Identification of Breed Preference on Cross-breeding among Beef Cattle Farmers in Central Java, Indonesia

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ABSTRACT

Cross-breeding between Peranakan Ongole (PO) and exotic breed are increasingly by smallholder farmer to obtain productivity improvement. Uncontrolled cross-breeding can be a threat to the existence of PO as local cattle in Indonesia. This study aims to identify the reasons behind cross-breeding breed preference among beef cattle farmers in Central Java. Primary data were obtained by interviewing a total of 121 smallholder farmers as respondents who were randomly selected. Blora, Grobogan, Klaten, and Rembang Districts have been chosen due to their high beef cattle farmer households population. Descriptive analysis by using cross-tabulation was performed to analyze the data. The results showed that 60.66% of farmers who raise PO cows would prefer Limousin semen to other semen due to the extension worker recommendation and the availability of frozen semen. Meanwhile, 22.95% of farmers prefer PO semen for their PO cows because of extension workers' recommendation and their intention to improve the calf productivity. It may indicate that the role of extension workers is prominent in the breed preference of cattle farmers.

Keywords: Artificial Insemination, Local Cattle Development. Smallholder Farmers.

1. INTRODUCTION

Beef cattle cross-breeding has been practiced in Indonesia. The Indonesian Government has implemented cross-breeding since the 1980s, especially between local cattle and European cattle, to improve the performance of local Indonesian cattle [1]. Fulfilling the beef demand, which continues to increase along with population growth, is the main reason for cross-breeding. As an illustration, the consumption of meat equivalent to fresh beef in 2017 was 2.40 kg/capita/year. This number increased by 3.85% from consumption in 2016, which was 2.31 kg/capita/year [2].

Artificial insemination (AI) is a reproductive technology that is often used in cross-breeding in beef cattle. This technology has an impact on reproductive performance [3]. Several things support the success of AI, including the quality of frozen semen, reproduction of female cattle, the skills of the officers, accuracy, and

reporting of estrus detection and rearing of cows [4]. In addition, the selection and provision of superior bull, production, and distribution of semen are the most important factors because the main benefit of AI activities is the maximum utilization of superior bull [5]. Thus, accuracy in selecting bulls also plays an important role in the success of AI [6]. There are various types of frozen semen used in AI, ranging from frozen semen from local cattle, such as PO (Peranakan Ongole) cattle, to European cattle, such as Simmental and Limousin. It makes farmers have to choose the right type of frozen semen for their cows [7].

PO cattle are one of the local Indonesian cattle that have been established based on the Decree of the Minister of Agriculture number 2907/KPTS/OT.140/6/2011 [8]. PO cattle have the ability to adapt to climate, feed, and disease conditions in Indonesia [9]. Previous studies have shown that cross-breeding using AI between PO cows and *Bos taurus* frozen semen, such as Simmental and

Limousin, produces offspring with chest girth and estimated adult body weights greater than the parent. However, uncontrolled cross-breeding will cause genetic damage and the extinction of the germplasm [10].

When making decisions, farmers are often faced with various choices when making decisions, so farmers must seek information from various sources before deciding [11]. The decision-making process carried out by farmers as consumers of frozen semen from beef cattle breeds is often influenced by opinions from people who are considered opinion leaders or their colleagues [6]. This influence is called verbal communication or opinion leadership process [12]. A person's decision-making is usually influenced by personal characteristics, such as education level, number of dependents in the family, land ownership, livestock ownership, and access to information [13]. Based on the important role of frozen semen in the cross-breeding process, it is necessary to study the reasons why farmers choose frozen semen. Thus, this study aims to identify the underlying reasons for farmers to choose frozen semen.

2. MATERIALS AND METHODS

This study was designed by surveying 121 beef cattle farmers purposively. Blora, Grobogan, Klaten, and Rembang regencies were selected as representative areas of Central Java Province. These locations were chosen due to they have more than 60% of small-beef cattle farmers' households. Data collection was carried out from March to April 2021 by conducting face-to-face interviews. The data was then analyzed descriptively using cross-tabulation with STATA 14 to determine farmers' preferences in choosing frozen semen. The reasons underlying breed preference in crosses between beef cattle farmers in Central Java were obtained descriptively using the same analysis.

