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Factors Influencing Indonesian Dairy Farmers in Making Business Decisions

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Abstract. *The development of the dairy industry in Indonesia is concentrated in Java and is dominated by the traditional farm with small-scale ownership, which is farmers do not get a big profit, farm management is very simple, farmers low level of education, and most farmers have dairy cattle that functioned as savings. This research was conducted to answer questions about how the behavior and decisions of farmers are influenced by interactions with other agents or factors; and how to encourage farmers to increase the cattle population and milk production so that farmers' income increases and have a sustainable business farm to develop the dairy industry in Bandung Regency. Agent-based modeling was conduction with the help of the SOARS program. In this research, dairy farmers are categorized into three clusters using cluster analysis, which is, the motivated, the survived, and the unsatisfied. Agent-based modeling is suitable for the complexities of this research which are the motivation, behavior, decision, and interactions of dairy farmers will be affecting the output of the dairy industry system as a whole; and to implement some policy scenarios.*

Keywords: *Agent-based, dairy farmer, milk production, business decisions, behaviour*

1. Introduction

Local dairy farmers are the strategic partners that support dairy companies, both to help the Government meet the needs of milk in Indonesia and to grow the company's business (Fauzi, 2018). Bandung Regency is an ideal area for the development of dairy cows and has high growth potential for the dairy industry in Indonesia due to its suitable degree of temperature.

The Agriculture and Livestock Office of Bandung Regency stated that the total number of dairy cows from 12.000 farmers in Bandung Regency is 38.900 cows (Husodo, 2019). Within a day, milk production produced by cattle farmers in West Bandung Regency reaches 200 thousand tons.

Unfortunately, dairy farmers face limited land issues and the difficulty of getting green feed. Therefore, dairy farmers are forced to buy foods for their cattle. With these limitations, the Government of the Bandung Regency continues to look for solutions to improve the quality and the quantity of milk and beef.

Other problems also emerge. Firstly, the increasing amount of cow's milk production has not significantly increased the income of farmers. Secondly, small-scale ownership is less efficient. Thirdly, traditional farmers have relatively low education in terms of farming skills as well as a person in which the service provided by Indonesian public schools. Fourthly, farm management is still traditional and that is the reason for the relatively high production costs. Fifthly, the lack of adoption of technological practices such as food

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processing and the lack of motivation of traditional farmers to increase the quantity of milk production. All of these problems contribute to the low competitiveness of traditional dairy farmers in terms of large-scale milk production and the increased rate of milk imports as presented in Table 1.

The research objective is to examine the factors that can influence the behavior and decisions of dairy farmers in running their businesses. This study continues the findings of Hall, Turner, and Kilpatrick (2019) who previously measured the behavior of dairy farmers who are considered important in making their decisions in doing business. The implications of this study can be used to create a strategic plan by the Government as the most powerful and interested stakeholder to increase cattle farmers' income so that sustainable dairy farming business can be realized.

2. Literature Study

The Motivation of Dairy Farmer

Valeeva, Lam, and Hogeveen (2007) divided dairy farmers' motivation into 3 groups, namely basic economic motivation, motivation to have efficient agriculture, and premium motivation. Farmer performance factors (internal) affect motivation more than reward factors (external). Another finding is the pleasure factor of raising animals provides the same motivation as the expected benefits from business activities.

Dairy farmers are influenced by the value of use and not use in their work related to the animal welfare of dairy cows (Hansson & Lagerkvist, 2016). The intended use values include: 1) maximum production, (2) maximum profitability, (3) the possibility of continuing business, (4) having time available for other activity, (5) own work environment, (6) adjustments production at current producer prices, (7) comply with animal welfare laws, and (8) make a living from the business.

Factors Affecting Dairy Farming

The conjoint analysis identifies the most important factors in dairy farming including access to animal feed, body condition scores, hock lesions, and the encouragement required for a dairy cow to walk into the parlor (Angus, Bowen, Gill, Knowles, & Butterworth, 2005). Hogeveen, Huijps, and Lam (2011) mentioned that good udder health can increase consumer interest in the whole milk production chain including the way milk products are produced, improving animal welfare, communicating to consumers the values in which dairy products are produced. In contrast to Dries, Germenji, Noev, and Swinnen (2009), which showed that for small-scale dairy farming, the vertical coordination process has a positive impact on business by providing access to a wider and more valuable market.

