A typological characterization of dairy farming system towards economic sustainable farm in West Java (Indonesia)

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Abstract. Small scale farms play an important role in Indonesia. However, shortage of capital become the main challenge for small farms. To foster the economically sustainable farms, the diversity and the characteristic of dairy farms should be understood. This study identified farmers' types by using typology approach based on the capital as active variables. The data were obtained from interview with experts, direct observation, formal survey to 353 farmers, and recording from the public authorities and the milk cooperatives. We performed MFA, HCA, desciptive as well as comparative analysis. The indicator of economic sustainability was chosen through in-depth interview with experts and the scoring was created. Results showed that there were five farmers' types and farmers type 5 was the most economically sustainable type. In other words, specialized farms with higher level of capital and more productive worker were able to generate more family income and might be more sustainable economically. The study underlined the importance of typology approach to understand the diversity and the characteristic of farming system. It was also useful to identify in what condition dairy farm is economically sustainable. To have more economically sustainable farm, strategy in increasing farm capital and productive worker should be done.

1. Introduction

The main constraints and appropriate policy related to the development of small farm sometimes seems difficult to be identified due to the diversity of agro-ecosystems in Indonesia [1]. Therefore, understanding the farms' diversity is important to design the policy and to adapt new technology [2] in order to develop smallholder dairy farms to be more sustainable.

Multiple Factor Analysis (MFA) and Hierarchical Cluster Analysis (HCA) were applied to establish the typology of dairy farming systems. MFA can be used if the group of variables belong to the different types of data (quantitative or categorical data) [3].

The aim of this study was to describe and to characterize the diversity of dairy farming systems using typology approach in West Java Province: Bandung Barat District and Subang District. This study also aimed at understanding in what conditions farms are more economically sustainable.

2. Methods

2.1. Study site

The study was carried out in Bandung Barat District and Subang District. Subang (Sagalaherang, Ciater, and Jalancagak sub-district) is highland with altitude between 500 – 1500 m. The activities generating income are mainly tea plantation, tourism (hot spring water), crop production and livestock. Bandung Barat is high plateau with an altitude of more than 700 m.

2.2. Research design and sampling

The survey was done from May to August 2015. A typology and comparative study were conducted using both primary and secondary data.

We collected primary data from interviews with stakeholders (KPSBU staff, public authorities, and NGO), direct observation, and farm survey. We conducted formal survey to 353 farmers whom were active members of the milk cooperative (KPSBU). In 2015, a total around 4000 farmers were members of KPSBU. In addition, we had secondary data from literature, published and unpublished data from the KPSBU, the NGO and the public authorities.

Participatory approach was carried out to select the main indicator to assess the economic sustainability. It was done by discussing in several interviews with farmers and experts. Total income per family worker (Economic Pillar) was chosen as an indicator of sustainability. The discussion and interview with experts underlined the importance of this indicator for farmers' livelihoods and local communities.

The data collected to characterize farms were divided into seven categories: natural capital, physical capital, human capital, social capital, financial capital, milk sold, and constraints to expand the dairy business.

2.3. Data analysis

We employ R program to analyze MFA and HCA. In addition, data were summarised using descriptive and statistical analysis to describe each type of farms. Descriptive analysis, ANOVA and Tukey Test (95% of confidence level) were performed using Minitab 17. Descriptive analysis included level of education, biogas unit, investment and constraints. ANOVA and Tukey's test (95% confidence level) were used to analyze the rest of variables.

To score the economic sustainability "total income per family worker", we considered 5 classes of income based on poverty line and regional minimum wage [4].

3. Results and discussion

3.1. MFA and Hierarchical Clustering Analysis

The MFA showed Factor 1 had the highest eigenvalue (Fig. 1). Physical capital was globally correlated to financial capital, natural capital and milk sold to cooperative. Those variables defined Factor 1 and explained 26.06% of the variances. Groups human and social capital give more or less the same information on farms. Human capital was strongly correlated to social capital. As Factor 2,

those variables explained 16.54% (Fig 1). Milk sold and constraints are in supplementary status.