Table 1. Descriptive statistics of farmers characteristics

Variables	Mean (121)	Std. Dev (121)	Min	Max	PO (61)		Non-PO (60)		t-test
					Mean	Std. Dev.	Mean	Std. Dev.	diff
Age	48.10	11.64	21	80	47.56	12.68	48.65	10.56	-1.09[p]
Educ	6.81	3.39	0	16	6.73	3.58	6.88	3.22	-0.15[p]
Household	3.76	1.41	1	9	3.44	1.11	4.08	1.61	-0.64[q]
Experience	19.07	11.45	2	49	16.75	10.22	21.43	12.23	-4.07[q]
TLU[a]	1.92	1.00	0.78	9.14	1.96	1.21	1.89	0.74	0.08[p]
Land	2,656.39	4,004.81	0	30,000	2387.57	4688.84	2929.65	3179.94	-542.08[p]
S/C	2.31	1.07	1	7	2.03	1.03	2.60	1.04	-0.57[q]
Revenue	$1.1*10^7$	$8.5*10^6$	0	$6.40*10^7$	$8.80*10^6$	$5.76*10^6$	$1.33*10^7$	$1.02*10^7$	$-4.46*10^{5q}$

[a]TLU is Tropical Livestock Unit; bull (>3 years) = 1.2 TLU, castrated adult males (>3 years) = 1.42 TLU, immature males = 0.85 TLU, mature cow = 1 TLU, heifer = 0.78 TLU, pre-weaning female = 0.43 TLU, and pre-weaning male = 0.38 TLU. diff is the mean difference score between PO and non-PO analyzed by unpaired t-test; *p* showed that the mean difference is not significant statistically, and *q* is the otherwise.

Table 2. Cross-tabulation between cow and bull semen

Cow	Bull semen					Total
	PO	Simmental	Limousin	Brahman	Do not know	
PO	14 (22.95%)	0 (0%)	37 (60.66%)	4 (6.56%)	6 (9.84%)	61 (50.41%)
SimPO	21 (47.73%)	8 (18.18%)	1 (2.27%)	1 (2.27%)	13 (29.55%)	44 (36.33%)
LimPO	5 (31.25%)	8 (50.00%)	2 (12.50%)	0 (0%)	1 (6.25%)	16 (13.22%)
Total	40 (33.06%)	26 (21.49%)	40 (33.06%)	5 (4.13%)	20 (16.53%)	121 (100%)

3. RESULTS AND DISCUSSION

The descriptive statistics of farmers' characteristics in this study are presented in Table 1. The analysis results showed that farmers have an average of 48.10 years with a formal education of around seven years. It means that most farmers are only graduated from elementary school, which can be concluded that farmers' education level is categorized as under the compulsory education program by the Indonesian Government. Farmers kept beef cattle approximately 1.92 ± 1.00 TLU as equivalent to raising one to two mature cows with two pre-weaning female cattle. Farmers manage the land around 2656.4 m2. These indicated that they are small-scale rural farmers, where the land they cultivated is below 10,000 m2, and kept beef cattle with a limited number.

As presented in Table 1, the mean difference for PO farmers is not significant in terms of age, formal educational background, and cattle ownership compared to non-PO farmers. The land managed by PO farmers is also not significant. The mean difference between PO cattle farmers and non-PO cattle farmers for household size, farming experience, S/C, and farmer's income was shown to be statistically significant. PO farmers have smaller household sizes, are less experienced, and have lower S/C than non-PO cattle farmers. It showed that farmers who cross-breed their cows (SimPO and LimPO) perform more often using AI than breeders who maintain PO cattle. PO cattle farmers' income from selling livestock is lower than that of non-PO farmers. This result aligns with previous research that farmers who own cross-breeds are more economically profitable than farmers who own local cattle [14].