Howley, Donoghue, and Heanue (2012) emphasized that the reproductive management factors of dairy cows are very significant in the profitability of all farms. In addition to the previous argument, in applying technology in cattle farms, the involvement of agricultural program advisors has a positive impact on the process of technology adoption. The findings of Barkema et al. (2015) in evaluating dairy farms, that nutrition, management, genetic selection, and adoption of new technologies have a significant effect on increasing milk production. The new technologies in question include automatic calf feeders, cow activity monitors, and automatic milking systems. Whereas Hansen (2015) emphasizes the importance of interaction between farmers and between farmers and extension services to improve agricultural knowledge systems and to improve agricultural performance.

The Decision in Dairy Farming

Smit, Driessen, and Glasbergen (2009) mentioned 4 factors that influence the decision of dairy farmers to convert their business, namely: short-term finance, market demand, innovation, free trade, and common agricultural policy (CAP) reform which enables production methods that save cost.

Howley, Donoghue, and Heanue (2012) stated that the factors of farmer's age, technology awareness, total farm milk production and sales, extension visits per year, and the quality of artificial intelligence services provided to farmers are positively related to the adoption and use of technology on farms cow. Rehman et al. (2007) reminded the need for the promotion of technology and the transfer of good knowledge, to gain trust and influence farmers' decisions in adopting technology. Options, consequences, structured comparisons of potential results based on their agricultural performance, and other farmers 'experiences influence farmers' decisions in developing their business (Garforth et al., 2004).

3. Methodology

Research Design

Based on the type and analysis of the data, the study adopted is a mix-method research type. The first stage is the exploration stage by using a qualitative approach and the second stage that uses a quantitative approach. The sources of the data in this research are obtained from:

Observation

In this research, observation is used to gather insights about the location of the research, the physical and technical conditions of the location, the ease of access to the location, how many places to be visited, how many respondents are needed, and how firm the relationships are between stakeholders.

Focus Group Discussion (FGD)

FGD was conducted in June 2018 at the Department of Animal Husbandry and Fishery in Bandung Regency and Dairy Cooperatives (KPBS) in Bandung Regency. The topic of FGD related to local government programs (dairy farming sector), the constraints they face in the dairy sector, the structure of local government control of the farmer, and the condition of the farm and farmer. The members of FGD at the Department of Animal Husbandry and Fishery are the head of the department, the head of the animal husbandry division, the head of field sub-division, and the head of the animal health division.

Questionnaire and Interviews

Questionnaire and Interview participants were dairy farmers in Bandung Districts. Interview and questionnaire distributed towards 30 dairy farmers in Bandung Regency. The data collection includes the identity of the respondent, respondent's educational level, number of family responsibilities, experience and status of the dairy cattle business, barriers, and motivation of the respondents in running the business of dairy cattle.

Profile of Dairy Farmers in Bandung Regency

The number of member dairy farmers who joined the dairy cooperative was 5.055 farmers, including active farmers 3.145 farmers, and 1.905 non-active farmers. This study focuses on cattle ranchers who are members of the South Bandung Livestock Cooperative (KPBS), which consists of 134 groups of dairy farmers.

Profile of Dairy Farming in Bandung Regency

The average milk production received from members of the cooperative in 2018 was 2.34 million litters with an average production of 84.2 thousand litters per day. The numbers of cow population in real data are between 7.500 until 8.400 cows, but in the result of model simulation in condition A between 8.400 until 10.000 cows, in condition B between 9.000 until 11.000 cows, and condition C and D between 8.000 until 10.000 cows.

Agent

There are 3 types of dairy farmer agents created in this study, namely the motivated type (type 1), the survived (type 2), and the unsatisfied (type 3). The division of this agent type is based on several variables, including education level, age, experience, number of families that are still covered, number of cow population, number of lactation cows, and milk production per day.

1) The motivated

They like their job and think that their profession as farmers have good prospects and profitable. They are highly motivated to expand their business. Therefore, farmers of this type do not have another job besides being a farmer. They have a lot of lactation cows so that they have highly profitable farm businesses.

2) *The survived*

They perceive that their business is adequate and does not need an improvement. They are senior citizens and have sufficient experience being a farmer. They are traditional-oriented in terms of the way they run their business. Although they have the least number of cattle, they are satisfied with their income. This is because they have a relatively mature family in which most of their children already "left the nest." They have quite a large number of savings. They have a high potential to increase the number of their cattle but restrained by the limited number of laborers.

3) *The unsatisfied*

They feel unsatisfied with their business farm. Most of them are young farmers and has the least experience being a farmer. They have the largest number of family members that need their financial support (breadwinner). Their income is not sufficient to cover the cost of living and the cost of production. Therefore, most of them have a second job as a vegetable farmer and as porters to add their income.

