Factors Determining Smallholder Farmers to Upscale their Cattle Business

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Abstract. The maintenance of beef cattle in Indonesia is mainly carried out by smallholder farmers, so to meet national demand, beef cattle population needs to increase. While the government-initiated programs to increase e cattle population are many, studies to analyze smallholder farmers' interest to improve their cattle size remain limited. This study aims to analyze factors influencing the interests of smallholder farmers in improving their beef cattle business. The variables were farmers' age, gender, education level, family size, land ownership, beef cattle ownership, monthly income level, and cattle breed. The potential obstacles farmers faced to increase their beef cattle business were investigated. Conducted in Blora, Grobogan, Kebumen, Klaten, and Rembang Regencies, Central Java Province, this study purposively selected 287 beef cattle farmers aged 15-24 years as study respondents. The collected data were then subjected to binary logistic regression analysis using Stata 16. The findings showed that farmers' motivation to increase the population of cattle they raised was influenced by their age and monthly income. The older the farmers, the less probable they were interested in improving their business. Farmers earning >IDR 1,000,000.00-3,000,000.00 per month showed probability of interest in increasing their business by growing beef cattle population.

Keywords: beef cattle, binary options, farmers' welfare, rural development

Abstrak. Pemeliharaan sapi potong di Indonesia mayoritas dilakukan oleh peternak rakyat. Saat ini, populasi sapi potong Indonesia belum mampu memenuhi kebutuhan nasional. Pemerintah hingga saat ini membuat program peningkatan populasi sapi, namun belum ada kajian yang menganalisis sejauh mana minat peternak rakyat untuk meningkatkan jumlah sapi yang dipeliharanya. Sehingga, penelitian ini bertujuan untuk menganalisis faktor-faktor yang mempengaruhi minat peternak rakyat untuk meningkatkan sapi yang dipeliharanya. Adapun peubah yang digunakan, antara lain usia peternak, gender, tingkat pendidikan, jumlah anggota keluarga, luas lahan yang dimiliki, kepemilikan ternak sapi potong, tingkat pendapatan per bulan, dan bangsa sapi yang dipelihara saat ini. Selain itu, studi ini akan mengkaji kendala yang mungkin dihadapi oleh peternak dalam usaha untuk meningkatkan skala usahanya. Penelitian ini dilakukan di Kabupaten Blora, Grobogan, Kebumen, Klaten, dan Rembang, Provinsi Jawa Tengah. Penelitian ini melibatkan 287 peternak sebagai responden. Pengambilan sampel menggunakan purposive sampling dengan kriteria responden adalah peternak sapi potong yang minimal telah memasuki usia muda dan produktif (15-24 tahun). Data yang telah didapat selanjutnya dianalisis menggunakan regresi logistik biner menggunakan software Stata 16. Hasil penelitian menyebutkan bahwa usia peternak dan pendapatan per bulan menjadi faktor yang berpengaruh terhadap keinginan peternak untuk menambah populasi sapi yang dipelihara. Semakin tua usia peternak maka probabilitas minat untuk meningkatkan usaha akan semakin berkurang. Peternak dengan pendapatan > Rp 1.000.000,00 hingga Rp 3.000.000,00 per bulan memiliki probabilitas minat untuk meningkatkan usaha dengan menambah populasi sapi potong.

Kata kunci: kesejahteraan peternak, logistik biner, pengembangan pedesaan, sapi potong

Introduction

Raising beef cattle has been a livelihood for rural communities in Indonesia for many years (Widi, 2015). The beef cattle business in Indonesia is 90% managed by smallholder farmers, of which 6.5 million farmers live in rural areas (Agus and Widi, 2018; Mayulu et al., 2010).

Smallholder farmers in Java usually own and manage 2 to 4 head of beef cattle and integrate their livestock with crop business (Widi, 2015). Smallholder farmers account for 65-70% of domestic beef production (Asikin et al., 2020; Setianto et al., 2014). For them, cattle serve as a source of income, an asset, an indicator of one's

wealth status, and support for the family economy (Setianto et al., 2014). However, the lack of capital ownership, weak technology resources, and the lack of farmers' bargaining position has made the agribusiness system unable to appropriately apply to beef cattle farming (Ekowati et al., 2011). In addition, smallholder farmers face obstacles that prevent them from benefiting from market opportunities because farmers often live in remote areas with poor infrastructure and face high transaction costs that can reduce their profitability (Fischer and Qaim, 2012; Key et al., 2000).