Table 3. The reason underlying preference of bull semen by PO farmers

Reason	Bull semen (number of farmers)				
	PO	Simmental	Limousin	Brahman	Do not know
Preference for the breeds	2	0	5	2	1
Availability of bull semen	3	0	9	1	1
Improvement of calf quality	4	0	1	0	0
Maintaining existing breeds	0	0	7	0	0
Recommended by extension agents	4	0	10	1	4
Recommended by farmer group	0	0	1	0	0
Selected by inseminator	0	0	2	0	0
Others	1	0	2	0	0
Total	14	0	37	4	6

Table 4. The reason underlying preference of bull semen by SimPO farmers

Reason	Bull semen (number of farmers)				
	PO	Simmental	Limousin	Brahman	Do not know
Preference for the breeds	7	6	1	0	1
Availability of bull semen	2	1	0	0	0
Improvement of calf quality	3	0	0	0	0
Maintaining existing breeds	4	0	0	0	0
Recommended by extension agents	5	1	0	1	10
Recommended by farmer group	0	0	0	0	0
Selected by inseminator	0	0	0	0	2
Ohers	0	0	0	0	0
Total	21	8	1	1	13

Table 5. The reason underlying preference of bull semen by LimPO farmers

Reason	Bull semen (number of farmers)				
	PO	Simmental	Limousin	Brahman	Do not know
Preference for the breeds	2	3	1	0	0
Availability of bull semen	0	0	0	0	0
Improvement of calf quality	1	1	0	0	0
Maintaining existing breeds	0	1	0	0	0
Recommended by extension agents	1	3	1	0	1
Recommended by farmer group	0	0	0	0	0
Selected by inseminator	1	0	0	0	0
Ohers	0	0	0	0	0
Total	5	8	2	0	1

The bull semen of the farmers' choice was presented in Table 2. As shown in Table 2, most PO cattle are reared by farmers (50.41%), followed by SimPO cattle, which are reared by 36.33% of farmers, and LimPO cattle are reared by 13, 22% of farmers. It shows that the majority of farmers have PO cows. Then, about 60.66% of farmers who raise PO cows prefer to choose frozen semen from the Limousin breed, then 47.73% of farmers who have SimPO cows prefer to choose frozen semen from PO breed, and about 50% of farmers who raise LimPO cows prefer to choose Simmental frozen semen. Around 16.53% of farmers do not know what type of frozen semen using during AI. The reasons why farmers choose bull semen grouped by a breed of cattle (PO, SimPO, and LimPO) are presented in Table 3, Table 4, and Table 5.

Farmers with PO cows choose Limousin frozen semen during AI due to the recommendation from the extension agent, followed by the semen stock availability. Meanwhile, farmers who continue to choose PO frozen semen during AI are influenced by extension agent recommendation and improvement of the calf quality. SimPO farmers prefer PO frozen semen during AI due to their preference of PO breed, followed by recommendations by extension agents. Most farmers who keep SimPO cows prefer to choose Simmental frozen semen because they prefer the breed. Then, farmers with LimPO decide to have Simmental semen during AI because of the recommendation by the extension agent and their preference of Simmental breed compared to the other breed. Farmers with LimPO cows prefer PO frozen semen during AI due to their preference of PO breed. The rest of the farmers stated that they did not know what type of frozen semen was used during AI. They rely on extension workers to decide which breed to use during AI.

Both PO and non-PO farmers have different perceptions and purposes about rearing beef cattle.

Farmer's preferences of certain breeds influence them in deciding bull semen. Previous studies reveal that farmers' stopping keeping PO may be due to the high value of cross-bred cattle, in which the selling price is higher than PO [15]. This study shows that cross-bred farmers have higher revenue than PO farmers. However, cross-bred cattle have a higher rate of S/C and a bigger household size than PO, which indicates that SimPO and LimPO may require more capital and labor. This finding is also in line with the previous study, which stated that PO cattle need less feed, low capital, easy management, and require less labor than cross-bred cattle [1]. Farmer's preference for specific breeds can also be influenced by cattle appearances, such as Simmental cross, which farmers prefer because of its shiny red skin and rectangle head shape [16]. All of these aspects may affect the farmer's preferences in selecting bull semen breeds.