Parameter

The success of the development of the dairy industry in Bandung in this simulation can be measured by 2 two things, which are, dairy productivity and farmer's welfare. Parameters of dairy productivity include milk production, cattle population, and cow population. For the farmer's welfare, the parameters are income, expense, and saving.

Total of Milk Production = milk production x cow population

Total of Cattle Population = cow + heifers + calves

Total of Lactation Cow

Total of Farmers Income = milk income + selling income + cattle income + additional income + meet cow income + urgency income + loan

Total of Farmers Expense = family expenses + cost of production + loan rate + paying loan + purchase heifer + tertiary needs

Family expenses = basic family expense + family member expense

Cost of production = basic cost + cage cost + feed cost + fodder cost + labour cost

Total of farmers saving = total income - total expense

Experiment

The simulations aim to propose effective policies for the development of the dairy industry in the Bandung Regency. Therefore, some alternative policies would be applied in the system model that has been made, and then compare the results. Total farmer agents were 3,200 breeders. Simulation experiments were terminated in the fifth year or 60 months of iteration, where each iteration is one month and has been carried out 30 times, each proposed scenario was applied under four conditions, namely conditions A, B, C, and D. The experiment of simulation is presented in Table 1. The proposed scenarios in this experiment are based on interviews with farmers and discussions with the Department of Animal Husbandry and Fishery, Bandung Regency where farmers expect help from the government.

Table 1.
Experiment of Simulation

Scenario		Condition			
		A	B	C	D
		1.067:1.066:1.067	1.600:800:800	800:1.600:800	800:800:1600
0	Existing condition	- Concentrate: IDR 1.600/kg - Milk price: IDR 3.400/lt			
1	The government provides heifer for granted	- In the initial stage, every farmer type 3 adds 1 heifer - Concentrate: IDR 1.600/kg - Milk price: IDR 3.400/ lt			
2	The government raised the basic price of milk in the farmer level	- Concentrate: IDR 1.600/kg - Milk price: IDR 3.500/ lt			
3	The government provides funds to subsidize cattle feed	- Concentrate: IDR 1.475/kg - Milk price: IDR 3.400/ lt			
4	Combination of scenario 2 and 3	- Concentrate: IDR 1.475/kg - Milk price: IDR 3.500/lt			

Simulation Process

Simulation in this research constructed using the SOARS 4.1.1 (Spot Oriented Agent Role Simulator) program. The SOARS Program is an agent-based program where each agent has attributes and can interact with other agents through the spot. Every agent can have different rules that define their activity (Kurata, Deguchi, & Ichikawa, 2015; Tanuma, Deguchi, & Shimizu, 2006).

The framework of simulation is described in Figure 1. Simulation framework based on the thought of each farmer, which affected by the condition of their welfare, their needs, their capabilities, government regulations, resources, social, trends, and price. Those things will determine their decision rule, which will affect their activity includes taking a loan or taking another job. In their activities, farmers will take several decisions in running their farm business, and of course, these decisions are closely related to the elements of production, namely, feeding, breeding, and management. Those elements of production will affect productivity.

Parameters that are affected by farmer's productivity are dairy production and farmers' welfare. In dairy production, there are cattle population and milk production, which are used as indicators of the development of the dairy industry. The higher the productivity of farmers, the higher the dairy production, and then the higher the welfare of farmers. The welfare of farmers is determined by their income, expense, and saving. Farmer's welfare will influence their decision rule for their next activity. It continues repeatedly and forms a closed loop.