The population of beef cattle in Indonesia in 2018 was around 17 million Direktorat Jenderal Peternakan dan Kesehatan Hewan, 2018). In the same year, the human population was 266.8 million. Indonesia's human population has been predicted to continue to increase to 305.6 million in 2035 (Statistics Indonesia, 2014), while Indonesia's domestic beef production can only meet 45% of domestic demand (Agus and Widi, 2018). In addition, the number of beef consumption in Indonesia is predicted to increase by 9% in 2022 (Meat and Livestock Australia, 2018). This increase in consumption rates is caused by population growth, urbanization, and increasing people's incomes (Delgado et al., 2001). Therefore, efforts can be made to meet the beef needs of the Indonesian people, among others, by increasing the population, production, and productivity of beef cattle (Mayulu et al., 2010). Currently, the beef cattle population in Indonesia is concentrated on Java Island, one of which is Central Java Province. Therefore, the growth number of beef cattle in Central Java will impact the country's population (Sunyigono et al., 2021).

The most crucial thing in developing the beef cattle industry in Indonesia is to improve the performance of smallholder farmers (Hadi et al., 2002; Setianto et al., 2014). Smallholder farmers on Java Island usually own and maintain two to four cattle raised intensively and integrate their agriculture with livestock business. It is certainly different from smallholder farmers in the Nusa Tenggara islands, where each smallholder farmer has 5 to 50 cattle that are reared extensively (Widi, 2015). The government has made programs to increase the beef cattle population, such as Upaya Khusus Sapi Indukan Wajib Bunting (UPSUS SIWAB). However, smallholder farmers face several obstacles in increasing production and marketing. The obstacles include the low quality and quantity of feed (especially during the dry season), the slow process of adopting technology to increase beef cattle productivity, and limited market access. In addition, lack of financial access causes farmers cannot afford to buy males, brooders, and machines for cattle houses (Asikin et al., 2020; Permani, 2013; Priyanti et al., 2012; Waldron et al., 2012). Another obstacle is farmers' age, who is getting older, and the farmers do not have an heir who wants to continue their business. Young people prefer to migrate from rural areas rather than continue their family farm businesses (Cavicchioli et al., 2018).

Several studies have been conducted on farmers' interest in developing their businesses. For example, research on the intention of dairy farmers to improve management practices of foot injuries that cause lameness in dairy cattle was conducted by Dutton-Regester et al. (2019). This study determines the interest of farmers in improving the management of foot lameness in dairy cattle. Another research is factors influencing the interest of farmers in adopting the use of fertilizers based on the results of soil tests (Daxini et al., 2018). Research conducted by Daxini et al., (2018) on farmers in Ireland stated that farmers' intention arises from the influence of their socio-economic characteristics, applicable policies, and resources received. Research on the interest of smallholder farmers to increase business scale by increasing the population of their beef cattle needs to be carried out in Indonesia, considering that currently, the program to increase the population of beef cattle continues to be carried

out in Indonesia to meet national needs. The results of this study are expected to be considered in formulating a development strategy for the beef cattle business for smallholder farmers by considering the farmers' socio-economic characteristics. Therefore, this study aims to determine the socio-economic factors that influence the interest of smallholder farmers in increasing business scale.

Materials and Methods

This research was conducted from March 2021 to February 2022 in Blora, Grobogan, Kebumen, Klaten, and Rembang Regencies, Central Java Province. Central Java province was chosen as the research area because it has more than 60% beef cattle farming households (Statistics Indonesia, 2013). In addition, this province will have a beef cattle population of 1,863,327 heads in 2021, as well as being the second province that produces the largest beef cattle population in Indonesia, after East Java Province (Statistics Indonesia, 2013).

Respondents were selected using purposive sampling with the criteria of respondents being beef cattle farmers who were at least of a young age (15-24 years) according to the National Planning and Development Agency (2022) requirements. When a person is between the ages of 15 and 60, the corresponding person is considered to be of productive age (Nul Hakim, 2020). Based on the purposive sampling method, a total of 287 respondents met the respondents' qualifications, (Blora 90; Kebumen 36; Klaten 36; Grobogan 72; and Rembang 53 respondents). The data collection was conducted through a survey with a structured questionnaire and direct interviews with the farmers. The data obtained from this study were analyzed using descriptive analysis to determine the social characteristics of farmers and binary logistic regression analysis to determine the factors that influence the farmers' interest in increasing the beef cattle population. In this study, Stata 16 was employed for the data analysis.