This study showed that extension agent recommendations affect the decision-making process of choosing bull semen. Extension agents have influenced farmers by transferring the information which consents to farmers' goals of keeping livestock and their circumstances. Quite some farmers rely on extension worker decisions without knowing what breed farmers are used for during AI. It means that extension agents are considered a reliable source of information by farmers. Another factor that may influence farmers' choice in selecting bull cement is the availability of bull cement.

The availability of breed varieties offers both possibilities and problems for livestock development [1], [17]. The use of cross-breeding has been widely recognized to increase cattle productivity and farmers' income. However, cross-breeding can threaten valuable breeds, including PO as a local breed [17]–[19]. Previous studies reveal that extension workers greatly influence every farmer's decision-making in many government programs [20]–[22]. Therefore, to maintain the existence

of PO as local cattle, extension workers have a prominent role in leading the breeding program.

4. CONCLUSION

The selection of frozen bull semen during AI by farmers in the four districts was motivated by the level of preference for certain breeds of cattle, the availability of frozen semen, and recommendations from extension workers. This study shows that although breeders mostly do cross-breeding, efforts to maintain the blood of local PO cattle are still carried out by some breeders because of the level of preference for PO. In addition, the extension agent's opinion can influence farmers both in maintaining PO cattle and cross-breeding.

AUTHORS' CONTRIBUTIONS

This scientific work would not have been possible without the contributions of all of the authors. RA helped with research concept development, data analysis, and paper writing. The first author has significantly benefited from NAAW's assistance with data analysis and paper writing. IWP assisted the primary data collection and enumerator coordination. As the supervising team, EB, MAUM, and ARSP have provided many best suggestions so that this research can be written systematically and informatively. Many suggestions on cross-breeding studies with the Animal Production approach were given by EB, while MAUM and ARSP mostly gave the socio-economic approach.

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REFERENCES

[1] T. S. M. Widi, H. M. J. Udo, K. Oldenbroek, I. G. S. Budisatria, E. Baliarti, and A. J. van der Zijpp, Is cross-breeding of cattle beneficial for mixed farming systems in Central Java?, Anim. Genet. Resour., 2015, vol. 56, pp. 127–144, https://doi.org/10.1017/S2078633615000259

[2] Kementerian Pertanian, Outlook Daging Sapi. Jakarta: Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal Kementerian Pertanian, 2017.

[3] K. Diwyanto and I. Inounu, The impact of cross-breeding in the artificial insemination program on reproductive performance of beef cattle, Wartazoa, 2009, vol. 19 No 2, pp. 93–102.

[4] Badan Standardisasi Nasional Indonesia, SNI 4869.1:2008 Semen beku – Bagian 1: Sapi, Jakarta, 2008.

[5] T. Saili and M.R. Toelihere, Pengelolaan Semen dan Inseminasi Buatan, 2015, www.researchgate.net/publication/282292186

[6] R. Agustine, Farmers Decision Making Analysis to Select Bull Breeds for Artificial Insemination, Thesis, Universitas Gadjah Mada, 2019.

[7] R. Agustine, S. Bintara, S. Andarwati, M. A. U. Muzayyanah, T. S. M. Widi, and A. R. S. Putra, Analysis in making making decision of farmer to select bull frozen semen in Indonesia, J. Indones. Trop. Anim. Agric., 2019, vol. 44, pp. 323–332, https://doi.org/10.14710/jitaa.44.3.323-332

[8] Badan Standardisasi Nasional, Bibit sapi potong: Sapi Peranakan Ongole, Jakarta, 2015.