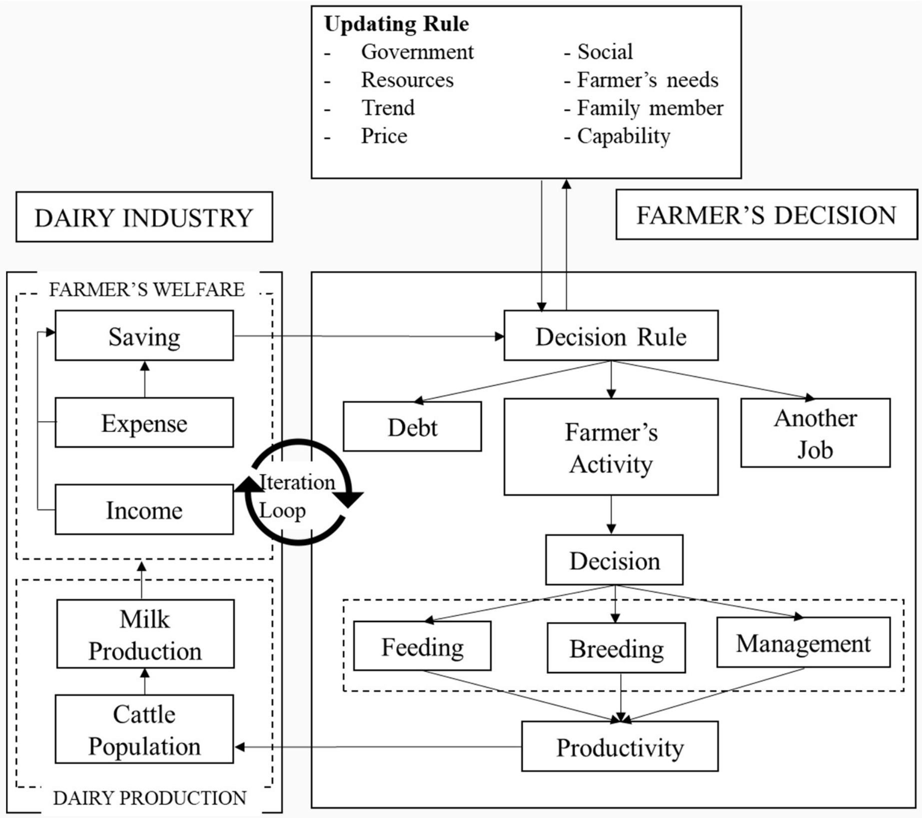

Figure 1.
Model of Simulation

4. Findings and Discussion

In the simulation experiments, the authors make several alternative policy scenarios, which are:

1) The first policy scenario proposes giving pregnant cows to give to farmers. In this scenario, it is assumed that farmers are given grants to livestock farmers only type 3, which is "not satisfied". The price of milk at the farm level and the price of concentrate feed are the same as the existing condition. This policy can only be done by the national government, which is a cattle procurement program for traditional farms, considering the provision of livestock requires enormous funds.
2) The second scenario proposes raising the basic price of milk at the farmer level from IDR 3.400 to IDR 3.500 per litter. This policy can be done by the cooperative itself, considering the cooperative who bought milk from farmers and then sell it back to the dairy processing industry, nor is assisted by local governments.
3) The third scenario proposes providing funds from the government to subsidize cattle feed concentrate from IDR 1.600/kg to IDR 1.475/kg. This policy can be done by local governments.
4) The fourth scenario proposes a combination of the 2nd scenario and 3rd scenario. In this scenario, the government provides funds to subsidize cattle feed concentrate from IDR 1.600/ kg to IDR 1.475/kg and raised the basic price of milk at the farmer level from IDR 3.400 to IDR 3.500 per litter.

Experimental simulation of population simulation results can be seen in Table 2.

Table 2.
Total Population Simulation Result

Population	Position	Year				
		1	2	3	4	5
A	Existing	12.853	12.409	12.437	12.574	12.610
	Scenario 1	13.143	13.244	14.156	15.149	15.806
	Scenario 2	12.949	13.185	14.190	15.188	15.806
	Scenario 3	12.963	13.221	14.282	15.304	15.916
	Scenario 4	13.006	13.456	14.725	15.874	16.601
B	Existing	13.841	13.669	14.068	14.633	15.032
	Scenario 1	14.312	14.855	16.312	17.812	18.782
	Scenario 2	14.367	14.877	16.490	18.018	18.933
	Scenario 3	14.200	14.978	16.663	18.216	19.162
	Scenario 4	14.290	15.272	17.215	18.902	19.948
C	Existing	12.078	11.462	11.251	11.152	11.041
	Scenario 1	12.317	12.195	12.841	13.583	14.070
	Scenario 2	12.145	12.141	12.899	13.693	14.199
	Scenario 3	12.186	12.234	13.064	13.903	14.417
	Scenario 4	12.252	12.464	13.505	14.486	15.145
D	Existing	12.316	11.733	11.586	11.612	11.536
	Scenario 1	12.817	12.700	13.350	14.105	14.607
	Scenario 2	12.572	12.526	13.184	13.831	14.186
	Scenario 3	12.508	12.533	13.202	13.873	14.245
	Scenario 4	12.559	12.725	13.596	14.387	14.856