Table 1. Variable Definition

Variables	Definition
Dependent Variable	
Farmers Interest	Farmers' interest in increasing the population of beef cattle kept (1=eager to increase population; 0=not eager to increase population)
Independent Variables	
Age	Respondent's age (years)
Gender	Gender of respondent (dummy, 1=female, 0=male)
Education	Length of time the respondent received formal education (years)
Family Members	Number of family members financed by the respondent, including the respondent himself (person)
Land ownership	The area of land owned by the respondent (m^2)
Livestock ownership	Number of beef cattle owned by respondents (Tropical Livestock Unit/ TLU)
Income level	The range of income per month received by the respondent (categorical) 1 = ≤ IDR 1,000,000.00; 2 = IDR 1,000,000.00 – IDR 2,000,000.00; 3 = IDR 2,000,001.00 – IDR 3,000,000.00; 4 = IDR 3,000,001.00 – IDR 4,000,000.00; 5 = IDR 4,000,001.00 – IDR 5,000,000.00; 6 = > IDR 5,000,000.00)
Cattle Breed	Number of cattle breeds (dummy, 1=only *Peranakan Ongole* (PO) cattle; 0= PO cattle and others)

Binary logistics regression is an analysis used if the dependent variable is binary or dichotomous (Hosmer et al., 2013). In other words, the Y variable has two categories (not interval or ratio scale). To make the two categories easier for a statistical software program to process, they are typically recoded as "1" and "0." Regular linear regression models (whether simple or multiple) are inappropriate in these circumstances (Fritz and Berger, 2015). The dependent variable (Y) in this study is farmers' interest in increasing the beef cattle population, which is dummy (1 = eager to increase population; 0 = do not eager to increase population). The independent variables used in this study included age, gender, education, family members, land ownership, livestock ownership, income level, and cattle breed. Definitions for each variable showed in Table 1.

In this study, the logistic regression model characterizes the interest of beef cattle farmers to increase the population of beef cattle that are kept, determined by the following equation:

$$\ln\left[\frac{P_i}{1-P_i}\right] = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} \qquad (1)$$

where subscript i denotes Observation: "i" -th in the sample; P_i is the probability of the outcome; β_0 is the intercept; $\beta_1, \beta_2, …, \beta_k$ are the regression coefficient of the variables X_1, X_2, ..., X_k, respectively (Daxini et al., 2018), (Timprasert et al., 2014). If the coefficient is positive, it indicates an increase in the log probability, that is, the possibility of farmers increasing the population of their beef cattle.

Results and Discussion
Farmers' Characteristics

The farmers' characteristics in this study are presented in Table 2. The data were divided into two groups: the farmers who were not eager to increase the cattle population (n = 86) and those who were eager to increase the cattle population (n = 201). Characteristic data included farmers' age, education level, number of family members, land ownership, and livestock ownership. A two-sample t-test for the two groups was conducted to determine the difference in the mean of the two groups.

Table 2 shows that farmers who are reluctant to increase their population are 53 years old, while their counterparts are 48 years old. There was a statistical difference (P<0.01) in age between the farmers who are reluctant to increase the cattle population and those who were eager to increase the cattle population; likewise, in terms of education (P<0.1) and the number of family members (P<0.05). Farmers eager to increase the beef cattle population were at their productive age. Productive ages' farmers will find it easier to develop the livestock business they have been running (Sahala et al., 2016).

Table 2. Demographic statistics and farmers' characteristics

Socio-economic variables (Units)	Not eager to increase the population (n=86) Average ± SD	Eager to increase the population (n=201) Average ± SD	Overall (n= 287) Average ± SD
Age (years)	53.80 ± 11.76***	48.24 ± 11.01***	49.91 ± 11.51
Education (years)	6.49 ± 4.21*	7.27 ± 3.40*	7.03 ± 3.67
Family Members (person)	3.51 ± 1.39**	3.90 ± 1.26**	3.79 ± 1.31
Land Ownership (m^2)	1,473.35 ± 2,016.87	1,889. 69 ± 2,694.48	1,763.53 ± 1.55
Livestock Ownership (TLU*)	2.20 ± 0.99	2.39 ± 1.73	2.34 ± 1.55

SD is the Standard Deviation. A two-sample t-test was used to estimate the mean difference between the two groups. ***, **, and * represent the significance level at p<0.01, p<0.05, and p<0.1, respectively. Tropical Livestock Unit=TLU (pre-weaning male equal with 0.38 TLU; pre-weaning female equal to 0.43 TLU; heifers equal to 0.78 TLU; mature cow (have calves more than one time) equal to 1 TLU; immature male (<3 years) equal to 0.85 TLU; castrated adult male (>3years) equal to 1.42 TLU; and bull (>3 years) equal to 1.2 TLU.

Farmers eager to increase their beef cattle population had a higher level of education than the reluctant ones. The former averagely earned education up until the first year of Junior High School, while the latter were generally Elementary School graduates. Individuals with higher level of understanding and knowledge are more productive workers because of their level of education (Hidayat et al., 2021; Saputra et al., 2022).

The average family size of farmers who were reluctant to increase their cattle population was three people, while that of their eager counterparts was four people. It has been reported that the size of productive family members in the beef cattle business greatly influences work productivity and ability to manage the business (Sahala et al., 2016).

