer, cash income, power, and transportation (Hoffmann et al. 2014). The preference for cattle breed selection usually relates to the purpose of keeping (Mekonnen et al. 2012; Traoré et al. 2017). In Indonesia, PO cattle are used as meat producers, as are Bali cattle and Madura cattle, while Frisian Holstein (FH) cows are used to meet milk needs (Sutarno and Setyawan 2015). Regarding socio-cultural functions, Indonesia has various traditional performances involving only certain cattle breeds. For example, the karapan and sonok festivals use Madura cattle. In addition, The Jailolo Bay Festival is an annual agenda of the West Halmahera District Government. The festival is held to revive the local culture of West Halmahera. One of those featured in the festival is the traditional transportation of ox carts. This ox cart is pulled by PO cattle or Bali cattle (Bakri et al. 2020).

The selling price is the last priority for farmers in raising livestock, especially if the farmer considers livestock as an investment function. The selling price is one of the benefits livestock provides in human livelihoods from the selling price of livestock as a product, the selling price of livestock as seed stock, and the selling price for services. The selling price of livestock as a product is considered the most important compared to the other two (Ayala et al. 2013).

The investment function is closely related to the role of livestock as an asset (Herrero et al. 2013). The reproductive ability is the most important thing to realize the function of livestock as an accumulation of assets (Anderson 2003). Assets are deposits of wealth that can be sold to finance their children's tuition fees or in times of need, such as illness or drought conditions. Assets can act as collateral, facilitate access to credit and financial services, and improve social status (Herrero et al. 2013). Smallholder farmers in sta Province usually sell beef cattle for education costs (7.50%), health costs (4.35%), to meet daily needs (63.53%), family party costs (3.41%), religious ceremonies (0.41%), and other purposes (20.80%) (Statistics Indonesia 2014). Cattle is an agricultural commodity that is resilient in various economic conditions due to low volatility and higher-than-average agricultural commodities returns (Powell et al. 2019). Therefore, cattle are considered suitable as an investment for smallholder farmers.

Cash income derives from selling livestock, products, or services to consumers. Smallholder farmers in Indonesia usually sell beef cattle to local traders. Then the cattle price is determined based on the approximate live weight, without using scales. Only a small percentage of livestock markets in Indonesia use scales to determine the price of beef cattle. The absence of regulation from the government to protect smallholder farmers from intermediary traders is one of the causes of the low growth of the beef cattle industry in Indonesia. Smallholder farmers only get a small profit from this cattle trading system due to the low farmers' bargaining position (Agus and Widi 2018). Things that need to be considered regarding the criteria for cash income as a purpose for maintaining PO local cattle are the cattle breed, cattle characteristics, and adaptability. The cattle breed is related to the level of consumers' preference. Intermediary traders usually offer different prices for different livestock breeds. In addition, the selling price of livestock is also influenced by the muscles, frame score, skin color, body condition, sex, and horn shape (Troxel and Barham 2012).

Livestock also plays a vital role in socio-cultural terms, especially in rural communities in developing countries (Bettencourt et al. 2014). Livestock gives its owners a social status that shows wealth and provides socioeconomic status. The more livestock owned, the higher the social status (Rustinsyah 2019).

Efforts that can be proposed to improve the quality of farmers' livelihoods based on research findings include (1) increasing farmers' knowledge of cow reproduction through counseling from the local extension officer; (2) improving the skills of inseminators in providing artificial insemination

services, through training; and (3) government regulation for the certainty of PO cattles' selling price so that the maintenance of PO cattle is feasible as an investment as well as to stimulate the interest of farmers to raise PO cattle. Training supported by the proper information system is essential for human assets as an effort to enhance livelihoods (Mulika and Routray 2016).

The activity of beef cattle smallholder farmers in Indonesia always engages with the role of extension workers. Extension workers are an extension of the government to educate farmers about livestock management and the socialization of government programs and policies. To increase agricultural production, extension workers play a crucial role in providing critical information to farmers (Yakubu et al. 2013). They disseminate helpful information for farmers using appropriate methods (Matthew et al. 2017).

In conclusion, the study revealed that smallholder farmers consider reproductive ability a priority as it functions as an investment tool. Based on the research findings, farmers are encouraged to improve their knowledge about cows' reproduction with the assistance of extension workers/inseminators. Routine training needs to be held to improve the knowledge and skills of extension workers/inseminators, especially in cows' reproduction. With the upgrading of knowledge, the ability of extension workers/inseminators to convey information to farmers has also increased. In addition, so that the maintenance of PO cattle is feasible as an investment, it is necessary to have certainty in the selling price of PO cattle. At the same time, this can be used to stimulate farmers' interest in raising PO cattle.

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