Table 2 shows that the implementation of all policy scenarios can increase the population of dairy cows in every condition. Above all, the 4th policy scenario provides the best result in increasing the total population. The 4th policy scenario can reduce production costs and increase the income of farmers. As the result, farmers can save money and eventually bought more cattle to expand their business. In the simulation, farmers have the rule in deciding to increase the cattle population. It means that farmers who have a certain amount of savings have a probability to buy pregnant heifer. This heifer in a few months will give birth to a calf. Therefore, the total dairy cattle population increased quite a lot. 1st, 2nd, and 3rd policy scenarios also provide significant effects although the effect is not as big as the effect of the 4th policy scenario.
Table 3 shows the result of the experimental simulation in terms of the total cow. The implications of the four policies that have been proposed in any conditions produce different output. The largest amount of total cow population is in the application of policy scenarios 1 in condition D. It happens because, in the first policy, government grants dairy cows to farmers type 3, or "The Unsatisfied" that dominates the system in Conditions D. The output from this parameter is very important in the effort to developing dairy industry. After all, the variable that has the most influence on the amount of milk production is the number of cow population.

In the simulation farmers never purchase a cow, by purchase a cow can directly increase milk production, but in the economic calculation in the farm business, purchase a pregnant heifer is a good investment.

Table 3.
Cow Population Simulation Result

Population	Position	Year				
		1	2	3	4	5
A	Existing	9.845	9.092	8.552	8.132	7.702
	Scenario 1	10.676	10.932	11.525	12.342	12.983
	Scenario 2	9.924	10.033	10.693	11.562	12.150
	Scenario 3	9.921	10.053	10.754	11.652	12.249
	Scenario 4	9.943	10.176	11.062	12.073	12.764
B	Existing	10.626	9.938	9.674	9.640	9.522
	Scenario 1	11.254	11.865	12.871	14.133	15.064
	Scenario 2	10.757	1.228	12.347	13.681	14.575
	Scenario 3	10.777	11.286	12.470	13.833	14.748
	Scenario 4	10.819	11.450	12.842	14.342	15.355
C	Existing	9.308	8.358	7.612	7.026	6.455
	Scenario 1	9.892	9.976	10.854	10.970	11.437
	Scenario 2	9.382	9.289	9.744	10.434	10.912
	Scenario 3	9.409	9.347	9.855	10.588	11.079
	Scenario 4	9.446	9.468	10.153	11.014	11.628
D	Existing	9.452	8.548	7.876	7.397	6.848
	Scenario 1	10.596	10.952	11.369	11.997	12.478
	Scenario 2	9.621	9.580	9.993	10.561	10.026
	Scenario 3	9.606	9.578	9.997	10.591	10.970
	Scenario 4	9.636	9.681	10.263	10.972	11.428

As explained previously, the most influential factor in improving milk production is the cow population. As can be seen in Table 4, the 1st policy scenarios provide the greatest output in raising the cow population. Therefore, the milk production in the 1st policy scenario has the largest amount. Also, the 4th policy scenarios show a better output compared to other policy scenarios. Even in the 5th year at conditions B and C, the total milk production as the result of the 4th policy scenarios exceeds the 2nd policy scenarios. It can be concluded that the 1st policy scenarios provide the greatest output in milk production.

Table 4.
Milk Production Simulation Result

Population	Position	Year				
		1	2	3	4	5
A	Existing	2.723.027	2.516.061	2.413.000	2.315.970	2.237.579
	Scenario 1	2.932.252	3.002.223	3.230.293	3.450.157	3.637.600
	Scenario 2	2.748.505	2.776.257	2.992.099	3.218.081	3.397.320
	Scenario 3	2.748.014	2.780.736	3.008.143	3.242.351	3.425.200
	Scenario 4	2.753.964	2.813.076	3.085.072	3.354.332	3.568.205
B	Existing	2.911.517	2.739.827	2.724.979	2.723.657	2.733.614
	Scenario 1	3.114.704	3.255.828	3.596.323	3.937.582	4.215.777
	Scenario 2	2.975.012	3.096.013	3.443.941	3.800.096	4.074.842