The farmers who were reluctant to increase their cattle population by far were averagely older, pursued lower education, and had fewer family members than their eager counterparts. However, the amount of land and livestock owned by both groups of farmers did not differ statistically. The average land size and number of cattle owned by farmers who were reluctant

compared to those eager to increase the population was 1,473 m^2 and 2.39 TLU vs. 1,889 m^2 and 2.20 TLU, respectively.

Descriptive statistics were also based on nominal research data, such as gender, farmers' income, and cattle breeds. Cross tabulation between gender and interests of farmers, the range of income and interests of farmers, and breed of cattle and interest in raising livestock, respectively, can be seen in Tables 3, 4, and 5.

Table 3 shows that the number of male and female farmers is not statistically different. The number of male and female farmers in this study was 169 vs. 118 people, respectively, consisted of 45 male and 41 female farmers who were reluctant to increase the population, and 124 male and 77 female farmers who were eager. Overall, farmers eager to increase the cattle population outnumbered the reluctant ones.

Table 4 shows farmers' range of monthly income. A total of 126 farmers earned IDR 1,000,000.00, which was much smaller than the provincial minimum wage in Central Java Province (IDR 1,812,935,00) based on Government Regulation Number 36 of 2021.

Table 3. Cross tabulation between gender and breeder interests

Gender	Breeders' Interest		Total Farmers
	Reluctant to increase the population	Eager to increase the population	
Male	45	124	169
Female	41	77	118
Total Farmers	86	201	287

Person chi2 = 2.3285, Pr=0.127

Table 4. Cross tabulation between farmer's monthly income and farmer's interest

Income	Farmers' Interest		Total Farmers
	Reluctant to increase the population	Eager to Increase the population	
≤ IDR 1.000.000,00	51	75	126
IDR 1.000.001,00 – IDR 2.000.000,00	18	68	86
IDR 2.000.001,00 – IDR 3.000.000,00	8	37	45
IDR 3.000.001,00 – IDR 4.000.000,00	5	13	18
IDR 4.000.001,00 – IDR 5.000.000,00	3	1	4
> IDR 5.000.000,00	1	7	8
Total Farmers	86	201	287

Person chi2 = 18.2329; Pr = 0.003

Table 5. Cross tabulation between breeds of cattle kept and breeders' interest

Cattle Breeds	Farmers' Interest		Total Farmers
	Reluctant to increase the population	Eager to increase the population	
Only PO Cattle	54	118	172
PO Cattle and other breeds	32	83	115
Total Farmers	86	201	287

Person chi2(1) = 0.4184; Pr = 0.158

Only eight farmers earned more than IDR 5,000,000.00 per month, while 153 farmers have an average income between IDR 1,000,000.00 - IDR 5,000,000.00. The cattle farmers' income increases with the quantity of livestock sold, hence the more livestock sold, the more income received by farmers (Indrayani and Andri, 2018).

Table 5 shows that the cattle breed kept by farmers are divided into two groups PO cattle, and the farmers' group does not only raise PO cattle. PO cattle are local breeds widely cultivated in Central Java, with a population of 51.3% (Kusuma et al., 2017). It can be seen in Table 5 that the number of farmers who only raise PO cattle is more than the number of farmers who do not only raise PO cattle. Farmers who not only raise PO cattle mean that farmers have kept cattle of other breeds. Cattle of other breeds are usually crossbred cattle, such as Simmental-PO cattle and Limousin-PO cattle. The majority of farmers in both groups were eager to increase their cattle population. Compared to cross-bred cattle, PO cattle require less labor, less capital, and less feed (Widi et al., 2015). However, crossbred cattle have higher selling price than PO cattle (Agustine et al., 2019), thus cross-bred farmers have a higher income than PO farmers (Agustine et al., 2022).

Factors Affecting Farmers' Interest to Increase Cattle Population

The logistic regression analysis results show that the model has a Prob>chi2 value of 0.0018. In other words, all the information used in this model can significantly explain farmers' interest in increasing the scale of the beef cattle business. In the regression analysis model, two of three independent variables have a "baseline." These variables include gender, income, and cattle breed. In the "gender" variable, code 0 (male farmer) serves as the "baseline"; on the variable "income," code 1 or income ≤ IDR 1,000,000.00 serves as the "baseline"; and in the variable "cattle breed," code 0 or farmers who maintain not only PO cattle serves as the "baseline." The baseline serves as a comparison for dummy or other categories in the same variable. The binary logistic regression results with the regression coefficient values are shown in Table 6, and the results of the analysis of the marginal effects are shown in Table 7.