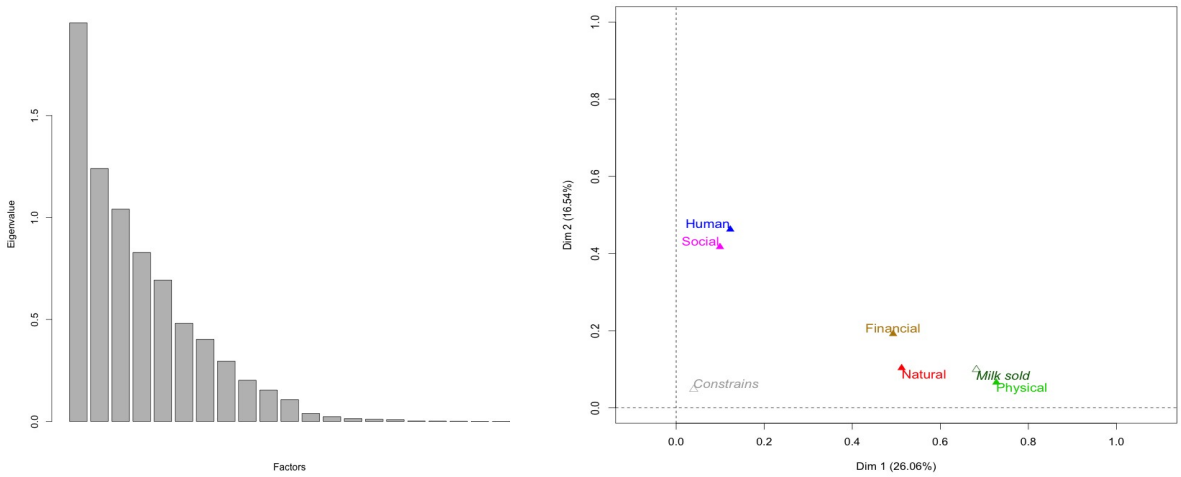

Figure 1. MFA Eigenvalues (variances by factors) and factorial groups representation

Table 1. Comparison of the capital in each type of farms

Variables	Type of farms				
	1 (n=61)	2 (n=113)	3 (n=77)	4 (n=87)	5 (n=17)
Natural Capital					
Total Area (m2)	993 ± 1250 ^{D}	5410 ± 4250 ^{B}	1670 ± 1460 ^{CD}	2620 ± 2320 ^{C}	10800 ± 9460 ^{A}
Land for forage/Total Area (%)	54 ± 39 ^{B}	75 ± 27 ^{A}	55 ± 37 ^{B}	75 ± 31 ^{A}	73 ± 29 ^{AB}
Altitude (m2)	1170 ± 230 ^{AB}	1140 ± 247 ^{B}	1150 ± 234 ^{B}	1250 ± 194 ^{A}	1180 ± 214 ^{AB}
Physical Capital					
herd size (AU)	2.3 ± 0.8 ^{C}	4 ± 1.8 ^{B}	2.2 ± 0.9 ^{C}	4.5 ± 1.8 ^{B}	13 ± 6.2 ^{A}
Number of species (number)	1.4 ± 0.6 ^{AB}	1.4 ± 0.6 ^{AB}	1.5 ± 0.6 ^{A}	1.3 ± 0.5 ^{B}	1.4 ± 0.6 ^{AB}
Investment "a la carte" (%)	28	35	35	20	35
biogaz unit (%)	25	42	26	40	53
Number of facilities (number)	5 ± 2 ^{A}	5 ± 2 ^{A}	5 ± 1 ^{A}	5 ± 1 ^{A}	6 ± 1 ^{A}
Human Capital					
experience (year)	9 ± 5 ^{B}	16 ± 10 ^{A}	12 ± 7 ^{B}	11 ± 5 ^{B}	18 ± 10 ^{A}
Family size (persons)	4 ± 1 ^{A}	4 ± 1 ^{A}	4 ± 1 ^{A}	4 ± 1 ^{A}	4 ± 1 ^{A}
worker size (persons)	2 ± 1 ^{A}	2 ± 1 ^{A}	2 ± 1 ^{A}	2 ± 1 ^{A}	2 ± 1 ^{A}
off farm activities (number)	1 ± 1 ^{A}	1 ± 1 ^{A}	1 ± 1 ^{A}	0 ± 0 ^{B}	0 ± 1 ^{AB}
age (years)	34 ± 7 ^{B}	50 ± 11 ^{A}	46 ± 9 ^{A}	34 ± 7 ^{B}	43 ± 11 ^{A}
training (times)	5 ± 6 ^{C}	11 ± 13 ^{A}	6 ± 6 ^{BC}	5 ± 6 ^{C}	12 ± 12 ^{A}
Work hour/day/farm (hours)	8.8 ± 3.4 ^{C}	11.4 ± 5.4 ^{B}	9.6 ± 4.7 ^{BC}	9.7 ± 4.0 ^{BC}	16.0 ± 8.6 ^{A}
Social Capital					
diversity of activity (number)	2 ± 1 ^{B}	2 ± 1 ^{A}	2 ± 1 ^{A}	1 ± 1 ^{B}	2 ± 1 ^{B}
number of association (number)	1 ± 1 ^{C}	2 ± 1 ^{A}	2 ± 1 ^{BC}	1 ± 1 ^{C}	2 ± 1 ^{AB}
Financial Capital					
coop net income/herd size (in million IDR/year/AU)	9.3 ± 4.0 ^{A}	8.9 ± 4.7 ^{A}	10.8 ± 15.6 ^{A}	10.8 ± 4.8 ^{A}	12.8 ± 5.3 ^{A}
coop net income/forage land (in thousand IDR/year/m2)	73 ± 78 ^{A}	20 ± 52 ^{B}	55 ± 21 ^{AB}	62 ± 110 ^{A}	53 ± 125 ^{AB}
coop net income/worker (in million IDR/year/person)	11.1 ± 5.1 ^{D}	17.1 ± 10.5 ^{C}	10 ± 6.8 ^{D}	25.6 ± 11.6 ^{B}	73.5 ± 34.9 ^{A}
Milk sold to cooperative					
average milk sold (L/farm/month)	535 ± 180 ^{D}	898 ± 473 ^{C}	538 ± 257 ^{D}	1170 ± 502 ^{B}	3630 ± 1480 ^{A}
Constrains					
dont have enough land for forage (%)	44	24	21	33	41
dont have enough labor (%)	11	19	10	14	24
dont have enough money (%)	82	66	81	74	47
dont have enough space in the barn (%)	23	21	22	24	24
need money from selling calves (%)	3	3	0	5	0