Population	Position	Year 1	2	3	4	5
	Scenario 3	2.981.843	3.112.039	3.476.243	3.842.972	4.123.150
	Scenario 4	2.993.244	3.154.488	3.572.953	3.980.811	4.293.919
C	Existing	2.589.243	2.321.092	2.164.315	2.016.739	1.900.864
	Scenario 1	2.745.493	2.751.762	2.907.062	3.064.857	3.201.858
	Scenario 2	2.601.651	2.578.284	2.731.006	3.904.751	3.048.740
	Scenario 3	2.610.184	2.594.413	2.761.062	2.945.937	3.094.413
	Scenario 4	2.619.621	2.626.176	2.838.342	3.069.878	3.247.066
D	Existing	2.580.243	2.321.092	2.164.315	2.016.739	1.900.864
	Scenario 1	2.939.079	3.000.689	3.191.974	3.361.230	3.509.942
	Scenario 2	2.664.540	2.652.061	2.802.439	2.946.442	3.058.723
	Scenario 3	2.661.455	2.652.061	2.802.153	2.963.290	3.070.815
	Scenario 4	2.668.570	2.679.025	2.872.156	3.065.994	3.918.344

From Table 5, as the implications of the 1st policy scenario, farmers have additional cow population since the beginning of the simulation. It means that, in the 1st year, the average income of farmers under the 1st policy scenario is higher than the others. However, starting from the 3rd year, the 4th policy scenarios produce better output. this indicates that the 4th policy scenario can improve the welfare of farmers in the long term. While the 1st policy scenario only improves the welfare of farmers in the beginning. It means that providing grants of livestock to farmers will indeed directly increase the cow population, milk production, and farmers' income. Nonetheless, if the system does not change, farmers will be back to their old habits, especially the behavior of farmers type 3. They will be tempted to sell their livestock in case they need money or when the price of meat in the market increases.

Table 5.
Average Income Simulation Result

Population	Position	Year 1	2	3	4	5
A	Existing	5.189.198	4.801.092	4.869.661	5.079.069	5.293.711
	Scenario 1	5.427.642	5.346.173	5.727.630	6.172.040	6.574.663
	Scenario 2	5.124.656	5.094.015	5.517.259	5.999.574	6.416.571
	Scenario 3	5.032.563	5.011.321	5.435.027	5.924.248	6.345.583
	Scenario 4	5.104.662	5.127.397	5.634.618	6.164.544	6.614.921
B	Existing	5.410.506	5.113.946	5.254.415	5.558.158	5.887.097
	Scenario 1	5.638.283	5.667.430	6.230.329	6.860.309	7.394.495
	Scenario 2	5.431.312	5.523.438	6.144.327	6.825.172	7.374.675
	Scenario 3	5.337.894	5.443.555	6.071.835	6.744.634	7.290.800
	Scenario 4	5.424.362	5.596.877	6.317.450	7.051.153	7.634.306
C	Existing	4.900.994	4.094.373	4.467.810	4.588.200	4.777.481
	Scenario 1	5.050.132	4.922.428	5.217.145	5.582.414	5.934.191
	Scenario 2	4.827.812	4.732.404	5.063.322	5.470.877	5.850.755
	Scenario 3	4.743.470	4.670.436	5.018.155	5.431.007	5.813.041
	Scenario 4	4.814.492	4.781.978	5.199.460	5.655.226	6.081.705
D	Existing	5.156.651	4.717.557	4.726.700	4.891.845	5.049.330
	Scenario 1	5.606.525	5.446.306	5.750.967	6.008.760	6.420.775
	Scenario 2	5.118.139	5.015.734	5.334.777	5.699.548	6.028.305

Population	Position	Year				
		1	2	3	4	5
	Scenario 3	5.020.810	4.931.357	5.244.699	5.606.529	5.935.591
	Scenario 4	5.094.200	5.045.173	4.419.421	5.834.660	6.187.082

From Table 6, expenses in the simulation are the costs incurred by farmers to finance their needs and to finance the cost of production of the farm. The amount of expense incurred by the farmers highly dependent on the number of family members of farmers and the population of dairy cattle. Because the implications of all of the policy scenarios are make the livestock population increases, the expense of farmers will also increase.