Table 6 shows that age is a significant factor (P<0.05) to the interest of farmers to improve their business scale by growing the number of cattle. The regression coefficient shows that the older the farmers, the more reluctant they became to increase cattle population. Similarly, Brown et al. (2019), who state that older farmers will tend to refuse, are reluctant to trial-and-error attempt, or are not easily conform to social expectations and focus more on financial performance. They also demonstrate reluctance to adopt new technologies and low probability to orchestrate solid plans to convert land and intensify existing land use. Research on the impact of the age structure on the technical .

Table 6. Binary logistic regression results

Farmers' Interest	Coefficient	Standard Error	Z	P>|z|
Age	-0.04225**	0.01404	-3.01	0.003
Gender (Female)	-0.49632	0.31029	-1.60	0.110
Education	0.00899	0.04750	-0.19	0.850
Family Members	0.12169	0.11121	1.09	0.274
Land Ownership	0.00005	0.00006	0.77	0.441
Livestock Ownership	-0.04676	0.10465	-0.45	0.655
Income				
IDR 1.000.001,00 – IDR 2.000.000,00	0.84819**	0.34398	2.47	0.014
IDR 2.000.001,00 – IDR 3.000.000,00	0.79799*	0.47404	1.68	0.092
IDR 3.000.001,00 – IDR 4.000.000,00	0.20981	0.65336	0.32	0.748
IDR 4.000.001,00 – IDR 5.000.000,00	-1.45477	1.31881	-1.10	0.270
> IDR 5.000.000,00	1.31465	1.16363	1.13	0.259
Cattle Breed	0.03934	0.29555	0.13	0.894
Constant	2.46707	1.11118	2.22	0.026

***, **, and * represent the significance level at p<0.01, p<0.05, and p<0.1, respectively.

efficiency of agriculture in Thailand stated that while workers aged 60+ contributed to inefficient technicality issues, and those aged 15-59 years could improve technical efficiency in agricultural production (Saiyut et al., 2019). This present study confirmed the findings by Sahala et al. (2016) that the older the farmers, the fewer the cattle they owned because they had less intensity and attention to raise their cattle.

Another contributing factor to farmers' interest to increase their cattle population is income (P<0.05 and P<0.1). Farmers who earned IDR 1,000,000,00 - IDR 2,000,000.00 monthly would tend to increase their cattle population compared to farmers who earn ≤ IDR 1,000,000.00 per month, as well as farmers who have a monthly income between IDR 2,000,001.00 - IDR 3,000,000.00 per month. Income strongly influences farmers' interest in increasing the scale of the beef cattle business (z=2.44). Limited capital and dependence on family labor make farmers only have small-scale beef cattle farms business. They are often faced with the problem of low livestock productivity, scarcity and low quality of forage, and the unavailability of concentrated feed. They also

have difficulty meeting their families' needs with food and income. On the other hand, they prefer artificial insemination because they assume it can increase beef cattle's productivity by producing good offspring. However, artificial insemination is relatively expensive and self-funded. Moreover, artificial insemination is not always successful due to transportation problems and long distance between the inseminator and the farmer (Gayatri and Vaarst, 2015).

The results of the marginal effect analysis in Table 7 show that for every 1 unit increase in age, the probability of farmers to grow their cattle population will decrease by 0.00781 or 0.78%. If farmers earning IDR 1,000,000.00 – IDR 2,000,000.00 per month had a higher income, their probability to have more cattle was 0.16196 or 16.19% higher than those earning ≤ IDR 1,000.000,00 per month. Similarly, if farmers earning IDR 2,000,001.00 – IDR 3,000,000.00 per month had a higher income, they would have a 0.15389 or 15.39% higher probability of increasing their cattle population higher than farmers earning only ≤ IDR 1,000,000.00 per month.

Table 7. Marginal effect

	dy/dx	Standard Error	Z	P>|z|
Age	-0.00781	0.00245	-3.19	0.001
Gender (Female)	-0.09333	0.05855	-1.59	0.111
Education	0.00166	0.00878	-0.19	0.850
Family Members	0.02251	0.02042	1.10	0.271
Land Ownership	9.30e-06	0.00001	0.77	0.440
Livestock Ownership	-0.00865	0.01933	-0.45	0.655
Income				
IDR 1.000.001,00 – IDR 2.000.000,00	0.16196**	0.06353	2.55	0.011
IDR 2.000.001,00 – IDR 3.000.000,00	0.15389*	0.08463	1.82	0.069
IDR 3.000.001,00 – IDR 4.000.000,00	0.04469	0.13656	0.33	0.743
IDR 4.000.001,00 – IDR 5.000.000,00	-0.32548	0.26215	-1.24	0.214
> IDR 5.000.000,00	0.22693	0.14702	1.54	0.123
Cattle Breed	0.00726	0.05454	0.13	0.894