[9] Sutarno and A. D. Setyawan, Review: Genetic diversity of local and exotic cattle and their cross-breeding impact on the quality of Indonesian cattle, Biodiversitas, 2015, vol. 16, pp. 327–354. https://doi.org/10.13057/biodiv/d160230

[10] S. Prastowo, T. S. M. Widi, and N. Widyas, Preliminary analysis on hybrid vigor in Indonesian indigenous and cross-bred cattle population using data from published studies, IOP Conf. Ser. Mater. Sci. Eng., vol. 193, https://doi.org/10.1088/1757-899X/193/1/012028

[11] J. R. Bettman, E. J. Johnson, and J. W. Payne, Consumer decision making, in Handbook of Consumer Behavior, 1991, vol. 6, pp. 50–84.

[12] L.G. Schiffman and K. Kanuk, Consumen Behavior. Jakarta: PT Indeks, 1999.

[13] A. R. S. Putra, Z. Liu, and M. Lund, The impact of biogas technology adoption for farm households – Empirical evidence from mixed crop and livestock farming systems in Indonesia, Renew. Sustain. Energy Rev., 2017, vol. 74, pp. 1371–1378, https://doi.org/10.1016/j.rser.2016.11.164

[14] T. S. M. Widi, H. Udo, K. Oldenbroek, I. G. S. Budisatria, E. Baliarti, and A. van der Zijpp, Designing genetic impact assessment for cross-breeding with exotic beef breeds in mixed farming systems, Outlook Agric., 2021, vol. 50, pp. 34–45, https://doi.org/10.1177/0030727020915206

[15] E. Nugroho, S. J Oosting, R. Ihle, and W. J. M. Heijman, Smallholders' perceptions of policies for preserving the traditional Ongole cattle breed of

Indonesia, Outlook Agric., 2021, vol. 50, pp. 188–195, https://doi.org/10.1177/0030727020983588

[16] S. Sutresniwati, F. A. Steenstra, and H. M. J. Udo, The invasion of cross-bred cattle: Stakeholders' Perspectives in Central Java, Indonesia, in Proceedings of the 4th ISTAP, 2006, pp. 461–466.

[17] M. Kamuanga, K. Tano, K. Pokou, M. Jabbar, B. Swallow, and G. D' ieteren, Farmers' preferences of cattle breeds, their market values and prospects for improvement in West Africa : A summary review, Proc. 25th Meet. Int. Sci. Counc. Trypanos. Res. Control, 1999, vol. 120, no. 120, pp. 271–298, https://doi.org/10.22004/ag.econ.182892

[18] T. S. M. Widi, H. M. J. Udo, K. Oldenbroek, I. G. S. Budisatria, E. Baliarti, and A. J. Van Der Zijpp, Unique cultural values of Madura cattle : Is cross-breeding a threat ?, Anim. Genet. Resour., 2014, vol. 54, pp. 141–152, https://doi.org/10.1017/S2078633613000349

[19] R. Favero, G. R. O. Menezes, R. A. A. Torres Jr., L. O. C. Silva, M. N. Bonin, G. L. D. Feijo, G. Altrak, M. V. G. Niwa, R. Kazama, I. Y. Mizubuti, and R. C. Gomes, Cross-breeding applied to systems of beef cattle production to improve performance traits and carcass quality," Animal, 2019, vol. 13, pp. 2679–2686, https://doi.org/10.1017/S1751731119000855

[20] E. Bryan, T. T. Deressa, G. A. Gbetibouo, and C. Ringler, Adaptation to climate change in Ethiopia and South Africa: options and constraints, Environ. Sci. Policy, 2009, vol. 12, pp. 413–426, https://doi.org/10.1016/j.envsci.2008.11.002

[21] M. Suvedi, R. Ghimire, and M. Kaplowitz, Farmers' participation in extension programs and technology adoption in rural Nepal: A logistic regression analysis, J. Agric. Educ. Ext., 2017, pp. 351–371, http://dx.doi.org/10.1080/1389224X.2017.1323653

[22] N. A. A. Widarni, A. Astuti, S. Andarwati, T. A. Kusumastuti, and A. R. S. Putra, Adoption of the mixed crop and livestock farming's technology in Magelang Regency, Central Java, IOP Conf. Ser. Earth Environ. Sci., 2020, vol. 518, https://doi.org/10.1088/1755-1315/518/1/012046