Table 6.
Average Expense Simulation Result

Population	Position	Year				
		1	2	3	4	5
A	Existing	4.655.810	4.812.892	4.938.393	5.137.754	5.355.783
	Scenario 1	4.001.950	5.290.333	5.716.739	6.161.030	6.570.562
	Scenario 2	4.388.702	5.038.015	5.518.769	5.988.303	6.414.880
	Scenario 3	4.292.764	4.951.297	5.434.938	5.910.647	6.339.426
	Scenario 4	4.325.959	5.077.505	5.610.068	6.145.155	6.605.204
B	Existing	4.829.617	5.137.746	5.298.379	5.608.928	5.922.559
	Scenario 1	4.850.094	5.395.791	5.754.633	6.796.086	6.481.444
	Scenario 2	4.659.053	5.464.472	6.132.753	6.716.897	7.082.373
	Scenario 3	4.552.469	5.385.098	6.052.176	6.716.897	7.276.124
	Scenario 4	4.605.363	5.543.491	6.280.289	7.011.269	7.608.567
C	Existing	4.409.952	4.516.147	4.532.961	4.662.725	4.832.445
	Scenario 1	4.314.122	4.859.819	5.219.071	5.583.499	5.935.782
	Scenario 2	4.149.610	4.670.285	5.074.191	5.465.703	5.853.374
	Scenario 3	4.057.050	4.606.997	5.022.340	5.421.754	5.808.654
	Scenario 4	4.087.261	4.730.527	5.182.372	5.641.214	6.066.763
D	Existing	4.612.431	4.743.061	4.802.354	4.963.163	5.000.341
	Scenario 1	4.699.234	5.399.428	5.737.428	6.091.772	6.418.350
	Scenario 2	4.373.551	4.961.386	5.336.988	5.701.821	6.034.724
	Scenario 3	4.266.453	4.878.666	5.248.233	5.605.592	5.941.421
	Scenario 4	4.307.201	4.992.769	5.409.942	5.820.554	6.189.524

Saving in Table 7 is the accumulation of the average saving of every farmer in the simulation. Saving in conditions A, B, and C will accumulate more money if scenarios 4th policies are applied. However, at condition D, where the farmers type 3 get livestock grants from the government, the implications of the 1st policy scenarios provide better output.

Table 7.
Average Saving Simulation Result

Population	Position	Year 1	2	3	4	5
A	Existing	5.173.430	6.818.595	6.212.379	5.170.341	4.502.473
	Scenario 1	6.561.404	9.942.194	10.109.193	10.189.082	10.222.746
	Scenario 2	6.253.937	9.379.625	9.494.858	9.466.487	9.484.642
	Scenario 3	6.311.816	9.451.463	9.577.107	9.001.296	9.435.008
	Scenario 4	6.574.219	9.854.111	10.085.890	10.247.450	10.310.418
B	Existing	5.665.653	7.339.008	6.924.251	6.132.438	5.574.639
	Scenario 1	7.049.005	10.365.956	10.617.291	10.770.558	10.976.648
	Scenario 2	6.810.486	10.006.402	10.188.337	10.370.418	10.572.827
	Scenario 3	6.910.805	10.141.531	10.367.423	10.000.105	10.804.636
	Scenario 4	7.240.669	10.545.528	10.863.594	11.258.966	11.516.612
C	Existing	4.573.011	6.006.729	5.467.989	4.549.842	3.722.816
	Scenario 1	5.851.276	9.120.577	9.284.301	9.166.600	9.144.460
	Scenario 2	5.680.395	8.790.926	8.853.204	8.172.080	8.723.599
	Scenario 3	5.390.527	8.000.168	9.005.358	8.084.407	8.982.961
	Scenario 4	6.034.362	9.345.409	9.526.443	9.644.233	9.708.745
D	Existing	5.004.537	6.683.852	6.070.962	5.081.965	4.297.489
	Scenario 1	6.813.379	10.184.000	10.616.576	10.600.075	10.567.911
	Scenario 2	6.298.475	9.386.510	9.362.081	9.217.996	9.078.385
	Scenario 3	6.264.854	9.368.300	9.456.664	9.303.063	9.190.505
	Scenario 4	6.527.902	9.760.154	9.903.461	9.908.273	9.814.938

From the data analysis, the real problems in the dairy industry in Bandung are the low production of milk due to the decreasing lactation cow population and the lack of farmers' motivation in running their farm due to low income. According to the result of the simulation, all of the policy scenarios provide a significant contribution to increasing cow population, milk production, and farmer's welfare, the entire graphics of the resulting output is increasing.

Hansen, Moland, and Lenning (2019) identified important drivers of income efficiency that can be changed by farmers in the short or medium term. These drivers include automatic milking systems, high beef production per cow, low age in first calves, and organic farming. These drivers can be deemed as technical drivers. However, to complete the consideration, O'Leary, Tranter, and Bennett (2018) predict the profitability of dairy farmers using three personality measures, namely awareness, leadership, and relaxed attitude. In simple linear models, those personalities contribute up to 40% to agricultural profitability. To increase the motivation of dairy farmers, Yamada, Shimamoto, and Wakano (2015) report the importance of providing informal training in introducing new technology through informal extension agents.

From the results of the modeling system in the Bandung dairy industry, system models that most closely to the real situation of dairy industry systems are condition C. Under this condition, "The survived" farmers dominate the system and inhibit the growth of the cow population because these farmers are not able to raise cattle in large quantities. This finding reveals that the system of the dairy industry in Bandung is dominated by farmers type 3.