***, **, and * represent the significance level at $p<0.01$, $p<0.05$, and $p<0.1$, respectively.

Farm management operated by smallholder farmers hold on to the belief that that business motivation is solely based on economic benefits. There are three factors related to motivation: interests, needs, and ambitions or determination. Previous studies have shown the importance of the interest factor. When doing agricultural work based on interest or preference, there is a positive relationship with income. Furthermore, the "ambition or need" factor describes the relationship of an individual's economic accumulation to the possible needs of their personal and family (Maican et al., 2021). Based on the interviews with farmers, farmers were reluctant to increase their cattle population due to several limitations, including cages, labor, capital, human resources due to old age, and feed due to cost. Meanwhile, farmers were eager to increase cattle population as an investment, hobby, additional income, and pride.

Responding to the problems that arise from the study results, a strategy is needed to overcome the problem of age and capital to overcome economic obstacles in increasing the scale of the beef cattle business. The most important thing to overcome the problem of aging farmers is to foster farmer regeneration. Regeneration is equivalent to inheriting or handing over agricultural businesses, bringing new players into the agricultural business (Anwarudin et al., 2020). The problem of aging in society is faced by both developed and developing countries, which will impact business productivity in the agricultural sector. Older farmers are less productive than younger farmers (Zou et al., 2018). Farmers' regeneration processes, approaches, and strategies can perform through family role improvement, agricultural extension, communities, agricultural modernization, and farmer corporations. The strategy for applying respect, socialization, and inheritance of agricultural businesses can be done through the role of the family while strengthening the institutions of young farmers and consulting through the role of agricultural extension workers. Communities can play a role in socialization, information transfer, and consultation. Agricultural modernization can be done through agricultural mechanization and digital farming. At the same time, corporate strategies can be developed to attract youth because it opens opportunities for the availability of economically viable land and the use of agricultural machinery and increases farmers' bargaining position (Anwarudin et al., 2020).

Furthermore, potential strategies to overcome farmers' limited capital included the formation of livestock groups, the establishment

of cooperatives, and the development of collaborations. Farmer groups play a significant role in devising strategies for managing finances, elevating beef cattle, and planning to improve livestock productivity (Sugiarto et al., 2021). Livestock groups provide access to capital for farmers through credit, knowledge transfer, and market access (Castella and Bouahom, 2014), while cooperatives enable organizations and companies to collaborate to achieve a goal. Collaborative strategies (e.g., cooperatives-joint ventures) are a way to overcome their size constraints and succeed in an increasingly competitive market environment (Matopoulos et al., 2005). Support from the government and the private sector through capital, assistance, and training for smallholder farmers is essential to increase beef cattle production (Rustinsyah, 2019).

Conclusions

Age and monthly income are two contributing factors to farmers' interest to expand their beef cattle business through growing cattle population. This study concluded that farmers' desire to increase cattle population decreases with age, and mostly younger farmers condoned to grow their business. Furthermore, farmers interested to increase their cattle population earn between IDR 1,000,000.00 and IDR 3,000,000.00 per month. Strategies to address the first issue of aging farmers included fostering farmers' regeneration through the roles of family and community, agricultural extension and modernization, and farmer corporations. Meanwhile, the low-income farmers' limited capital can be solved by forming livestock groups, establishing cooperatives, and developing collaborations.

Acknowledgement

References

Agus, A, and TSM Widi. 2018. Current situation and future prospects for beef cattle production in Indonesia - A review. Asian-Australasian Journal of Animal Sciences. 31(7):976–983.

Agustine, R, S Bintara, S Andarwati, MAU Muzayyanah, TSM Widi, and ARS Putra. 2019. Analysis in making making decision of farmer to select bull frozen semen in Indonesia. J. Indonesian Trop. Anim. Agric. 44(3):323–332.

Agustine, Restiyana, NAA Widarni, IW Pratama, E Baliarti, MAU Muzayyanah, and ARS Putra. 2022. Identification of breed preference on cross-breeding among beef cattle farmers in Central Java, Indonesia. In   Proceedings of the 9th International Seminar on Tropical Animal Production (ISTAP 2021) (pp. 281–286).

Anwarudin, O, S Sumardjo, A Satria, and A Fatchiya. 2020. Process and Approach to Farmer Regeneration Through Multi-strategy in Indonesia. Jurnal Penelitian Dan Pengembangan Pertanian. 39(2):73.

Asikin, Z, D Baker, R Villano, and A Daryanto. 2020. Business models and innovation in the Indonesian smallholder beef value chain. Sustainability: 12(17).