Source: our survey for 2015 data (some data have been used in Sembada et al., in press)
Note: Means in the same column with different superscript differ significantly (P<0.05); ns= not significant

3.2. Farms' types

Type 1 were very small farms with pluriactivity but high productivity of land. **Type 2** were small farms with low productivity of land for forage production. **Type 3** was very small farms characterized by other activity as main income and less productive land. The characteristics of **Type 4** were specialized farm with higher productive land and worker. **Type 5** was specialized farm with the most productive worker and higher level of capital than other types.

3.3. Economic sustainable farms

The result showed that farmers' type 5 was more sustainable economically than other types (Fig 2). The specialized farm with higher capital and productive worker could generate more total income per family worker. It might foster the economic sustainability. In contrast, farmers' type 3 was less economic sustainable than others. It indicated that the capital for type 3 is need to be improved in order to have better family income and fostering economic sustainability.

A total of only 17 farms belonged to the farms type 5. It is the smallest number compared with others. They had higher capital than other types for dairy farming activity. The total quantity of milk sold to cooperative and the total income were the highest. Therefore, farmers' type 5 was more economically sustainable compared to the other types. Farms' capital might directly affects family income. The study confirmed the importance of capital endowment in the sustainability and coherent with the literature on livestock farms in many countries of the world [5].

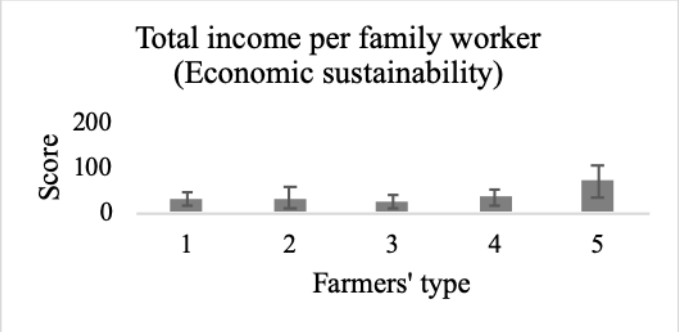

Figure 2. Economic sustainability in each farm

4. Conclusion

The study underscored the importance of typology approach to understand the characterictic and the diversity of farming system in the study sites. It also allowed us to identify in what condition dairy farms were more sustainable economically. In the future, the strategies are needed to fostering the sustainability of farms by improving farms' capital, for instance by providing credit, land access, trainings and technical supports in order to secure the livelihoods of family farms.

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