From the simulation results, the most contributing scenario policies are the 1st and

4th policy scenarios. The 1st policy scenarios will provide a good output if applied at condition D. However, in the reality, the government has limitations in providing livestock grants for farmers. Grant livestock to farmers is like giving business capital to farmers. Any business capital could be discharged as long as the farmer knows how to manage it. The 4th policy scenario can greatly ease the burden on farmers because this policy can decrease production costs and improve the welfare of farmers. By implementing this policy, the dairy farm business will be more profitable in a long period.

As the result of this research, the author suggests the government make the policy that related to:

1) The increasing price of milk at the farmer's level. It can be done by making the regulation to define the range price of milk from farmers level until consumers level in order not to harm the farmers as producers and community as consumers. Setianti, Ekowati, and Setiadi (2017) also stated that there is integration between milk prices and the level of the Milk Processing Industry;
2) Subsidize feed concentrate. The government suggested not only provide the low price of feed concentrates. They must provide a good quality of feed concentrate by developing the animal feed industry in Indonesia. This industry has advanced technology to provide good quality feed concentrate at a low cost. These findings are relevant to the opinion of La Terra et al. (2015) that the quality of dairy products is strongly influenced by feeding the animal with quality food that affects the physical-chemical and sensory characteristics of milk;
3) An attempt to increase lactation cow, it can be done by making program to provide cattle for free to the farmers with improving the management of reproduction and developing the good dairy farming industry. Programmed reproduction management can improve reproduction efficiency in dairy farming with seasonal breeding by increasing the level of submission and conception at the beginning of the breeding season and in the voluntary waiting period (Cavestany et al., 2007).

However, the important thing is not only about choosing the policy that provides the best results. It is also important to consider the policies that can be easily implemented and provides a good influence on the system.

5. Conclusions

Based on these factors, dairy farmers in Bandung Regency can be categorized into three clusters, namely "The Motivated", "The Survived", "The Unsatisfied". Farmers have a set of rules of behavior and in making decisions, factors that can influence the behavior and rules of farmers including milk production, number of cattle populations, and milk production.

The effort to develop dairy industry, things to consider is the dairy farmers, because they are the main actor in the sub-system production of system dairy industry, they must have an insight into the macro level, where farmers did a micro behavior in running the dairy cattle business that affects the overall system of output.

The system in the dairy industry is very complex, because there are various parties, activities, interactions, and interests hence, the micro approach of computational model simulation is the right approach to develop the dairy industry. The simulation model that was built in this research can represent the system of the dairy industry in Bandung.

The best policy scenario to develop the dairy industry in Bandung that has been simulated to empower and support the farmer are provide heifer for granted to the farmer and to raise the selling price of milk at the farm level as well as provide subsidies for feed concentrates, so it can increase the income of farmers and reduce the cost of production, but the important thing is to find what policies that can easy to implied in the system and provides a good influence in the system.

As the result of this research, the author suggests the government to make some policy related to:

a. The increasing price of milk at farmers level;
b. Subsidized of feed concentrate;
c. Making program to provide cattle for granted to the farmers with improving the management of reproduction and developing the good breeding industry.

Limitation and Further Research

This study has several limitations. The first limitation is the data empirical of the total population of cows and milk production which is used as a reference in creating simulation models exist only within a period of 12 months, thus the trends from year to year cannot be known. Although the data of cow populations exist from year to year, however, population numbers are not consistent. The second shortcomings are, in making the simulation model, the number of farmers over time is static, or fixed, whereas farmers who always suffer losses will eventually stop doing their business farm, while in the simulation model, farmers who continue to experience losses, will still be struggling running the farm business despite having a lot of debt, it actually will greatly affect the productivity of the dairy industry, concerning livestock numbers and milk production. The third shortcomings are, that in this research, the authors did not explain in detail each policy scenario. This research only explains the purpose of each policy scenario, without explaining how the policy implied in the system, and who has responsibility for the policy. in making policy for the dairy industry in Indonesia, things to be aware of not only industrial productivity, but also in terms of the technical ability of the government to implicate the policy, and in terms of providing funds.

For further research, the authors suggest that the model simulations need to be more dynamic, thus the number of farmers, farmers' number of family members may change within a certain period. Also, further research should find out more about whether there is the possibility of change in the type of farmers thus, it is known how to bring up "the Motivated" farmers more generated in the system.

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