Badan Pusat Statistik. 2014. Proyeksi Penduduk menurut Provinsi, 2010-2035. Retrieved March 20, 2022, from https://www.bps.go.id/statictable/2014/02/18/1274/proyeksi-penduduk-menurut-provinsi-2010---2035.html

Badan Pusat Statistik. 2022, August 11. Populasi Sapi Potong Menurut Provinsi 2019-2021. Retrieved September 6, 2022, from https://www.bps.go.id/indicator/24/469/1/populasi-sapi-potong-menurut-provinsi.html

Brown, P, A Daigneault, and J Dawson. 2019. Age, values, farming objectives, past management decisions, and future intentions in New Zealand agriculture. Journal of Environmental Management. 231:110–120.

Castella, J, and B Bouahom. 2014. Development in Practice Farmer cooperatives are the missing link to meet market demands in Laos. Development in Practice. 24(2):185–198.

Cavicchioli, D, D Bertoni, and R Pretolani. 2018. Farm succession at a crossroads: The interaction among farm characteristics, labour market conditions, and gender and birth order effects. Journal of Rural Studies. 61:73–83.

Daxini, A, C O'Donoghue, M Ryan, C Buckley, AP Barnes, and K Daly. 2018. Which factors influence

farmers' intentions to adopt nutrient management planning? Journal of Environmental Management. 224:350–360.

Delgado, C, M Rosegrant, H Steinfeld, S Ehui, and C Courbois. 2001. Livestock to 2020 : the next food revolution. Outlook Agriculture. 30(1):27–29.

Direktorat Jenderal Peternakan dan Kesehatan Hewan. 2018. Statistik Peternakan dan Kesehatan Hewan 2018. Jakarta: Kementerian Pertanian Republik Indonesia. Retrieved from http://ditjenpkh.pertanian.go.id

Dutton-Regester, KJ, JD Wright, AR Rabiee, and TS Barnes. 2019. Understanding dairy farmer intentions to make improvements to their management practices of foot lesions causing lameness in dairy cows. Preventive Veterinary Medicine. 171.

Ekowati, T, DH Darwanto, S Nurtini, and A Suryantini. 2011. The analysis of beef cattle subsystem agribusiness implementation in central Java Province, Indonesia. Jitaa. 36(4):281–289.

Fischer, E, and M Qaim. 2012. Linking smallholders to markets: Determinants and impacts of farmer collective action in Kenya. World Development. 40(6):1255–1268.

Fritz, M, and PD Berger. 2015. Will anybody buy? Logistic regression. Improving the User Experience Through Practical Data Analytics. 271–304.

Gayatri, S, and M Vaarst. 2015. The implementation of Indonesia's Beef Self-Sufficiency Programme (BSSP) as seen from a farmer-family perspective. Jornal of Rural and Community Development. 10(2):166–186. Retrieved from www.jrcd.ca

Hadi, PU, N Ilham, A Thahar, B Winarso, D Vincent, and D Quirke. 2002. Improving Indonesia's Beef Industry. Canberra: ACIAR.

Hidayat, NN, K Muatip, and R Widiyanti. 2021. Developing Beef Cattle in Banyumas Regency: Potentials and Strategies. Animal Production. 23(1):62–68.

Hosmer, DW, S Lemeshow, and RX Sturdivant. 2013. Applied Logistic Regression (Third). New Jersey: John Wiley & Sons.

Indrayani, I, and D Andri. 2018. Faktor-faktor yang mempengaruhi pendapatan usaha ternak sapi potong di Kecamatan Sitiung, Kabupaten Dharmasraya. Jurnal Peternakan Indonesia. 20(3):151–159.

Key, N, E Sadoulet, and A De Janvry. 2000. Transactions costs and agricultural household supply response. American Journal of Agricultural Economics. 82(2):245–259.

Kusuma, SB, N Ngadiyono, and S Sumadi. 2017. Estimasi dinamika populasi dan penampilan reproduksi sapi Peranakan Ongole Di Kabupaten Kebumen, Provinsi Jawa Tengah. Buletin Peternakan. 41(3):230.

Maican, S Ştefania, AC Muntean, CA Paştiu, S Stępień, J Polcyn, IB Dobra, M Dârja, and CO Moisă. 2021. Motivational Factors, Job Satisfaction, and Economic Performance in Romanian Small Farms. Sustainability. 13(11):5832.

Matopoulos, A, M Vlachopoulou, and V Manthou. 2005. Exploring clusters and their value as types of business networks in the agricultural sector. Operational Research. 5(1):9–19.

Mayulu, H, Sunarso, I Sutrisno, and Sumarsono. 2010. Kebijakan pengembangan peternakan sapi potong di indonesia. Jurnal Penelitian Dan Pengembangan Pertanian. 29(1):34–41.

Meat and Livestock Australia. 2018. Market snapshotof beef in Indonesia. Retrieved March 20, 2020, from https://www.mla.com.au/ globalassets/mla-corporate/ pricesmarkets/doc uments/os-markets/export-statistics/oct-2018-snapshots/mla-beef-market-snapshot-indonesia---oct-2018.pdf

Nul Hakim, L. 2020. Urgensi revisi undang-undang tentang kesejahteraan lanjut usia. Jurnal Masalah-Masalah Sosial. 11(1):43–55.

Permani, R. 2013. Determinants of Relative Demand for Imported Beef and a Review of Livestock Self-Sufficiency in Indonesia. Southeast Asian Economies. 30(3):294. http://doi.org/10.1355/ae30-3e

Priyanti, A, VW Hanifah, IGAP Mahendri, F Cahyadi, and RA Cramb. 2012. Small-Scale Beef Cattle Production in East Java, Indonesia. In Australian Agricultural and Resource Economics Society (pp. 1–22).

Rustinsyah, R. 2019. The significance of social relations in rural development: A case study of a beef-cattle farmer group in Indonesia. Journal of Co-Operative Organization and Management. 7(2):100088.

Sahala, J, R Widiati, and E Baliarti. 2016. Analisis kelayakan finansial usaha penggemukan sapi Simmental Peranakan Ongole dan faktor-faktor yang berpengaruh terhadap jumlah kepemilikan pada peternakan rakyat di Kabupaten Karanganyar. Buletin Peternakan. 40(1):75–82.

Saiyut, P, I Bunyasiri, P Sirisupluxana, and I Mahathanaseth. 2019. The impact of age structure on technical efficiency in Thai agriculture. Kasetsart Journal of Social Sciences. 40(3):539–545.

Saputra, Y, S Sugito, and S Samadi. 2022. Evaluating the Implementation of the Local Regulations (Qanun) to Control Productive Female Cattle and Buffaloes in Aceh Besar. Animal Production. 24(1):45–56.

Setianto, NA, DC Cameron, and JB Gaughan. 2014. Structuring the problematic situation of smallholder beef farming in Central Java, Indonesia: using systems thinking as an entry point to taming complexity. International Journal of Agricultural Management. 3(3):165–174.

Setianto, NA, D Cameron, and JB Gaughan. 2014. Identifying Archetypes of an Enhanced System Dynamics Causal Loop Diagram in Pursuit of Strategies to Improve Smallholder Beef Farming in Java, Indonesia. Systems Research and Behavioral Science. 31(5):642–654.

Statistics Indonesia. 2014. Jumlah rumah tangga usaha peternakan menurut wilayah dan jenis ternak Provinsi Jawa Tengah. Retrieved September 30, 2017, from http://st2013.bps.go.id

Sugiarto, M, YN Wakhidati, OE Djatmiko, S Nur, and D Gandasari. 2021. Understanding Motives of Indigenous Cattle Farmers Joining Farmers Group in Brebes Regency, Indonesia. Animal Production. 23(2):120–126.

Sunyigono, AK, I Suprapti, and N Arifiyanti. 2021. Inter-market variability of smallholder beef cattle farming in east java indonesia. Agraris. 7(2):176–190.

Timprasert, S, A Datta, and SL Ranamukhaarachchi. 2014. Factors determining adoption of integrated pest management by vegetable growers in Nakhon Ratchasima Province, Thailand. Crop Protection. 62:32–39.

Waldron, S, D Mayberry, M Mulik, S Quigley, and D Poppi. 2012. Eastern Indonesia-Agribusiness Development Opportunities: Beef Value Chain Study. Canberra. Retrieved from www.ei-ado.com.au

Waldron, S, M Halliday, J Ngongo, J Nulik, D Kana Hau, Silvia Kusuma Putri Utami, T Panjaitan, B Tutik Yuliana, B Pengkajian Teknologi, S Kusuma Putri Utami, M Shelton, and D Nulik. 2016. Economic analysis of cattle fattening systems based on forage tree legume diets in Eastern Indonesia 1. ACIAR Small Research Activity LPS.

Widi, TSM. 2015. Mapping the impact of crossbreeding in smallholder cattle systems in Indonesia [Ph.D Thesis]. Wageningan, The Netherland: Wageningen University.

Widi, TSM, HMJ Udo, K Oldenbroek, IGS Budisatria, E Baliarti, and AJ van der Zijpp. 2015. Is crossbreeding of cattle beneficial for mixed farming systems in Central Java? Animal Genetic Resources/Ressources Génétiques Animales/Recursos Genéticos Animales. 56:127–144.

Zou, B, AK Mishra, and B Luo. 2018. Aging population, farm succession, and farmland usage: Evidence from rural China. Land Use Policy. 77:437–445.